

THE VISUAL SCREENING of a K-8 CATHOLIC SCHOOL

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Abstract

The New York Optometric Association Vision Screening Battery (NYSOA) and the Developmental Eye Movement Test (DEM) were administered to 278 of the 410 students enrolled in a Catholic School, grades kindergarten through grade eight. Most all of the 278 students came from middle class, Catholic homes with much parental involvement. A multiple regression statistical model had limited success in predicting students' language arts, mathematics, and total achievement scores from the subtests of the NYSOA and DEM. Fusion-Balance on the NYSOA Battery and Total Failure on the DEM each accounted for 8% of total variability. In other words, knowing the failure rate on the NYSOA and on the DEM was of limited value in predicting academic success in reading, mathematics, and /or total academic achievement. The most significant finding was the success of the students on the Horizontal subtest of the DEM. We propose that the use of special pedagogical techniques enabled our subjects to perform well on tracking exercises such as on the Horizontal subtest of the DEM.

Key Words

American College Testing; National Achievement Test (ACT), Catholic school students, Developmental Eye Movement Test (DEM), multiple regressions, New York Optometric Association Vision Screening Battery (NYSOA), statistical techniques, vision screening

Introduction

Large numbers of children and adults struggle with learning in the classroom and on the job. An information based, competitive, technological society demands increasingly higher levels of literacy and creates serious consequences for those who are unable to meet the challenges of efficient learning and information processing. Almost all jobs require a minimum level of literacy.

Various visual efficiency and visual information processing skills have been proposed as prerequisites for learning in general and reading specifically. Indeed, the American Optometric Association has published clinical practice guidelines in this regard.¹ Early detection and treatment when these visual efficiency and visual information processing disorders are flawed are deemed important. Vision screening has been recommended as a cost-effective way to identify children who would benefit from further vision care.²

The need for comprehensive visual screening has been established. In 2000, Johnson et al.³ noted a high failure rate of Title 1 students on the following two vision screening measures: New York State Optometric Association Battery⁴ (NYSOA) and the Developmental Eye Movement Test (DEM).⁵ Title 1, a federal education program, provides additional money to local school divisions to improve the literacy skills of children from low-income families. Eighty-five percent of the Title 1 students in the Johnson et al.³ screening study failed at least one subtest of the NYSOA, while 93% of the Title 1 students failed at least one subtest of the DEM. More specifically, a chi-square statistical analysis indicated that Title 1 students failed the Tracking, Visual Acu-

ity-Far, Fusion, Convergence, and Color Vision subtests of the NYSOA at the .01 level of statistical significance. The Visual Acuity-Near and the Visual Motor Integration subtests were failed at the .05 level. The failure rate for the Horizontal and Ratio subtests of the DEM was also at the .01 level of significance.

The previous year (1999) Johnson and Zaba⁶ compared the failure rate of incarcerated juvenile offenders with a comparison group on the NYSOA and on the DEM. Forty-eight percent of the juvenile offenders failed the Tracking subtest of the NYSOA while all of the comparison group of graduate students passed. Large numbers of juvenile offenders also failed the Vertical subtest (34%), the Horizontal subtest (42%), and the Ratio subtest (28%) of the DEM. Before being tested, these juvenile offenders may not have realized that they had deficient visual skills. These undetected visual difficulties may have contributed to learning problems for these young men. Some of the juvenile offenders may have become "so frustrated with their perceived inability to perform academic tasks, that they displayed disruptive behavior in school."^{5,6} Without adequate diagnosis and treatment of their visual impairments, some students who are behaviorally at-risk may end up in the criminal justice system. Although it is very difficult to determine exactly what factors lead to criminality, it is important to rule out vision as a contributing factor.

In 1996 Johnson et al.⁷ reported on the screening of elementary, middle school, and high school students who had been designated as academically and /or behaviorally at-risk. Students who are academically at-risk resided in a section of the city in which most students failed to finish high school. Students who were

behaviorally at-risk were unable to attend regular public school classes due to behavior difficulties. Eighty-five percent of the academically at-risk students failed at least one subtest of the NYSOA with 37% failing the Tracking subtest. Ninety-seven percent of the students who had been categorized as both academically and behaviorally at risk failed at least one subtest of the NYSOA. Unless students with undetected visual problems are diagnosed and treated, they may demonstrate behavioral problems.

In a 1995 study, Johnson and Zaba⁸ visually screened (NYSOA) academically at-risk college freshman enrolled in a special recruitment and retention program to determine the incidence of visual problems in this population sample. The college freshman were at academic risk due to relatively low SAT scores (775) or mediocre high school grades (2.58 out of a possible 4.00). An 80% failure rate on the NYSOA battery was found among this group of at-risk freshman.

