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THE ROLE OF EYE MOVEMENT HABITS IN DETERMINING READING EFFICIENCY

FRANCIS P. ROBINSON

Since there is a correlation of about .60 between reading comprehension and eye movements, it is of importance psychologically to understand the nature of this relationship. Three possible causal relationships may exist. First, comprehension may determine the action of the eyes in reading; second, certain functions of eye movement may determine reading efficiency; or third, some undescribed factor may affect each of these and account for the relationship. The first possibility, that of comprehension determining the action of the eyes in reading, is more or less of an accepted fact and does not concern us here. However, there is a difference of opinion as to whether or not comprehension ability causes the whole relationship, so this study has attempted to evaluate the role of eye movements in determining reading efficiency. Specifically, it has attempted to evaluate the effect of eye movement habits on reading efficiency.

Since it was impossible to measure eye movement habits with a test as one does comprehension, another approach was used. This consisted of administering a controlled causative factor of such a nature as to increase the efficiency of eye movements and then measuring the effect. That is, after taking a cross section of the person's reading ability, he was put in a training situation which demanded efficient action of his eyes during reading over a period of time. After this another cross section was taken to find the gains made. Since the use of such a technique contained two difficulties: First, the forces in the training situation might not be limited to those described and, second, other psychological functions besides eye movement habits might be improved, an experimental evaluation of each of these was also carried out.

During two years, twenty-one freshmen, who scored in the lowest quarter on the Iowa Silent Reading Test, were given training. College freshmen were taken because their reading habits are matured and not apt to change unless specific training is given. They were given training by one of two clinicians in individual half hour conferences twice a week for ten weeks. This individual

treatment allowed the experimental conditions to be better controlled. The first meeting was used in giving a battery of analytic tests and in obtaining rapport with the student.

The other meetings were given over to applying training techniques. The one used most consisted of material typed off into "spaced phrases" which forced the eyes to cover a line in four fixations and emphasized rhythmicity of movement. Other techniques were used to give diversity to the training but were not emphasized. These included reading material with four red lines drawn vertically through it to indicate fixation points, skimming of easy material to find answers stated specifically in the same words as the questions and reduction of verbalization. Students were also urged to practise between meetings at increasing their reading rate while studying their lessons. The final meeting was devoted to administering different forms of the analytic test battery.

A comparison of the initial and final scores by the formula for the significance of the difference between means indicated that training, of the nature given, resulted in marked increases in reading efficiency. (Table I, column one).

However, before drawing the conclusion that the increased reading efficiency was due only to improved eye movement habits, the two difficulties of this approach noted above had to be evaluated.

This evaluation included an analysis of the role of those extraneous factors in the training situation that might have caused the gains. First, maturation due to adjustment to school demands was shown not to have caused the gains. A control group matched man to man with the experimental group on reading ability, intelligence, class, sex and clinician and measured before and after a comparable period of time with no training, made no significant gains. This was in spite of the fact that they knew that they were poor readers which most students do not realize until told. (Table I, column two).

Second, in spite of every effort to remove such training, comprehension abilities might have been improved unintentionally. To measure this possibility another matched group was given training in comprehension and the improvement was then compared with that of the experimental group. This was done on the premise that if the gains of the two groups were similar, they could be attributed to similar causes. But if the two types of training affected different aspects of reading ability, the training in eye movements

could then be considered as relatively free from comprehension training.

Every effort was made to keep the two general modes of training from overlapping. Training in comprehension emphasized the evaluation and organization of the ideas in the material read. All ideas obtained while reading were critically evaluated for their worth and suggestions were made for betterment. None of this was done in training eye movements, even in the case of erroneous ideas obtained by the student. The techniques used to aid comprehension included: the use of the preface and table of contents, the organization of chapters from bold face headings and summary paragraphs, reading for topic sentences, organization of the ideas through underlining and outlining, reading to answer questions about the lesson, vocabulary skills and skills in the use of maps, charts and indices. On the other hand no mention was made in comprehension training of any of the eye movement training techniques.

The comparison of the improvement due to both types of training by means of the formula for the standard error of the difference is shown in column three of Table I. A reliable difference in the gains resulting from the two types of training was found in seven tests. However, before the similarities of the other tests could be attributed to training in comprehension, other explanations had to be evaluated. First, neither group might have made any gain; second, an unreliable measuring instrument might have masked the reliability of a difference; and third, a test which measures several functions might have shown the same gain from two types of training because each affected different functions.

