AN EXPERIMENTAL STUDY OF SELECTED REMEDIAL READING TECHNIQUES

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Throughout the past two decades a great deal of attention has been focused upon the correction of poor reading habits. Reliable clinical procedures aimed at correcting defective reading habits have been brought into use and have done a great deal of good. The question still remains, however, as to whether one technique is more efficient than another.

A large volume of research has dealt with this question. The major part of this research, however, has concerned itself with comparing two or more techniques with little or no attention being paid as to whether or not the techniques being compared were optimal in and of themselves. By no means has the work been useless. It has contributed a vast amount of knowledge and has been extremely useful in dealing with remedial reading problems.

Answers to this question lie within the scope of Experimental Psychology and may be found by carrying out research involving these techniques. A great deal of this type of work has been carried out. However, little research has been done with any one technique alone in attempts to discover the optimal training procedure within the technique itself. An analogy may be drawn here to illustrate just what is meant in the above statement. The physiologist might, if he wished to determine the effects of a certain drug given orally or the effects of the drug taken in various forms, administer various doses of the drug at specified time intervals and observe the results. In this way he could obtain a reliable estimate of just how the drug will act under a certain set of specified conditions. Samples of behavior or experience may be examined in much the same manner in Experimental Psychology.

The present problem appears to be two sided. First, to discover the optimal training technique within the procedures themselves and then secondly, to compare these optimal techniques with one another to determine the most efficient procedures for use in the reading clinic.

A survey of the important literature on the use of the tachistoscope will serve to illustrate the type of work which has been carried out in the past and which serves as a background for this paper.

As early as 1885 Cattell experimented with the tachistoscope to control eye movements in reading. (6) However, no great use of this technique was made until Dearborn made one of the initial studies in respect to eye movements in reading. (7) It was he who first stated that reading could be improved simply by training the eye movements.

This opinion is not held by most investigators today. The general trend of thinking is that faulty eye movements are a clinical indication of some more deep-seated, faulty perceptual habit, just as, for a physiological example, a peripheral blood pressure reading may give an indication that something is amiss in the complex physiology of the circulatory system.

Experimental investigations subsequent to Dearborn's have all shown a slow, gradual trend to the opinion cited above, i.e. training with eye movement regulating devices tends to break through the barrier of clinical indications and attack the deeper mechanisms which are really causing the clinical symptoms.

Tinker aptly stated this course of thinking when he wrote that, "(1) There is no evidence that training eye movements as such, develops effective motor habits which improve reading ability. (2) On the

contrary, there are data from many sources which indicate that the nature of the oculomotor performance in reading is largely determined by central processes of perception and apprehension". (21)

Weber found in an experimental study that students trained with a tachistoscope under daylight conditions improved equally with another group trained with reading exercises. (23)

In his comprehensive review of the most significant literature Westover reached the following conclusions: (25)

"(1) Reading may be improved by ordinary practice or by practice under conditions of controlled eye movements.

(2) Experiments comparing the effectiveness of reading under controlled eye movements with reading under ordinary practice indicate that about equal results are secured, but none of these studies has been carefully controlled.*

(3) That gains obtained by controlling eye movements are secured by improvement in "the habit of mind rather than of eye movement".

(4) That expert opinion favors intrinsically motivated teaching methods directed toward improving comprehension, rather than methods using extrinsic motivation directed toward improving speed, such as controlling eye movements.

(5) That, although eye movement training, per se, is of doubtful value, devices for controlling eye movements may be constructively used to help force to higher levels of perception and speed readers who have become habituated to lower levels of performance than those which they

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* Underlining is this writer's.

are capable of reaching. Buswell in particular has made this point clear." (4)

Traxler in reviewing the literature in 1943 has aptly stated the need for the type of study attempted in this paper. (22) His conclusion is quoted here. "Notwithstanding the limitations in the data as a whole, however, it appears that the findings are somewhat more favorable to the value of controlled reading techniques than is the sum total of the opinion of the experts in the field of reading. Most of the studies do suggest that considerable improvement is made under teaching procedures employing controlled reading. There are, however, two limitations which greatly interfere with definite conclusions in this regard.* One limitation is that information concerning the permanence of the gains in test scores brought about by controlled reading is almost non-existent. The other limitation is that, --------, controlled reading has usually been only one of a number of techniques employed and it is almost impossible to say just what procedures have been responsible for the improvement shown by the subject ----------.

At any rate it seems evident that controlled reading techniques should have the benefit of a more extensive, detailed and rigidly controlled experimental study than has yet been made in this area."

It was with these questions in mind that the experimental work contained in this paper was designed. That is to add perhaps a little more to the background of knowledge drawn upon by so many workers interested in helping to correct this deplorable condition as it exists in many present-day students.

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* Underlining is this writer's.

This investigation is concerned with two experiments, each of which were designed to point out the direction in which certain pertinent answers may be found. Both investigations were constructed about one technique used in correcting defective reading. That is the tachistoscopic technique.

Reading is a way of using the organ of sight to convey an idea from one man to the next. Not only, however, is it a means of communication, but it is more basically a way of seeing. Once physical factors are ruled out or compensated for, seeing well or poorly becomes a matter of training. It is a habit pattern whose creation was begun at a relatively early age and which has become well established merely through constant use and reinforcement. The tachistoscope is an instrument which enables the clinician to force his way into this habit pattern. He is then in a position which enables him to retrain the subject's reading habits.

