Camera,[1] so the following experiments were carried out to determine the validity of the former technique.

Two clinicians, *M* and *R*, both of whom were experienced in counting eye movements, photographed the eye movements of 31 and 38 poor readers in college, respectively, and at the same time counted these movements through direct observation. Paragraphs about two hundred words in length taken from the Van Wagenen Reading Scales were used as reading materials. From the records thus obtained three scores were computed for each reader: (1) the number of eye movements actually made (photographed), (2) the number counted by direct observation, and (3) the time of reading the selection (from the time marker on the film). The intercorrelations of these variables for each clinician are as follows:

Tests	*M*	*R*
r of photographed and counted	.758 ± .051	.895 ± .013
r of photographed and time	.933 ± .011	.931 ± .010
r of counted and time	.811 ± .036	.928 ± .010

On the basis of the standard error of estimate[2] the above figures indicate that *M* can predict the photographed value 28 per cent. better by using time as a measure than he can by using the number counted. If *R* uses time his prediction is 7 per cent. better than if he uses the number of fixations counted through direct observation. Therefore, time, or rate of reading, is a better measure of the number of eye movements actually made than is the number counted by direct observation.

The question then arises as to whether or not the two variables, number counted and time, will give a better prediction of the number of eye movements actually made, *i.e.*, photographed number, than either variable alone. The multiple correlation of the photographed number with the number counted and time is .933 for *M* and .935 for *R*. For *M* to use both variables for prediction is no better than to use time alone and it is only 3 per cent. better for *R*. The reason for this is found in the fact that the true correlation between the number counted and the photographed number when time is held constant is .01 for *M* and .23 for *R*. This means that if all subjects had read for the same length of time, say one minute, the empirical correlation between the number counted and the photographed number would have approximated the above noted partial correlations. Just as Holzinger has pointed out that the correlation between ossification ratio and mental age is due to variation in chronological age,[3] so the zero order correlation between the number of eye movements counted by direct observation and the photographed number of eye movements is a function of variability in the time of reading the selection.

Counting eye movements is affected by many things. In this experiment, which continued through several months, each clinician found periods in which he tended to more nearly approximate the number actually made than at other times. At one period a tendency to count more than actually occurred was noted; on the average, however, the number counted represented for *M* 77 per cent. of the number photographed and for *R* 85 per cent. In other words, the clinicians in counting did not usually approximate the number of eye movements actually made. Also, the zero order correlations indicate that the number counted is more highly related to time than to the number of fixations made.

While it is to be noted that there is some variation in the correlations of the two clinicians, the significance of their predictions is comparable, so that the conclusions of this study have a general application. If good readers had been used, more accurate results would probably have been obtained because the larger excursions would have been easier to note. However, it is with the type of student used here who fixates almost every word that clinical diagnosis from eye movements is carried out.

The zero order correlations noted above indicate the validity of these measuring instruments in the actual reading situation. They show that both time and number counted are fair measures of the number of eye movements actually made. Of the two, however, time rather than the number counted gives a better prediction. Even this technique should be used only for preliminary diagnosis, though, since it gives at best a prediction of the photographed number only 64 per cent. better than chance. For an accurate picture of the nature of an individual's eye movements, photography must be used.

FRANCIS P. ROBINSON
PAUL G. MURPHY
STATE UNIVERSITY OF IOWA

[1] H. H. Jasper and R. Y. Walker, "The Iowa Eye-Movement Camera," SCIENCE, 74, 1931, 291–94.

[2] K. J. Holzinger, "Statistical Methods for Students in Education." New York: Ginn and Company, page 166.

[3] *Ibid.*, page 284.

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