The previous year Johnson and Zaba⁹ administered the NYSOA to 54 illiterate adults and to 54 graduate students in order to compare incidences of visual difficulties in the two groups. A chi-square statistical analysis revealed that the illiterate adults scored significantly lower on the Tracking and Acuity-Near subtests of the NYSOA Battery than the graduate students. Lastly, Suchoff and Mozlin¹⁰ visually screened 625 high school students, 45.8% of whom were receiving special education. Fifty-two percent of the total sample failed the screening battery. Nearly 57% of the special education students failed one or more screening measures, compared with nearly 49% of the regular education students. In summary, Johnson et al.^{3,6-9} and Suchoff and Mozlin¹⁰ have noted significant visual disorders among academically and/or behaviorally at-risk elementary school, middle school, and high school adolescents; incarcerated juvenile offenders; academically at-risk college freshman; and illiterate adults.

Students attending Catholic schools appear to learn more than their public school counterparts. As Youniss and McLellan¹¹ conclude, "a small but significant effect favors students in Catholic schools." A sense of community and shared values may enhance the Catholic educational process¹² Walch¹³ notes that

the greatest asset of Catholic schools is the commonly shared "goals and aspirations (and even the prejudices and fears) of the neighborhood Catholics who support them." This sense of community and shared values may encourage more parental involvement in the child's education than is usually found in the average public school.

Catholic schools succeed in low income communities where public schools often fail. For example, when minority Catholic students are matched with minority public school students on parent's educational and income levels, family structure and reading materials at home, attending a Catholic school increases the probability of graduating from high school by 26%. Neal¹² notes, however, that the reasons for "the astonishing high graduation rate in urban Catholic schools is not entirely clear."

In addition to a sense of community and shared values, the use of the Palmer Method,¹⁴ commonly employed for teaching penmanship in Catholic schools, also may contribute to student academic success. With the Palmer Method students are methodically instructed in letter formation, posture, and the grip of the writing instrument in order to accomplish print and script writing. This Palmer Method for teaching handwriting involves daily visual "tracking" exercises that may enhance the visual system, and thereby contribute to the success of Catholic elementary students.

Purpose

The primary purpose of this research was to visually screen the majority of students in a Catholic elementary school (K-8 grade) in order to examine possible interactions between instructional paradigms and vision difficulties. The secondary purpose was to determine whether scores on subtests of the NYSOA and DEM could predict students' language arts, mathematics, and/or total achievement scores.

Methods

Subjects and school description

More than two thirds (278 out of 410) of the students (K-8 grade) of St. Pius X Catholic School in Norfolk, VA served as subjects. When all students in the school were given an opportunity to be visually screened, more than two thirds returned

the permission slips. Those failing to return their permission slips did not receive a visual screening.

St. Pius X serves the children of middle class Catholic families and provides quality education with an emphasis on the basics of reading, writing, and mathematics. Through offering a comprehensive and integrated curriculum, this school strives to educate the whole person. There is strong parental involvement in the classroom, clerical duties, fund raising, etc.

Screening procedures and statistical analysis of data

A researcher assisted by undergraduate and graduate volunteers, screened 278 students enrolled at St. Pius X Catholic School with the NYSOA⁴ and the DEM.⁵ The NYSOA Battery includes the following nine subtests: Tracking, Stereopsis, Visual Acuity-Near, Visual Acuity-Far, Fusion, Convergence, Hyperopia, Visual-Motor Integration, and Color Vision. Each test was administered and scored according to the NYSOA protocol on all 278 subjects. Lieberman et al.¹⁵ offer support for the reliability and validity of this vision screening battery.

Garzia et al.⁵ have developed the DEM which is concerned with automatic number calling (visual-verbal numbering skills), a necessary component of a valid visual-verbal test of oculomotor functioning. The requirement for horizontal eye movement is eliminated by virtue of a subtest which requires reading numbers in a vertical array. Vertical arrays of numbers are often used in reading tests. There is a significant correlation between measures of reading comprehension and the vertical tracking subtest.⁵

The Horizontal subtest of the DEM measures the time required to read numbers that are presented in that manner. Omissions and errors are included in determining this score. A horizontal to a vertical performance ratio is also established. In the present study failure on all DEM subtests was set below the 31 percentile rank (.5 standard deviation), based on the work of Solan and Suchoff.¹⁶ The failure rate for the Vertical and Horizontal tracking tests was also set at the 31 percentile rank, based on the work of Solan and Suchoff.¹⁶

A multiple regression statistical technique determined if the subtests and the total failure rate of the NYSOA Battery

and the DEM could predict students' language arts, mathematics, and/or total achievement scores as measured by the ACT Achievement Test.¹⁷ In statistical terms, failing one or more parts of the NYSOA Battery or the DEM served as predictors. Language arts, mathematics, and/or total achievement served as criterion variables. Total achievement scores were the average of the language arts and mathematics tests. The researchers investigated whether students who failed a visual screening were likely to perform poorly in language arts, mathematics, and/or total achievement.