By now the question has arisen in the reader's mind that this is all well and good but what is the mechanism behind this retraining procedure. The rationale behind the procedure is not complex, although the actual perceptual processes are exceedingly complex. When one reads his eyes perceive a number of words at a glance or at an "eye-fixation". A wealth of evidence which has been gathered photographically, and by other procedures, has shown that the poor reader will perceive only one word or a part of one word in one eye fixation. Consequently his eyes will fixate as many words or part words as there are to a line of print. The good reader will perceive this same line in say three to five fixations. What occurs here is simply this, the good reader has lengthened his perceptual span so that he can perceive

three or more words at one eye fixation. This illustration is of course hypothetical but still the above descriptions may be called a fairly accurate picture of what the good and of what the poor readers perceive.

Thus the problem is posed. How can the perceptual span of the poor reader be lengthened? The answer? By training the reader to perceive more at one eye fixation. The tachistoscope enables us to do essentially this. It slices away the amount of time that the reader can use to a minimum. With practice he can come to see longer and longer spans of words or numbers per eye-fixation. Probably the most reasonable assumption as to just what mechanism lies behind this improvement is that the subject is aware of the short time interval allowed him and he orients himself to the tachistoscopic work and nothing else. Once this orientation occurs the whole procedure takes on the garb of ordinary learning or in this case the better word in terms of description alone might be retraining. The effects of this learning or retraining then transfer to an actual reading situation. The "How" and "Why" of this transfer is another aspect of the total problem which future experimental work may answer.

The tachistoscope itself is an adaptation of the old "Magic Lantern". The lantern, however, is fitted with a shutter similar to those used in cameras. This shutter allows for control of the time that the slide in the lantern is flashed upon the screen.

The slides used are of two general types. The first type is made up of jumbled letters, the second of jumbled numbers. Recent work has shown that there is apparently no significant difference in the results produced by use of these two types. (12) However, the experiment was conducted on an extremely small scale and there may be a statistical

unreliability due to the small number of cases from which the conclusions were drawn. (12)

The slides used in the following experiments are made up in varying digit lengths. That is a set may be made up of 1, 2, 3, 4, 7, 8, or 20 digits depending upon the need of the subject. Various commercial companies have produced sets which have for instance (30) four digit slides, (30) five digit slides, (25) six digit slides and so on.

The length of digits used depends of course on the subject who is in need of corrective work. Children must use shorter digit lengths than college students. It has been found that most students assisted by the clinic here at Washington and Lee at first can handle effectively only the four or five digit slides, when those slides are projected at a speed of 1/25th of a second.

The slides used in both of the following experiments were five and six digits long. These digit lengths were chosen since, as was stated above, college students can handle these lengths most effectively at the early stages of training and the lengths were still long enough to cause initial difficulty and thereby set up the orientation discussed above.

DIGIT PRESENTATION

The first problem that must be faced in setting up a remedial procedure for use with a tachistoscope is that of actual presentation. That is, "What shutter speed or speeds should be used and How is this speed related to the number of digits presented."

This first experiment was an attempt to find the interrelationships among several important facets bearing on this question. The primary problem being that of the actual tachistoscopic presentation and the secondary being that of the amount of transfer to an actual reading situation.

The primary problem was set up in the form of a question. "Does more efficiency come from beginning training with use of relatively high speed projection and short digit span or does it come from commencing training with relatively long digit span with slow increases in speed of presentation. But to specifically state the primary problem, the question was framed as follows. Which of the following procedures is more efficient? 1. Training by use of a constant speed of 1/25th of a second using five, then six digit span slides or 2., training by use of constant six digit span slides beginning with a speed of 1/10th of a second and then increasing this speed to 1/25th of a second.

After the primary problem was framed this question was also asked. Is it not conceivable that although one of the primary variables may appear to be more efficient, actually may there not be a greater transfer effect from the other variable. In the attempt to answer this question and also to equate the groups used, the Minnesota Speed

of Reading Test Form A was administered to all classes in General Psychology. Three groups of ten men each were equated on the basis of these test results.

A Model DD, S.V.E., slide projector of 150 W., its accompanying slide changer and a set of 2x2 digit slides made by Fotoshop Inc. of New York City were used. The 3" coated anastigmat lens was used in conjunction with an Alphax Shutter. White poster board was used as a screen.

As stated previously the Minnesota Speed of Reading Test was administered to all subjects. Form A was used in the initial testing and on the basis of these results three groups were equated. All three groups had a raw score mean of 23.1. The standard deviations of each group were as follows:

Group A, 3.6; Group B, 3.0; and Group C, 4.5. Groups A and B were used as the experimental groups. Group C was used as the control group.

Group A worked at a constant speed of 1/25th of a second using (20) five digit slides for the first five trials and (20) six digit slides for the last five trials. Group B worked with six digit slides throughout but at a speed of 1/10th of a second for the first five trials and then 1/25 second for the last five trials. Group C, the control group, simply took the Form B of the Minnesota test when the experimental work was completed with Groups A and B.

In order to orient the subjects in the experimental groups, they were read a detailed set of instructions and were given four dry runs with the four digit slides.

To illustrate the type of instructions given the instructions given to Group A are quoted below.

"Your experiment is set up in this fashion. We would like you to do your experimental work by using a flash speed of 1/25th of a second throughout the experiment. You will begin with a series of 20 flash slides each having five digits. You are to work with the five digit slides until you have completed 5 run-throughs of each series of twenty slides. That is, one complete run of twenty slides shall be considered as one trial. So that you will know just exactly when the flash is coming on the screen we would like for you to operate the shutter mechanism. As soon as you have seen the flash you are to call out the digits that you have seen. Remember call out the digits just as soon as you have seen the flash. After working with the five digit slides for five trials we want you to work with the six digit slides for 5 trials following the same procedure as when you were working with the 5 digit slides. Notice the small black dot on the screen. This is your fixation point. Look at this point when you are ready to open the shutter mechanism. It will help you to locate the area in which the digits will appear. Now, go ahead unless there are any questions." All questions were answered at this point. The instructions for group B were exactly like those of A except of course the statement concerning speed and number of digits to be used.