Since the Iowa Silent Reading Test and the Whipple Comprehension Test are not analytical but are dependent on many reading functions, a rough attempt was made to analyze the functions contributing to the total score into accuracy of comprehension and rate of reading (number tried). While this analysis did not show reliable differences, it did give a better indication of the different trends of the two training techniques. Comprehension training increased comprehension accuracy the most in both tests while training in eye movements increased the rate of reading the most in both tests. Due to the small number of items in these analyses and to their low validity, these tests were not good measures of the functions described which attenuated the differences found. However, the probability that the differences found were not due to chance were 880, 995, 998 and 992 times in a 1000, respective-

ly. Such a consistent trend for each group on both tests is very indicative of reliability. Since the duration of fixation was not reduced reliably in either group a final difference could not exist. Although variability of duration was not reduced reliably by comprehension training, the reduction was sufficient to make the differences between the two techniques unreliable. What the exact nature of this common effect was, is not known but it was not training in comprehension for habit training alone produced a reliable change. From these results the conclusion was then drawn that the gains from habit training could not be attributed to training in comprehension.

Likewise, motivation, or desire to gain, and adjustment to the experimental situation were eliminated as explanatory factors for they would have been common to both groups and would have caused similar gains if they had been operative. A change to skimming did not explain the gains, for weekly tests and notes taken during training showed that the gains were gradual increments on a typical habit growth curve and accuracy of comprehension actually showed improvement. Further, measurements of eye movements made in the photographic situation were valid because results on comprehension and rate of reading made during eye movement photography and in a normal situation were not reliably different.

Since the speaker had to explain the training situation to the other clinician, his results offered a parallel experiment and a check on the reliability of these results. The average gains of each training group under one clinician were compared to find the trends of each clinician's training results. When these trends for each clinician were compared on the tests used, a rank order correlation of .89 was found which is highly indicative that if the experiment were repeated similar results would be found.

The second difficulty in the use of a training technique to prove the existence of eye movement habits was to show that no other psychological function besides eye movement habits was improved. It has already been shown that comprehension abilities, as such, were not changed by the training in eye movements. Visual defects and eye incoördinations were not treated. Also perception span and accuracy measured tachistoscopically showed no improvement with training in eye movements. Further, no correlation was found between tachistoscopic span and width of fixation either before or after training in eye movements. Since this aspect of the experiment was carried out with only the second year group which was

very homogeneous only a tentative conclusion was drawn subject to further experimental study. It is that perception measured tachistoscopically has no more effect on the width of fixation than has the field of distinct vision. While this analysis is very gross, it covers the present status of the nature of reading and leads to the conclusion that training in eye movement "pacing" does result in improved reading efficiency mainly through increased rate of reading. The experiment has shown that the gains were due to the training given and that eye movements alone were affected. That such improvement is habitual was shown by the typical habit growth curves, the general transfer of improvement to other types of reading and the students improvement in school work. The analytical results of this study are later going to be used toward a description of the nature of these eye movement habits.

Table I

TEST	S. E. DIFF. BETWEEN I. & F SCORES HABIT	S. E. DIFF. BETWEEN I. & F SCORES CONTROL	S. E. DIFF. BETWEEN GAINS OF HABIT AND COMP. GROUPS
Iowa Silent Read.....	5.86	1.19	
Whipple Comp.....	3.52	.27	
Percent Accuracy I. S. R.....	1.44	.70	1.21
Percent Accuracy Whipple.....	.21	1.17	2.61
No. Tried I. S. R.....	7.56	.81	2.87
No. Tried Whipple.....	4.36	.31	2.40
Iowa S. R. Rate.....	5.80	.45	4.07
Rate at eye camera.....	7.79	.55	5.91
Minnesota Rate.....	4.80	.15	4.67
Eye Movements			
Width Fixation.....	8.33	.39	11.00
Regressions.....	9.40	.62	9.05
Extra Return Sweep.....	4.24	.30	4.97
Duration Fixation.....	1.41	.32	.86
S. D. Duration Fixation.....	4.52	.23	.92
Motor Manifestations.....	4.05	.92	3.40

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