THE EFFECT OF DIGIT AUTOMATICITY ON THE KING-DEVICK SACCADIC TEST

Senior Project

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Accurate, conjugate eye movements, saccades are critical in the reading process, but to clinically separate these movements from other complex factors involved in reading is extremely difficult. The King-Devick Saccadic Test (K-D Test), an optometric oculo-motility test, is widely utilized to detect poor saccadic movements of children or adults with possible reading disorders. The K-D Test, however, must be examined closely for possible contaminating elements that may be involved and taken for granted by the examiner when reviewing results of this test. The present study investigates one possible contaminating factor, the automaticity of digit knowledge, and how this may affect the outcome of the K-D Test.

An automated process is one that can occur because "lower-level functioning such as letter and word recognition become automated and thus free cognitive capacity for higher-level comprehension processes."[1] Laberge and Samuels (1974) have developed an automaticity model of reading in which skilled readers process words more automatically than less skilled readers, thus freeing them to read quicker and more efficiently. Stanovich, Cunningham and West (1979) stated that this automated process of letter and word recognition develops during the "crucial" first-grade period, and that "a sharp increase in automaticity occurs during the first grade, but that by the end of the year the development of automaticity has begun to level off."[2]

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[1] K. Stanovich, et al., "A Longitudinal Study of the Development of Automatic Recognition Skills in First Graders," Journal of Reading Behavior, XIII, No. 1 (1981), 57.

[2] Ibid., p. 72.

In view of this information, an experimental paradigm was developed to test the automaticity factor in digit knowledge and compare this to K-D Test results. Hypothetically, those children who score well on the K-D Test should have excellent digit knowledge and digit automaticity, but what about children who fail the K-D Test? Is this failure purely reflective of poor oculo-motility, saccadic eye movements, or could this failure indicate a poorly developed automaticity process, or lack of digit knowledge ? To answer this question, first and second grade children were given the K-D Test and were then tested in their digit knowledge and automaticity process.

METHODS AND MATERIALS

During late October, sixty-four subjects attending Hillcrest Elementary School, Big Rapids, MI, (forty first-graders and twenty-four second-graders), ranging in age from six years-one month to eight years-five months, were administered two sets of tests. Set I consisted of the K-D Test, including demonstration card, and Test One, Test Two, and Test Three. Each subject was instructed to read forty numbers on the cards as quickly as possible and to avoid using his finger or moving his head. The time required to finish each test, the total time for all three tests, and the number of errors (numbers misread or skipped) were recorded. All subjects held the test cards at their proper Harmon distance.

Set II, entitled the T.V.-K.D., was developed to eliminate all eye movements and to test digit knowledge and digit automaticity. This set consisted of a videotape of forty separate digits, zero through nine, flashed individually in the middle of a 14 x 18.4 cm. RCA video monitor (model #TC1210), (See Fig. a.).