An attempt was made to control or equate as many other factors as might influence the results. The tachistoscope was fastened in place one meter from the screen. All the subjects were placed in the same positions insomuch as this could be done when postural habits differed throughout the groups. The work was always done under daylight conditions which varied to some extent from day to day. However uncontrolled this may seem there were two good reasons for this procedure.

The first was to cut down as much as possible any afterimagery effects. The second to reduce the amount of direct glare from the projector which might hit the periphery of the subjects' eyes.

To reduce as much as possible the presence of any memory factor, the slides were thoroughly shuffled after each trial and spare slides were substituted for some of those used in the previous trial.

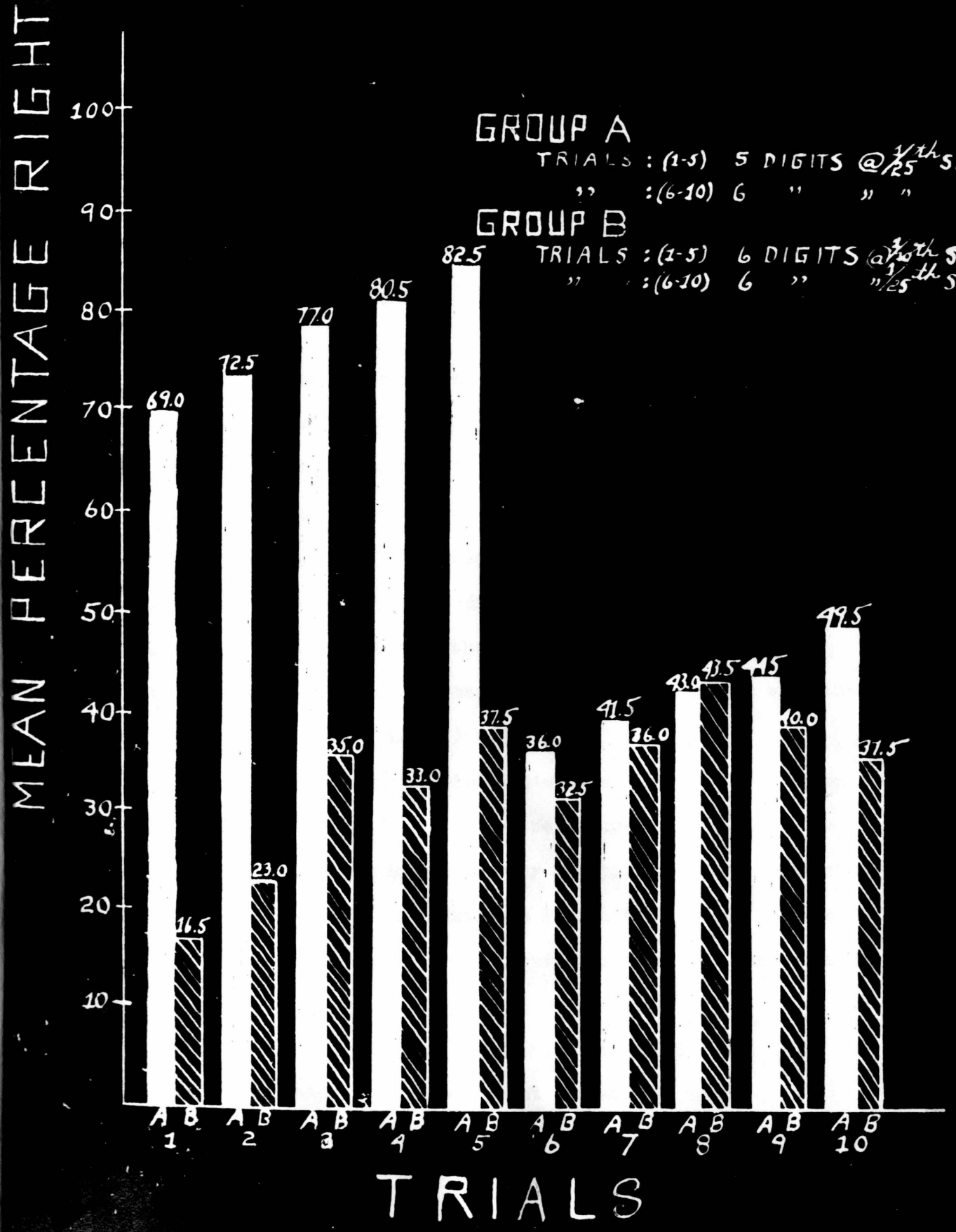
Fatigue was reduced by the interpolation of approximately one minute rest periods between each trial and approximately a five minute rest period between trials five and six.

As soon as the subjects finished trial ten they were read the instructions for Form B of the Minnesota Speed of Reading Test and then tested immediately.

The graph on the following page will show the mean percentage scores for Groups A and B on the ten trials. Group A is to the right in all trials.