Results

Table 1 shows the number and percentage of Catholic students (kindergarten through eighth grade) failing the NYSOA. As can be seen in Table 1, larger numbers of students at all grade levels failed the Fusion-Near subtest more than other subtests. At every grade from kindergarten through the seventh grade, at least 46% of the students failed Fusion-Near. Students at every grade level performed better on Fusion-Balance and Fusion-Far than on Fusion-Near.

Older students (Grades 5-8) passed approximately the same number of NYSOA subtests as did their younger counterparts (Grades K-4). Students in kindergarten, first, and second grades did seem to have more difficulty with the Convergence subtest, however. Twenty percent of the kindergarteners and 26% of the first and second graders respectively failed this subtest. However, no seventh graders and only 7% of the eighth graders failed Convergence. After the first two years of school, the percentage of each grade level failing the Tracking subtest drops from nearly 32% of the students down to 4% in the fifth grade. On the other hand, 21% of the eighth graders failed the Stereopsis subtest while not a single kindergartener, second, or third grader failed this subtest.

Table 2 shows the number and percent of Catholic students in grades K-8 that failed subtests of the DEM. Large numbers of students failed the Vertical tracking subtest at each grade level except for the eighth grade where only 2% of the students failed. Fewer students failed the Horizontal tracking subtest than the Vertical subtest at each grade level, except for the eighth grade level. The Ratio subtest

Table 1.
Number and Percent of Catholic Students, Grades K through 8, Failing the NYSOA
N = 278

	K	%	1	%	2	%	3	%	4	%	5	%	6	%	7	%	8	%
Numbers	25		35		47		26		34		26		47		29		29	
Subtests																		
Visual Acuity-Far	3	12	6	17	8	17	4	15	5	15	6	23	5	11	5	17	6	21
Hyperopia	1	4	2	6	0	0	1	7	0	0	0	0	2	4	0	0	1	3
Visual Acuity-Near	0	0	5	14	3	6	3	12	1	3	3	12	5	11	0	0	3	10
Convergence	5	20	9	26	12	26	0	0	5	15	3	12	7	15	0	0	2	7
Stereopsis	0	0	4	11	0	0	0	0	1	3	1	4	5	11	1	3	6	21
Visual Motor-Integration	2	8	6	17	4	9	6	23	1	3	1	4	5	11	1	3	3	10
Fusion-Balance	5	20	3	9	3	6	0	0	4	12	1	4	7	15	0	0	1	0
Fusion-Far	2	8	6	17	18	38	3	12	6	18	3	12	5	11	2	7	1	3
Fusion-Near	14	56	24	69	30	64	13	50	22	65	12	46	22	47	16	55	11	38
Color	0	0	4	11	1	3	2	8	1	3	1	4	5	11	5	17	0	0
Tracking	8	32	12	34	7	15	1	4	5	15	1	4	5	11	4	14	6	21
Fails at least 1 subtest	19	76	27	77	41	87	20	77	29	85	16	62	37	79	21	72	19	66

Table 2
Number and Percent of Catholic Students Failing the DEM Test by Grade Level
Grades Kindergarten through Eight
N = 278

	K	%	1	%	2	%	3	%	4	%	5	%	6	%	7	%	8	%
Numbers	25		35		47		26		34		26		47		29		29	
Subtests																		
Vertical	12	48	18	51	21	21	18	69	19	56	10	38	15	32	7	24	6	2
Horizontal	4	16	7	20	6	45	8	30	5	15	1	4	6	12	5	17	2	7
Ratio	2	8	0	0	5	11	0	0	0	0	1	4	5	11	1	3	3	10
Fails At Least 1 subtest	18	4	25	71	26	55	18	69	20	59	11	42	24	51	8	27	9	31

failure rates were quite low with only 11% maximum failing at any grade level.

A step-wise multiple regression model was used to determine if the subtests of the NYSOA Battery and the DEM could predict students' language arts, mathematics, and/or total achievement scores as measured by the ACT Achievement Test.¹⁷ None of the subtests of the NYSOA or the DEM reached the significance level for predicting language arts achievement. The only statistically significant predictor ($p < .01$) for language arts was the failure on all parts of the DEM. Thus, students who failed all parts on the DEM tended to have lower language arts scores. Total failure on the DEM only accounted for 4% of language arts variability.