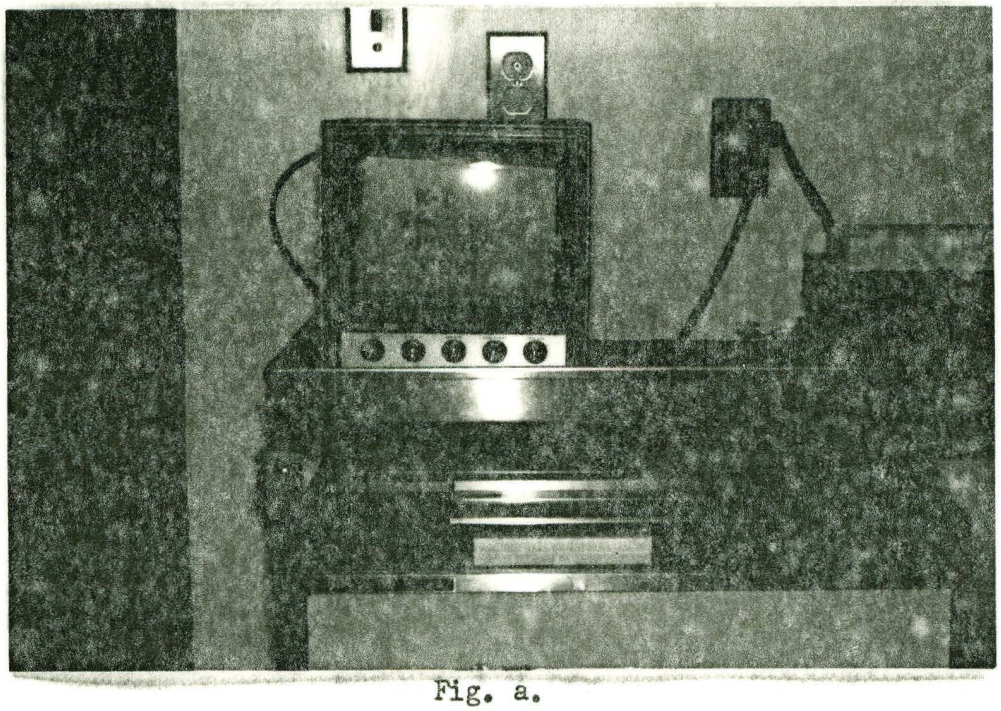

Fig. a.

Each digit was flashed at a rate of 950 msec. with a duration time of 632 msec. and an interval time of 316 msec. (See Fig. b.). This digit rate, derived from data collected by Cohen (1981) who normalized K-D Test Data on a population of 1202 school age children, is the mean rate of Cohen's six year old subjects, 38 sec. divided by the 40 digits in each test, creating a rate of 950 msec. per digit. The forty digits used in this T.V.-K.D. are the same forty digits used in the K-D Test Three. Part 2 of Set II includes the same forty

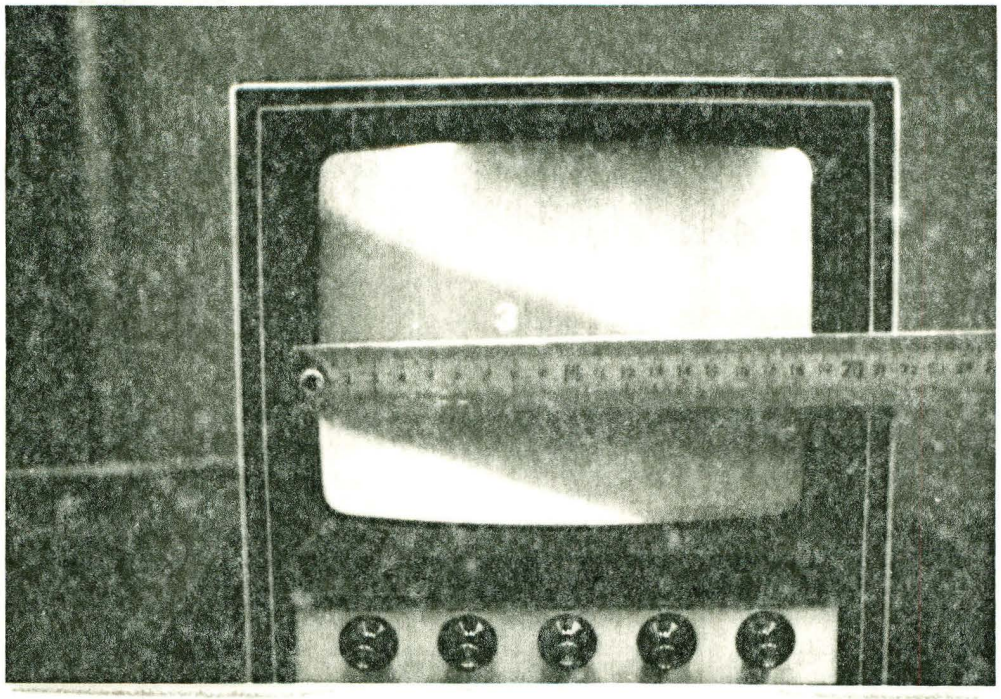

Fig. b.

digits with two x's on either side of the digit as a distractor. (See Fig. c.)