Group A shows an advantage in nine of the ten trials. On trial eight Group B shows an advantage of only 1/2 of one per cent. In the first trial Group A shows an advantage of 52 1/2%. In trial five Group A shows an advantage of 45%. This of course does not mean by itself that Group A's procedure is more efficient. This speed and digit span probably coincide more closely to the subjects' perceptual speed than does that of Group B. It does show, however, that after the switch was made to an increase of digits in trial six that Group A was more efficient than Group B which already had five trials to familiarize itself with these long span digits and whose only readjustment was to a slight increase of speed. The word "familiarize" is used intentionally because there was some memory factor involved in spite of the precautions taken and also because this group had a chance

Performance Graph
Experiment #1



to settle into a perceptual and response habit to six digit spans for which Group A had no opportunity.

At any rate the final validation of these data lies in the increase of efficiency of Group A in its last six trials after noticing that Group B remained very close to one level from trial three to trial ten. And also that Group A's level at trial six is a great deal higher than Group B's on trial one even though Group A was working at a speed 3/50th's of a second faster than Group B and both were using the same number of digits.

Therefore it is believed that the most efficient approach, without considering transfer effect as yet, was that taken by Group A even though there was a sharp decline in the Group's overall efficiency at trial six. Within the framework of this investigation this then answers our primary question. That is, more efficiency does tend to come from initial use of a relatively short digit span presented at a relatively high speed and the indication is that when this span is increased, the speed remaining constant, higher efficiency results than when the converse of this procedure is utilized.

To answer the secondary problem let's look first at the data on Group C, the control group. Initially the group mean was 23.1. On the retest, the mean score increased only one point which was expected as they had the experience of working on Form A of the test. It is interesting to note that the standard deviation decreased considerably, from 4.5 to 2.5.

The mean scores of groups A and B increased to 29.7 and 27.8 respectively. Allowing for the one point increase in the control group we find that Group A increased 5.6 points and Group B increased 3.7 points. Therefore, on this basis both groups showed some transfer

effect and in doing so they point out that both procedures are of some value.

Although there was an increase in mean scores, the standard deviations also increased for which an individual interpretation is necessary. That is some individuals in the two groups profited a great deal from the work while others profited very little. The difference between the standard deviations of Group A is 1.6 as opposed to 2.6 of Group B which tends to bear out the previous conclusion that the initial use of relative high speed and short digit span is more efficient.

In regard to the secondary problem, that of transfer from the experimental work to an actual reading situation both A and B groups showed increases. Group A showed an increase of 5.6 points, B an increase of 3.7 points. The reliability of these differences was computed in terms of the differences between the standard deviations and standard errors. It was found that Group A's increase was significant while Group B's was not significant in comparison to the control group.

In summary then, it was found that: (1) tachistoscopic presentation of digits tends to progress more efficiently when the training is begun with a relatively small number of digits which are projected at a relatively high constant speed than when training commences with relatively long strings of digits projected at a relatively slow speed, and, (2) transfer effects tend to be greatest when the training is begun with relatively short digits projected at a relatively high speed.

Lighting Conditions
Experiment #2

This experiment was performed in an attempt to further investigate the work reported by Weber (Introduction p. 3). He found that students trained under daylight conditions with the tachistoscope improved equally with those trained simply with reading exercises. In his study little attention was paid to the internal variables within each of the two techniques. Therefore, an unfair and perhaps an unreliable comparison was made at that time.

This experiment is then the result of the following question. "Are optimal lighting conditions for tachistoscopic training in a remedial reading situation those of relative lightness or are they those of relative darkness?"

However, a second question was raised which had to be considered as a definite corollary of the first. As stated this second question was: "Is it not possible that although one or the other of these conditions may appear more efficient, actually may there not be a greater transfer effect from the other variable?"

In order to control the light factors involved a darkroom was constructed. Lumber stock measuring 1" x 1" x 1" was used for the framework. The covering for this frame was made by utilizing a light weight grade of tarpaper. The framework was fastened together with 1½" L corner braces. Wide masking tape was used to seal the edges of the tarpaper. The general outline and the rough proportions may be seen in the photographs of the apparatus on the following page. The actual dimensions for the darkroom were as follows:

THE DARKROOM

Darkroom	
Height	Six feet
Width	Two feet - One inch
Depth	Three feet
Darkroom Door	
Height	Five feet
Width	Two feet
Apparatus Table	
Height	Two feet - Eleven inches
Width	Two feet - One inch

A piece of milkglass fourteen inches by eighteen inches was centered in the front panel of the darkroom nine and one-quarter inches above the table top. A small dot of India Ink was placed in the center of the glass.

An ordinary night light was fixed in place on the table halfway between the shutter of the projector and the glass screen of the darkroom. This light was on constantly during each experimental run. It served the purpose of illuminating the dot of India Ink which was used as a fixation point by each experimental subject. Another ordinary wall type lamp was used to illuminate the interior of the darkroom itself.

Two strong light cords were run from inside the darkroom to the shutter release mechanism. The subjects pulled one of these cords to release the shutter when they were ready for the exposure of a slide. The second served as an emergency spare.

As can be seen in the photographs a framework for a light baffle was also built around the projector. The end fartherest from the

darkroom was left open for convenience in operating the apparatus. This then left an open space between the projection booth and the darkroom. This open area was sealed with tarpaper making it light tight.

As a result of this two light tight compartments were integral parts of the apparatus, i.e. the darkroom and the space between it and the projection booth.

The projector was a Model DD-SVE slide projector of 150 w. with its accompanying slide changer. A 3" coated anastigmat lens was used in conjunction with an Alphax shutter. The shutter itself was adjusted so that it would cut across the light beam as near as possible to the focal point of the beam. The center of the lens was placed in line with the center of the glass screen and the distance from the lens to the screen was $12\frac{1}{2}$".

