The Stern Fixation test: A normative study on a grade school population

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The Stern Fixation test: A normative study on a grade school population

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The Stern Fixation Test: A Normative Study on a Grade School Population.

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The Stern Fixation Test: A Normative Study on a Grade School Population.

Presented to the faculty of Pacific University College of Optometry in partial fulfillment of the requirements for the Doctorate of Optometry degree.

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ABSTRACT

Saccade-fixation skills were evaluated in 556 first and fourth graders using the Stern Fixation Test. A brief history of the relationship of saccadic eye movements and reading is given and the theory behind the Stern Fixation Test is reviewed. The norms that were developed here agree closely with the norms that were found in the original study done by Stern in 1984.
INTRODUCTION

Any test, to be of value to the clinician, must have a set of valid norms. Only when equipped with the proper information can the clinician evaluate an individual’s visual performance accurately. The authors feel that saccade-fixation abilities are important visual skills, especially in children who are learning to read and reading to learn.

As part of a general screening effort in the Forest Grove, Oregon School District, 556 first and fourth graders were evaluated for saccade-fixation abilities using the Stern Fixation Test. Norms were calculated for first graders and fourth graders. No distinction was made for age differences within each grade. Testing was done in late Spring after first grade students were allowed appropriate time to acquire letter recognition skills.

Historical Significance

The importance of accurate saccades in reading has long been recognized. A saccade is defined in the Dictionary of Visual Science as "An abrupt voluntary shift in fixation from one point to another, as occurs in reading." (1) It was found by Taylor (2) that elementary students in grades one through six fixate at least once per word. A child must have the ability to release fixation from the first object, then judge the distance to the next object and accurately refixate on the second target. From this we get the familiar phrase reach-grasp-release. Poynter (3) suggests two reasons for saccade control failure. First: peripheral visual acuity may limit the accuracy of the saccade. Second: incorrect execution might occur from miscalculations of the amplitude of the saccade.

There have been a number of studies which have suggested that saccade-fixation patterns may be related to, or be influenced by reading ability.
Pavlidis (4) reviewed eye movements in dyslexia. He noted that eye movement disorders are accompanied by difficulties in maintaining fixation, holding the eyes on the same line, and maintaining a sequential scanning of words or lines. Gilbert (5) found a correlation between eye movement efficiencies and performance in reading and non-reading tasks. In 528 subjects of above average, average and poor readers he found no instance of where a student was superior at prose reading and not at digit reading. The above studies support the conclusions reached by Goldberg and Salgwick in 1982 (6) when they compared normal and reading disabled children. They concluded that "the findings support the idea that reduced occulo-motor control may be a significant factor in reading disability."

A study done by Griffin (7) et. al. looked at normal and disabled readers and evaluated how each group performed on simple fixation tasks and on more difficult prose reading. They found that the inadequate readers had less efficient saccadic eye movements, more regressions and increased tendencies to skip material resulting in over fixation. Longer saccades were easier to perform and short fixations more difficult. Of the inadequate readers two groups developed. The first group performed saccadic eye movements too fast, resulting in skipping and omitting material. The other group performed saccades too slowly, resulting in overfixation. They concluded that a disorder of saccadic eye movements is a problem of micro sequencing.

Pavlidis and Miles (8) looked at dyslexic, retarded, normal and advanced readers. Care was taken to exclude any known factor that could be a primary cause of reading problems. The number of forward and regressive eye movements was significantly higher in dyslexic readers than in matched retarded, normal and advanced readers. Pavlidis (9) further investigated the theory that poor saccadic eye movements are only a response to poor comprehension abilities.
He compared dyslexic and normal readers who were asked to fixate a pattern of sequential illuminated lights. He found a significant difference between the groups. The dyslexic readers showed more regressions, longer fixations and more omitting than the normal readers.

These studies strongly suggest that saccadic fixation skills can influence a child's reading ability.

This paper will determine a normative score for the Stern Fixation Test, which attempts to measure saccadic eye movements without the influence of comprehension.

The Stern Fixation Test

In order to evaluate fixation skills in a large sample of children, a quick, accurate and objective test is required. Additional factors involved in reading skills had to be limited as much as possible. The Stern Fixation Test (SFT) was developed by Norman Stern O.D. PhD. in 1979. It was developed to evaluate saccadic eye movement skills involved in reading while minimizing symbol recognition and comprehension (6). This is accomplished by using a grade equivalent test and omitting all the letters of each word except the first while maintaining the configuration of the paragraph. Two forms of the test were designed to simulate material in grades 1 through 3 and 4 through adult.