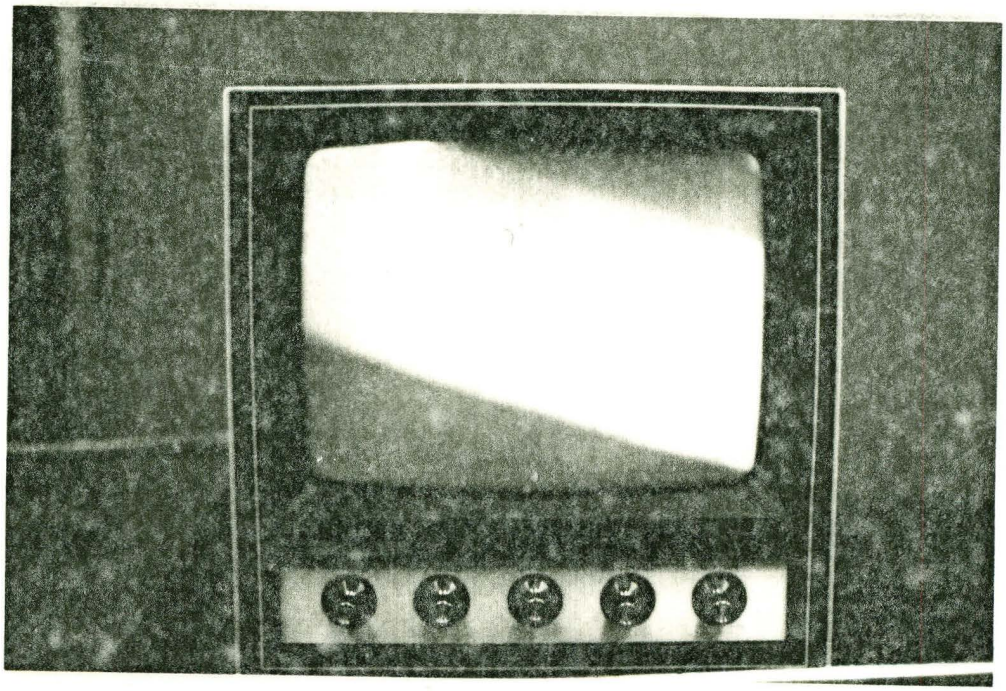

Fig.c.

Subjects were instructed to call out the flashed digits immediately after viewing them. The percentage of correct responses out of forty was recorded. Each subject was seated 40 cm. from the T.V. monitor with digits subtending a visual angle of 1.3°. Subjects were tested separately with Set I first (K-D Test One through Test Three), and then Set II (T.V.-K.D., and the T.V.-K.D. Part 2). The total testing time per child ranged from three to five minutes.

RESULTS

Failure on the K-D Test was denoted as a score larger than one standard deviation above Cohen's (1981) norm on two of the three K-D Tests when time to complete each test is considered. Time was chosen as the independent variable because on all three of the K-D Tests few errors occurred as far as digit recognition was concerned. Failure for the T.V.-K.D. and T.V.-K.D. Part 2 was established at missing six numbers out of the forty presented. (A correct response rate of 87.5%.)

The mean age of first-grade subjects was 6.4 $\pm$ 3 months. A very high correlation between all three K-D Tests was shown to exist. (See Table 1.) Each test, Test One through Test Three, correlated with at least an r factor of 0.93 with the total time of testing and a coefficient of determination, $r^2 = 0.86$. (86% of the time results will correlate this well.)

Another significant correlation was obtained when comparing results of the total time of the K-D Test and the T.V.-K.D..

An inverse correlation of - 0.72 demonstrated as the K-D total time increased, the T.V.-K.D. percentage of correct responses proportionally decreased. Even with running the T.V.-K.D. twice, once without distractors and once with x's as distractors, the correlation barely changed, (Part 2, Set II r = - 0.76). Also note, 62% of all first-grade subjects tested failed the K-D Test but 50% of all first-grade subjects also failed the T.V.-K.D., indicating 50% of all first grade subjects have poorly developed digit automaticity. Twelve percent of all first-grade subjects passed the T.V.-K.D. but failed the K-D Test, which might suggest subjects with poor saccadic movements.