The Minnesota Speed of Reading Test was used to measure the results produced by the two types of training delineated somewhat further on. It was also used as the basis for the equation of the groups operating within the experiment. Form B of the test was administered to several Freshmen English classes. Four groups of ten men each were equated on the basis of these test results. All of the men used fell between the 3rd and the 53rd percentiles. Ten men, or $\frac{1}{4}$ of the total, fell at the sixteenth percentile, which in this case may be taken as the "mode percentile". The remaining thirty were distributed on both sides of this point but with somewhat of a skew to the left. This group of men was chosen for the experimental work for two reasons. The first being that they more

nearly resemble those individuals who present themselves for remedial work and secondly, because in this range of the good - poor reader continuum it seemed probable that the differences produced by various techniques would be somewhat more clearcut than differences produced in the range of the good or above average reader. The raw score mean and standard deviation and the Standard Error of the mean for each group were as follows:

Group	Mean	S.D.	S.E.
D (ark)	14.7	2.54	±0.802
L (ight)	14.7	2.59	±0.815
C	14.7	2.39	±0.754
Cm	14.8	2.59	±0.815

Groups "D" and "L" were used as the experimental groups. Group "C" was used as the control group and Group "Cm" was used as an additional control group in an effort to check possible differences in motivational factors. Group "D" (for dark) was run under relatively low intensities of peripheral light. Peripheral light is used here as that light which did not come into the darkroom by means of the projector. Group "L", (for light), was run under relatively high intensities of peripheral light. This light was supplied by the lamp inside the darkroom. Of course this light was not on while members of Group "D" were operating. Peripheral light for Group D was supplied by the night light illuminating the glass screen before the subject. The light measures were as follows and are expressed in foot candles as measured by a Weston Master II Universal Exposure Meter.

Group	Without Projector	With Projector
D	less than one	100
L	50	150

Both experimental groups and Control Group$_m$ were oriented before they began their experimental work. The instructions given to the D and L groups will illustrate the procedure followed with the two experimental groups. Group Cm's instructions are also included here. The men in this group worked with certain stereoscopic procedures which were assumed to have no effect upon reading speed. The two sets of instructions follow.

Instructions to Groups D and L

You are about to participate in an experiment conducted for the Department of Psychology and Education. The Department is carrying out a program of remedial reading and several questions as to technique have arisen. This experiment has been designed to investigate the effect of several lighting arrangements on the efficiency of certain remedial reading procedures.

Now notice that you are seated in a darkroom. The reason for this is that we must have absolute control of all light factors. Please do not smoke as long as you are in the darkroom. You will be given an opportunity to relax between trials.

On the two days that you will be working we will run six trials of twenty slides each. These slides will be thrown on the screen in front of you. Each of the slides will have five numbers on it today and six numbers tomorrow and will be flashed on the screen as you pull on one of the white rings in front of you. You are to call back the numbers that you see on the screen.

Now notice the screen. On the glass there is a little black dot. This dot is your fixation point. Look at this dot when you are ready to pull the ring. To avoid tiring your eyes turn them away from the

screen after you have called out the numbers. When you are again ready to pull the ring look again at the black dot. The purpose of the dot is to help you locate the area in which the numbers will appear. Try to see the number group as a whole. You won't have time to look in two or more places.

Now, I am going to give you three practice slides. I will always say "ready" when a slide is in the projector. You may then pull the ring when you are ready. Remember to call the numbers back to me as soon as you have seen the flash. Now here is the first practice slide. "Ready" (#1) Now the second slide is "Ready" (#2) The third slide is "Ready" (#3). (The practice slides were (4) digit slides).

Now we are ready to begin the experiment. Remember call the numbers back to me just as soon as you have seen the flash on the screen. If you are not sure guess. Many times this half-sure guesswork pays off. Remember too that you are building up a new habit and this always takes practice so don't become discouraged. I'll let you know how well you have done at the end of each trial. Do you have any questions? All right, we can begin now.

"READY"

Instructions to Group Cm

You are about to participate in an experiment conducted for the Department of Psychology and Education. The Department is carrying out a program of remedial reading and several questions as to technique have arisen.

We are going to ask you to perform your part of this experiment, by carrying out certain procedures which have been highly useful in the past although the procedures have not been standardized for this application of them. In other words we are after experimental validation of actual corrective procedures now in use.

The exercises you are to perform will act upon your eye muscles and in doing so will tend to strengthen them. This exercise should tend to increase your reading efficiency.

Now as to the actual exercises. You see here certain pictures and figures on these stereoscope slides and here is a stereoscope. We would like

> for you to focus these slides in the stereoscope in several directions. Start by first drawing the slide holder toward the end on the stereoscope nearest you, then place the slide in and then slowly draw the slide away from you until there is just one picture instead of two. After you have done this move the slide holder to the far end of the carriage and then slowly draw it back until the picture is again in focus. You may then discard this slide and pick up the next in the series. You will repeat the whole series again tomorrow and then take a short test to see how much this work has increased your reading speed.

In order to investigate the question of transfer effect it was felt that more accurate results and a more comprehensive total picture might be developed by instituting a double measure of transfer. For this reason the experimental period was divided into halves. That is, both groups worked with only the five digit slides on the first day of experimental trials and then on the second day both groups worked on the six digit slides. By comparing the results for both groups one should then be able to estimate approximately how much transfer occurs within the procedure itself. It was hoped that this indicator would give some additional information as to the value of one technique over the other. In addition to this internal measure Form A of the Minnesota Test was administered immediately after the experimental subjects finished their last trial with the digits in an effort to determine whether or not one or the other of the experimental training conditions had shown more transfer effect to a reading situation. The time lapse factor was held as constant as possible in all groups by having the course of work spread over all groups instead of completing one group and then proceeding to another.