The SFT is a quick and reliable method of evaluating saccade accuracy allowing an objective score to be assigned to each child. Originally the SFT was normed on a relatively small sample size. The criteria required the child to be reading at grade level. The authors felt that by using a larger sample size, increased norm validity would result. Unlike the original study by Stern, only those students who passed the P.U.C.O. vision screening requirements were included in the data.
METHOD

Students were seated across from the examiner. The instructions were read to each student directly from the recording form (appendix A). A practice test was then administered (appendix B) to see if the directions were understood. If any student had letter recognition difficulties on the practice test, his/her score was not included in the data. Test form 1 was given to grade level one and Test 2 to grade level four (appendix C + D).

A select group of 3 instructors was used for all testing to reduce testing variation. Each child was instructed to call each letter out loud, as fast and accurately as possible. The child was allowed to hold the material at his habitual reading distance, and then asked to call out the letters in the same order as if they were reading sentences. Any use of fingers as guides was discouraged. Each student was timed until he/she finished calling all the letters on the page. Any omission or incorrectly named letter was judged to be an error. No penalty was given for a regression, since more time would be required to complete the task.

A score was assigned to each student using the following equations:

Test form 1 score = time (in seconds) + the number of errors

Test form 2 score = time (in seconds) + 2 times the number of errors

For example, a child in fourth grade who completes the task in 71 seconds with 5 errors would have a score of 81. (score = 71 + 2 x 5) This value was used in subsequent data analysis.
RESULTS

The screening was conducted on 326 first and 237 fourth graders, of whom 287 first and 193 fourth graders passed the P.U.C.O. general vision screening requirements. (Appendix E) The mean score for passing first graders was 85.8 with a standard deviation of 22.53. The mean score for passing fourth graders was 96.89 with a standard deviation of 22.27. The normative data based on those subjects who passed the general screening is shown in tables 1 and 2.

<table>
<thead>
<tr>
<th>Percentile Rank</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>10th</td>
<td>62.17</td>
</tr>
<tr>
<td>25th</td>
<td>70.24</td>
</tr>
<tr>
<td>50th</td>
<td>81.04</td>
</tr>
<tr>
<td>75th</td>
<td>95.37</td>
</tr>
<tr>
<td>90th</td>
<td>113.69</td>
</tr>
</tbody>
</table>

**TABLE 1**

1st Grade Students Passing the P.U.C.O. Vision Screening Requirements

N = 287
Mean = 85.80 Seconds
S.D. = 22.53 Seconds
TABLE 2

4th Grade Students
Passing the P.U.C.O.
Vision Screening Requirements

<table>
<thead>
<tr>
<th>Percentile Rank</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>10th</td>
<td>72.65</td>
</tr>
<tr>
<td>25th</td>
<td>80.05</td>
</tr>
<tr>
<td>50th</td>
<td>91.91</td>
</tr>
<tr>
<td>75th</td>
<td>106.63</td>
</tr>
<tr>
<td>90th</td>
<td>128.98</td>
</tr>
</tbody>
</table>

N = 193
Mean = 96.89 Seconds
S.D. = 22.27 Seconds
At first glance it appears as if the first grade mean is lower than the fourth, but it must be remembered that the fourth graders were given a form of the test which is more advanced to reflect the greater difficulty of their reading material. These norms agree closely to the original study of 86.18 mean and 20.77 S.D. for first graders and a 103.87 mean and a 18.76 S.D. for fourth graders. There was no significant difference between the SFT mean scores of those passing the P.U.C.O.screening and those failing the screening.

CONCLUSION

The norms we developed for 480 first and fourth graders are consistent with the norms reached by Stern (10) in 1984. He has tentative norms based on a small population for each of the elementary school grades. It would be beneficial to develop norms on a larger population in the remaining grade levels.