Fusion-Balance and Acuity-Distance were the only two visual subtests of the NYSOA Battery that reached significance level ($p < .01$) for predicting mathematics achievement. These two subtests only accounted for 6% of mathematics total vari-

ability. No subtests of the DEM reached the significance level for predicting mathematics performance. Fusion-Balance on the NYSOA Battery and Total Failure on the DEM were the only two visual predictors that reached the significance level for predicting total achievement (reading, language arts, and mathematics). Each variable (Fusion Balance and Total Failure) accounted for 8% of total variability. Larger amounts of total variability had been found in the 1999 study involving the screening of adjudicated adolescents.⁶ With the juvenile offenders having considerably more academic and visual difficulties, it is plausible that more variability would be explained by the various subtests of the NYSOA and DEM.

Discussion

As previously detailed, large numbers (38-69%) of students at each grade level failed the Fusion-Near subtest of the NYSOA Battery. All visual screening had

been done at the end of the school day. The investigators retested ten students at the beginning of the school day rather than after the school day in order to determine if fatigue may have caused the large number of failures on the Fusion-Near subtest. These 10 students who had failed Fusion-Near during the after school screening session, passed the same visual subtest at the beginning of the school day. Thus, it appears that fatigue and eyestrain from a highly academic, visual school day may have caused the high number of failures on Fusion-Near during the after school testing sessions. Although the original Fusion-Near results are still reported in Table 1, they should be considered as research artifacts in that the same students were able to pass them during the early morning hours. If Fusion-Near subscores were removed from Table 1, significantly fewer students would have failed the category of "one or more subtests." The other subtests of the NYSOA Battery did not appear to be susceptible to fatigue.

The finding that students (in seven out of nine grades) scored much higher on the Horizontal subtest of the DEM than on the Vertical subtest is contrary to Garcia et al.'s⁵ contention that the Horizontal subtest is more challenging. According to Garcia et al.⁵ the visual-verbal component requires sustained visual attention, a visual to vocal response, number recognition, and accurate oculomotor tracking skills, all of which contribute to the greater difficulty of the Horizontal subtest. The current findings are also contrary to Johnson et al.'s 2000³ and 1999⁶ studies in which significantly more of the Title 1 students and juvenile offenders failed the Horizontal subtests than did their comparison groups.

There may be several reasons why Catholic students made fewer errors on the DEM Horizontal subtest than other previously studied groups. Teachers at St. Pius X model appropriate tracking and decoding behaviors used in reading by showing students the first letter of each word, by pointing out letter combinations, by reciting various words and sentences, and by emphasizing a horizontal left to right directional flow. Through the use of enlarged textbooks teachers and students read every word aloud pointing to individual words as they progress across each line of print.

Students are encouraged to decode one word at a time through the use of phonetics or the sounding out of words. No scanning or skipping of words are allowed. Through these procedures students develop decoding skills. Students achieve fluency in oral reading by reading a word while using their eyes and simultaneously looking further ahead along a line of text to orally read the next word. Students read back to the teacher what she has read to them. This reading may take place in a whole group or in small groups.

In addition, various strategies and exercises using charts, workbooks, the chalk board, and overhead projectors are used to help students develop fluency in oral reading. Kindergarten students develop pre-reading skills through practice of activities that encourage them to read from a left to right orientation. This is an integral part of the reading program, which offers daily practice in horizontal tracking. Vertical tracking or scanning and skimming of text material is discouraged. Through the use of solid instructional methodologies and daily skills practice, students become more competent readers who develop high levels of literacy.

The parents of children attending St. Pius X work in close collaboration with the teachers by assisting students to develop pre-reading skills that have a strong left to right orientation. Parents further facilitate the reading process through using the same oral reading techniques as the teachers. Through frequently reading to their children, parents reinforce practices taught in school and assist in the educational process.

Students are instructed carefully in handwriting skills, which also foster a left to right orientation. Students initially trace letters and are instructed by the teacher in proper strokes (lines), which facilitate letter formation and horizontal tracking. Handwriting is instructed and practiced on a daily basis at the school.

Although it is very difficult to determine the exact etiology of reading and learning difficulties, vision must be ruled out as being a contributing factor. Unresolved visual deficits may impair one's ability to profit from school. Visual and language processing deficits may contribute or co-exist with reading disorders.^{1,18} Therefore, it is important that all students receive a comprehensive visual examination that includes nearpoint vision mea-

asures. Students that are deficient in vision need an appropriate diagnosis, followed by the application of lenses, prisms, and/or visual therapy. We propose that only through having a behavioral optometrist as a member of the child study team, can the visual needs of students be adequately addressed.

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