In addition to the controls which governed the lighting conditions themselves, it was also necessary to reduce as much as possible

the chance entrance of memory factors. This was done by thoroughly shuffling the slides between each experimental run and also by adding the leftover slides from the previous run to the group which were used on the succeeding run. A further control was instituted by having all subjects sit the same distance from the screen. However, postural variations in this instance allowed some degree of variation which could not be readily controlled. Fatigue was reduced by the interpolation of approximately one minute rest periods between each trial. It may be noted here that there were only a few complaints of fatigue throughout the course of the experiment.

Another control was set into the actual experimental procedure. A relatively constant time lapse between slide exposures was used. The actual lapse itself approximated 15 seconds. This seemed necessary as a rapid exposure rate with the "Dark" group would have destroyed their dark adaptation. Exploratory work showed that the intense negative afterimage disappeared in less than 3 seconds. The remaining time, about 12 seconds, allowed the subject to become dark adapted to a level which was assumed to be constant throughout each experimental run.

This period of time lapse as stated above was relatively constant since the experimenter used this period in which to write the digits called and to check them for correctness all of which took approximately the same time interval throughout the experiment. The same time lapse procedure was used with the "Light" group.

As soon as the subjects in Groups D and L finished their last run with the digits they were read the instructions for Form A of the

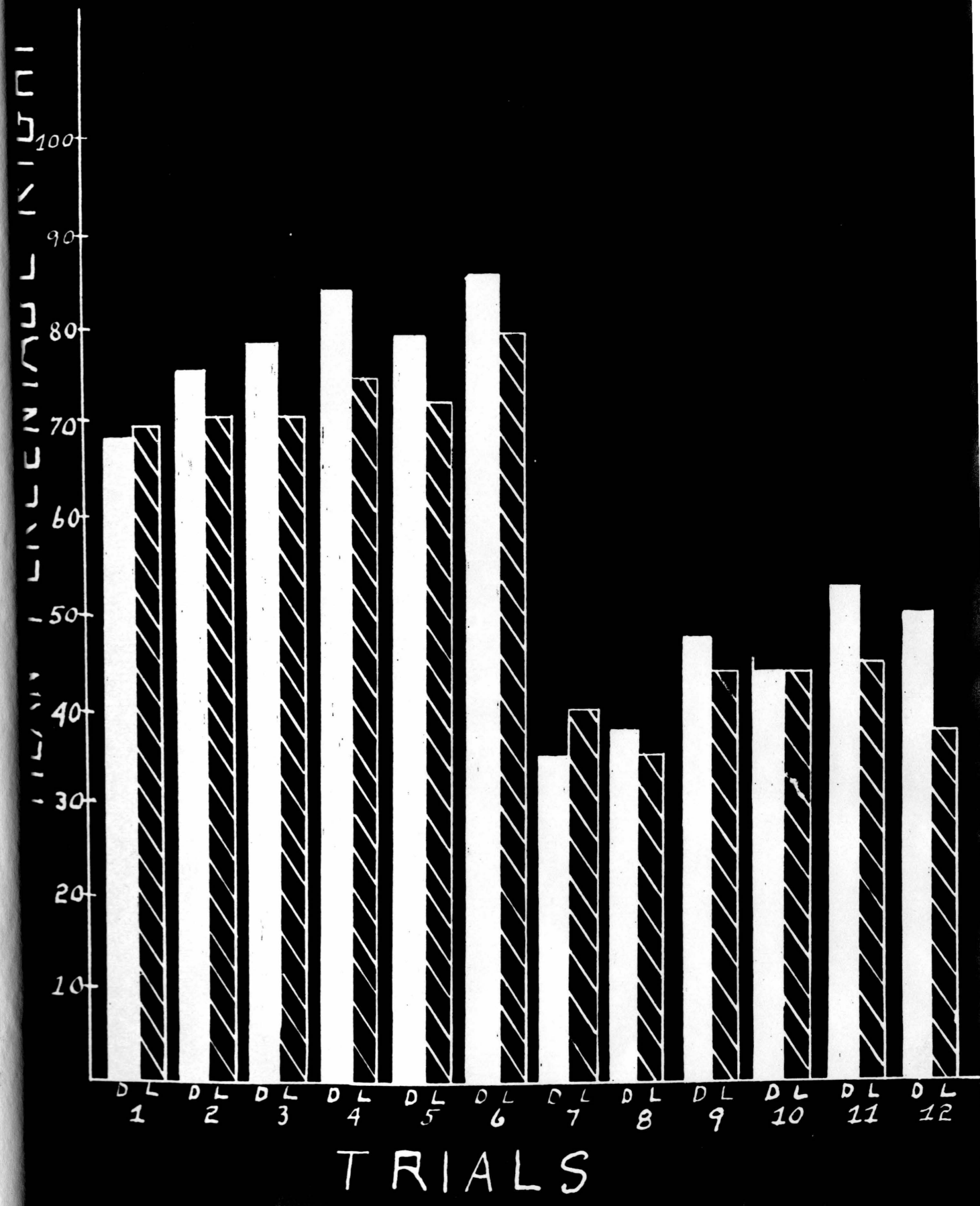
Minnesota Test and then tested immediately. Group Cm was tested in the same fashion after they had completed their second day's work with the stereoscope.