Before the Stern Fixation Test can be considered a valid measure of saccadic eye movements it would be of value to have a comparative study done with an Eye-Track and other paper fixation tests. The practitioner utilizing the SFT to predict saccadic eye movement problems in learning disabled children must first determine whether a lowered score on the test is due to poor saccadic eye movements, poor letter recognition or a combination of both before attempting to make any diagnosis based on these scores.
REFERENCES


INSTRUCTIONS:
1. "When I say GO, I want you to read each letter out loud as fast and as accurately as you can. Read them in the same order as you would sentences. You may not point with your finger at the letters."
2. Show the example card and have the child read all of the letters. Let the child hold the test at any distance they desire. When the child has finished reading the example card, ask him/her if there are any questions, if not say "Ready...GO!".
3. Start timing as soon as you say "GO" and continue until they have read the last letter.
4. Mark each error on the above copy of the test by drawing a line through it. Each skipped letter is an error, and if a whole line is skipped, mark a check by it and count each letter in that line as an error.

SCORING:
Record the total time in seconds to complete the test:

Record double the total of all the errors on the test:

Add the time and errors together for the score:

Name__________________________ Sex: M  F

Age______ Birthdate_______________ Grade in School______________

Wearing glasses during test: Yes  No  Date of last eye exam__________

Have glasses ever been prescribed in the past: Yes  No

Reading Level:_______ on grade level

_______ months above grade level

_______ months below grade level
INSTRUCTIONS:

1. "When I say GO, I want you to read each letter out loud as fast and as accurately as you can. Read them in the same order as you would sentences. You may not point with your finger at the letters."

2. Show the example card and have the child read all of the letters. Let the child hold the test at any distance they desire. When the child has finished reading the example card, ask him/her if there are any questions, if not say "Ready...GO!".

3. Start timing as soon as you say "GO" and continue until they have read the last letter.

4. Mark each error on the above copy of the test by drawing a line through it. Each skipped letter is an error, and if a whole line is skipped, mark a check by it and count each letter in that line as an error.

SCORING:

Record the total time in seconds to complete the test: __________

Record double the total of all the errors on the test: + __________

Add the time and errors together for the score: __________

Name_________________________ Sex: M F

Age _______ Birthdate __________ Grade in School __________

Wearing glasses during test: Yes No Date of last eye exam __________

Have glasses ever been prescribed in the past: Yes No

Reading level: _____ on grade level _____ months above grade _____ months below

33.152
Appendix B
Stern Fixation Test

J w i t p

C a p b J s
H s H t b

T t t h i
H m t b

J g b
J h t b
T r a t b
H g i

T a J h f
On R Fl BW
Hrar
Hwlff

SRFctaf
Hwanfc
Shtttch

Ccwtc
Tcwslttf
c0

RFSstf
Hwa
RFrafahc
HrBtBW

RFdnrrttch
Hsitw

PUCO 33.149
Stern Fixation Test Form 1 (grades1-3)

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Pacific University
Appendix D

PUCO 33.150
Stern Fixation Test
Form 2 (grades 4 and above)

Forman Stern, PhD

1979

Fixation rest

Form 2.
(grades 4 and above)

The hot root of the tooth

[Image of a tooth diagram]
APPENDIX E

PACIFIC UNIVERSITY COLLEGE OF OPTOMETRY VISION SCREENING PROGRAM - CRITERIA FOR REFERRAL

*A. Visual Acuity (Near or Far): worse than 20/30, either eye

*B. Refractive Error:
1. Hyperopia
2. Nearsightedness
3. Astigmatism
4. Anisometropia

*C. Two-Eyed Coordination:
1. At Distance (20 feet):
   a. Tropia
   b. Esophoria
   c. Exophoria
   d. Hyperphoria
2. At Near (16 inches):
   a. Tropia
   b. Esophoria
   c. Exophoria
   d. Hyperphoria

*D. Ocular Health: Any verified pathology or medical anomaly of eye and/or adnexa

*E. Ocular Pressure (if tested):
1. Measured IOP 26 mmHg or greater
   (Borderline IOP: 22-25 mmHg)
2. IOP (right) - IOP (left) 6 mmHg or greater
   (Borderline: 4-5 mmHg)

F. Near Point of Convergence (NPC):
1. Break (recorded in inches)
2. Recovery (recorded in inches)

G. MEM Retinoscopy:
1. 20/300 Snellen numbers
2. 20/30 Snellen letters

H. Stern-Fixation Test:
1. Level 1 (First through third graders)
2. Level 2 (Fourth graders and older)

I. Lens Rocks (+/-2.00D): Recorded number of cleats in 30 and 60 seconds.

J. Prism Rocks (8 BI/BO): Recorded number of cleats in 30 and 60 seconds.

Table 1: *A-E were used to determine pass/fail criteria. Tests F-J were used in screening study to develop normative data and were not used for referral.