The second grade subject's mean age was 7.4 $\pm$ 3 months. A similar high correlation was demonstrated between all three K-D Tests to the total testing time (See Table 2.), with an r factor of at least 0.88. Also, as the K-D Test total time increased, the T.V.-K.D. number of correct responses decreased proportionally with a slightly smaller r factor of - 0.65. Only three of the twenty-four second-grade subjects (12.5%) failed both the K-D Test and T.V.-K.D., a much smaller percentage as compared to the first grade subjects. Four subjects (16.7%) failed the K-D Test but passed the T.V.-K.D.

TABLE 1

Correlation between Total Time
of K-D Test and its individual components and
the T.V.-K.D. and T.V.-K.D. #2

r factor of:	K.D. I	K.D. II	K.D. III	T.V.-K.D.	T.V.-K.D. #2
Total Time	0.93	0.95	0.94	- 0.72	- 0.76

TABLE 2

Correlation between total time of K-D Test
and its individual components and the T.V.-K.D.

r factor of :	K-D I	K-D II	K-D III	T.V.-K.D.
TOTAL TIME	0.88	0.93	0.92	- 0.65

DISCUSSION

While testing first and second grade subjects, digit knowledge was evident, however, the time needed to process the information, when a digit was flashed on the T.V. monitor, was much too slow to distinguish or recognize the next letter presented. When many subjects took the time they needed to process the information of recognizing a digit and then calling the digit out loud, as in performing the K-D Test, these subjects could correctly recognize digits with few errors. However, when performing the T.V.-K.D., many first grade subjects and several second grade subjects reversed 6's and 9's, called out every other letter, or incorrectly named digits, indicating a lack in the development of digit automaticity. These subjects (50% of the first-grade subjects, and 12.5% of the second-grade subjects) who failed the T.V.-K.D. could not recognize digits quickly nor efficiently. This observation corresponds to the significantly high inverse relationship between the total time taken to complete the K-D Test and the number of correct responses on the T.V.-K.D., (As the Total Time increased, the number of correct answers

decreased.).

When reviewing only the percentage of failures on the K-D Test, (62% of the first-grade subjects), an examiner may conclude that these subjects all have poor saccadic eye movements. However, 50% of all first-grade subjects also failed the T.V.-K.D.! This comparison demonstrates how the digit automaticity process is an important factor complicating the K-D Test results.

A sharp decrease in the number of second grade subjects failing the K-D Test (28%) was noted, and only 12.5% of all second-grade subjects failed the T.V.-K.D.. Perhaps the decrease in percentage of second-grade subjects failing the T.V.-K.D. is indicative of Stanovich's et. al. (1979) theory that the automaticity process develops and has leveled off by the end of the first grade, thus not showing up as significantly in the second grade.

By combining results of both sets of tests an accurate diagnosis can be made separating those subjects with poorly developed automaticity processes and those with inaccurate saccadic eye movements. Twelve percent of the first-grade subjects and 16.7% of the second-grade subjects passed the T.V.-K.D., showing a fully developed digit automaticity process, but failed the K-D Test, indicating an inaccurate saccadic system. Without utilizing both sets of tests, a much higher percentage of children may have been diagnosed as having poor saccadic eye movements.

CONCLUSION

All subjects who passed the K-D Test also passed the T.V.-K.D.. This finding supports the initial hypothesis that subjects who score well on the K-D Test have a fully developed digit automaticity process. However, failing the K-D Test does not purely diagnose subjects with poor saccadic abilities. By combining data obtained from the K-D Test and the T.V.-K.D., examiners can more accurately project which subjects may benefit from oculomotility training, and by successfully determining where a deficit lies, proper therapy can be initiated to help poor readers of any age.

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