The graph on the following page illustrates the mean percentage scores for Groups D and L for the total twelve trials. Inspection shows that in all trials except the 1st and 7th that the Dark group's mean percentage scores exceeded those of the Light group. From this it would seem that training under relatively dark conditions progressed more rapidly than under relatively light conditions. This assumption is not, however, borne out when the transfer effects of these two types of training are considered. The following data and the chart of critical ratios following the percentage graph will show that the above assumption is not true, but that tachistoscopic training under relatively high conditions of peripheral light apparently is more efficient. The mean raw score, the standard deviation and the Standard Error of the mean for the first and second test follow.

	Form B (1st Test)			Form A (2nd test)		
Group	Mean	S.D.	S.E.	Mean	S.D.	S.E.
Dark	14.7	2.54	.802	21.5	5.05	1.598
Light	14.7	2.59	.815	22.1	1.19	0.371
Control	14.7	2.39	.754	15.2	1.16	0.365
Motivation	14.8	2.59	.815	18.4	3.163	1.00

From this table it may be seen that Group L showed a gain over Group D in the mean score alone. When these data are placed into the Critical Ratio formula the results obtained in the matrix on the page following the graph are obtained. Inspection of this matrix also

Performance Graph
Experiment #2



Critical Ratios

	D	L	C	C_1
D	3.80			
L	0.36	8.2		
C	3.84	13.45	0.60	
C_1	1.64	3.56	3.38	2.79

shows that training under relatively light conditions shows somewhat more transfer effect. This is based upon the following interpretation of these critical ratios.

First of all the control group showed no significant difference between its two means. Also there was no significance shown between the second test scores of the Dark and Light groups. However, both experimental groups showed significant gains in comparison to the control group with Light giving a much stronger critical ratio than Dark. This is also borne out by the fact that Light showed a much higher C.R. between its two means than did Dark although both had a C.R. of 3 or more.

These data then answer the first question and its corollary. That is, although tachistoscopic training progresses in itself more efficiently under relatively dark conditions, optimum transfer effects to actual reading situations seem to be more readily produced by tachistoscopic training under relatively light conditions.

The table also shows some very interesting results obtained from the work done with the motivation group. It may be seen that by using the stereoscope, which should have no effect in itself in increasing reading speed, some rather striking results were obtained. First of all the group's mean on the second test was 18.4 as compared to its first mean of 14.8. Secondly, on the retest the standard deviation and standard error of the mean decreased. All this points to the fact that the subjects, probably due to the individual interest taken in them and in their reading abilities, were able through some sort of extra effort to increase their reading speeds. This statement holds

for the group as a whole. However, one man decreased two points, and two others made the same score on both tests. But the other 7 men increased their scores from 3 to 9 points.

When these data are looked at in terms of critical ratios it may be seen that in comparison to itself the difference between Cm's first and second scores was almost significant. However, the difference between its second test and the second test of the ordinary control group was significant as well as the difference with Light's second test being significant. The difference was found to be not significant in comparing the data of Dark's second test.

Therefore, it may be assumed that increased motivational factors also tend to increase reading speed but not so much as with other directive and corrective types of training.

The results of this part may be summarized as follows:

1. Tachistoscopic training itself proceeds best under dark conditions which may be due to the subject's use of afterimage, but when transfer to an actual reading situation is desired daylight training conditions are more effective.

2. Motivational factors apparently account for some of the increase of speed but certainly can not account for all of the increase as some experts tend to believe. The data tends to invalidate to some extent their belief in the value of methods using intrinsic motivation.

In addition to these results another pattern of response was detected in the responses of many of the subjects. Unfortunately this was not foreseen when the design for this experiment was

constructed and provision for recording stimulus and response for all the subjects was not made. However, an accurate record of stimulus and response was kept on several of the last men who were run under Group L conditions.

These subjects' incorrect responses can be classified into three stages of errors. In the first stage the errors seem to have no relation whatsoever to the digits which were presented. The following are the correct numbers which are followed by the subject's response:

64927	67204
35817	37687
46503	45876
23584	28568
98628	98041

As seen here, the first digit of the group is usually responded to correctly with varying degrees of success with the remaining digits.

The second stage is typified by the confusion of certain of the digits and also by reversals of position. The following are examples of the errors made at this stage.

28651	28056
36428	36468
20982	20987
46503	46563
28659	28567

The third stage is characterized by all of the digits being called correctly but called with reversals in position alone. The following group illustrates this stage.

19347	19437
28659	28695
28659	28569
93417	93471
35817	38751

One other phenomena was noticed in connection with these error stages. It seemed that stage 1 was the dominating pattern in the early part of the experimental work, stage 2 in the middle and stage 3 toward the end. However, evidences of stages 2 and 3 could be seen while stage 1 was dominate, and during stage 2 evidences of 1 and 3 were present and even in stage 3 there seemed to be signs of the persistence of stage 1 and 2 errors.

With a slight modification of the experimental plan used here a procedure could be developed which would delve deeper into this error of response pattern and perhaps provide the answer as to how and why training with the tachistoscope transfers to an actual reading situation.

Summary

The purpose of this study was to raise several pertinent questions concerning the methodology of past research in the field of remedial reading, and also to attempt to point out some approaches that might lead to more definite information concerning the validity of retraining techniques used in actual remedial reading situations.

The work previously carried out was shown to be inconclusive in that all factors were not systematically controlled and varied. This investigation has attempted to illustrate the type of experimentation that must be continued if we are to discover the significant factors which are operative in remedial reading techniques.

The two experiments may be summarized as follows:

1. Optimal efficiency in retraining seems to be most favored within the tachistoscopic technique;

   a; when the shutter speed is relatively fast and the digit span proceeds from small to large.

   b; when the retraining with the tachistoscope is done under normal daylight conditions.

2. Increase of intrinsic motivation will to a limit increase reading speed but techniques aimed at correcting and broadening the perceptual span, such as the tachistoscopic, surpass the results obtained by simply increasing intrinsic motivation.

APPENDIX

The two case histories that follow will illustrate the work being done in the Remedial Reading Clinic at Washington and Lee University.

THE CASE HISTORY OF H. G.

H. G. is now a sophomore at this university. He first became interested in trying to speed up his reading after this topic was discussed in his class of General Psychology. He came to the clinic on his own and probably has been the most successful of the subjects seen thus far.

The usual pre-clinic procedure was carried out by first administering the Iowa Silent Reading Test. H.'s results on the initial test and then on another form of the test taken some 4 months later are listed below.

	Initial Test	Retest	
Rate	175	203	+28
Comprehension	193	199	+ 6
Word Meaning	200	210	+10
Sentence Meaning	186	226	+40
Paragraph Comprehension	190	173	-17

As can be seen from the initial test results H.'s rate fell significantly below his comprehension, word meaning, sentence meaning and paragraph comprehension scores. Therefore, it was deemed advisable to begin H.'s retraining on both the tachistoscope and on the reading rate controller. In the four months time he has not been able to get beyond the six digit stage with the tachistoscope and it is interesting to note that his mistakes are not mistakes in perceiving the individual numbers but are mistakes in perceiving them as whole, organized units. That is, he perceives all of the numbers correctly but in the process reversals of position occur.

Contrary to this apparent slow progress with the digits has been his rather remarkable progress with the reading rate controller. Initially he had no trouble in becoming accustomed to the shutter sliding down in front of him as evidenced by the fact that his first controlled speed was at the 400 words per minute level while his uncontrolled was at the 264 words per minute level. After a period of three months work with the two techniques he reached a level of 983 words per minute during uncontrolled reading.

As seen in the second column of the test results above, H significantly increased on all standard scores except that for Paragraph Comprehension. However, he made the comment that he seemed not to be able to concentrate on this last part of the retest. This comment seems to be a valid one since all other sections increased on the retest.

It may also be added that H has been in very regular attendance and has worked quite conscientiously throughout each practice period which may answer the question as to how he achieved so much in such a relatively short period of time.

In order to answer the question as to how much of this advance in speed will be retained after active remedial work ceases he will be retested upon his return to school after the summer vacation.

THE CASE OF R. D.

R. D., a 23 year old journalism student, presented himself at the clinic under his own volition. The immediate etiology of his reading difficulty was traced to his previous occupation as a proof reader in a printing plant. This type of reading involves not reading

for content but reading which is oriented to spelling, grammar, page numbers, etc.

The usual procedure followed in this clinic was carried through by first testing him on the Iowa Silent Reading Test. His standard scores were as follows, first on the initial pre-clinic test and then the retest taken about 4 months later.

	Initial Test	Retest	
Rate	157	184	+27
Comprehension	175	196	+21
Word Meaning	181	200	+19
Sentence Meaning	198	209	+11
Paragraph Comprehension	150	201	+51

In the initial discussion of his problem R. D. stated that after reading a paragraph meaning was lacking. This condition was substantiated by the Iowa Test which showed a paragraph comprehension score which placed him at the eighth percentile level for college freshmen. However, it seemed reasonable to assume that the major difficulty would be the alteration of his "proof-reading habits". The importance of this aspect is illustrated by his remark, "I even check to see that the page numbers are right."

Therefore, remedial training began in this case with an emphasis upon tachistoscopic work. Remarkably enough he had little difficulty with the five or six digit slides and a normal learning curve did not commence until he reached the seven and eight digit stage at which time he experienced the difficulties that most of other remedial reading subjects had at the five digit stage.

After the first month's work with the tachistoscope R. commenced work on the reading rate controller. His initial speed here was 335 words per minute and his uncontrolled speed was 408 words per minute. There seems to be an obvious discrepancy here but it must be remembered that to read while something is moving down the page and covering it is at first a great distraction and practice is required to overcome this initial distraction. In R's case after twelve practice periods on the controller his uncontrolled speed advanced gradually to 560 words per minute. After this he had to change his book and his uncontrolled speed once again dropped. It is impossible to say whether this drop was caused by the change itself, by more difficult material or whether his initially high motivation had dropped off somewhat since he began to work. Shortly after this he ceased working regularly in the clinic.

On the recent retest with another form of the Iowa the Rate standard score showed an increase of 27 points, Comprehension 21 points, and Word Meaning increased 19 points, which is probably due to the fact that he is now reading faster and consequently could answer more of the questions. Sentence Meaning and Paragraph Comprehension standard scores showed increases of 11 and 51 points respectively also due probably to the fact that his general speed and comprehension levels have increased.

At the time of testing his infrequent clinic visits reveal his uncontrolled reading speed to be still within the 500-525 words per minute range.

This case illustrates an extremely unusual difficulty. In the light of the fact that R. was considered an above average proof

reader which necessarily requires "part" rather than "whole" orientation his progress has been good even though lately he has not worked consistently. The writer believes, although experimental validation would be necessary to substantiate the statement, that his progress was due mostly to the early concentration on the tachistoscopic work which probably did more to reorient R to "wholes" than would have been possible with any other remedial technique.

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