THE LINK
VISION & ILLITERACY

ROGER JOHNSON, PH.D.
JOEL ZABA, M.A., O.D.

Abstract

The New York State Optometric Association Vision Screening Battery (NYSOA) was administered to 54 illiterate adults and to 54 graduate students in order to compare the incidence of specific visual problems in the two populations. A chi-square statistical analysis revealed that the graduate students scored significantly higher on the Tracking and Acuity-near subtests. Another significant finding was the 74% failure rate among the illiterate adults.

Key Words

illiterates, vision screening, trained volunteers

Illiteracy is one of the most pressing problems facing the United States today. According to the United States Department of Education, as stated in the Literacy Volunteers of America Fact Sheet, one in five Americans is unable to read, speak and/or compute in order to function effectively on the job and in everyday living.[1]

In our highly technological society, illiterate adults increasingly experience difficulty obtaining adequate employment. Heavy industry, such as automobile manufacturing, that previously employed thousands of unskilled workers have either moved overseas or no longer hire illiterate adults. Recently, researchers screened illiterate adults in order to determine the extent of their specific visual problems. Thau used optometrists to screen 117 adult students enrolled in the New York City Developmental Agency's literacy program.[2] She found that 66% of the students failed one or more parts of the screening. The largest number of failures (40%) occurred on the near visual acuity subtest. Students had difficulty seeing clearly at their reading distance, which averages approximately 16 inches from their eyes. Near refraction, the need for glasses for reading, ranked as the second most common area of failure with a 37% rate. In addition, 23% of the students failed distance acuity, while 18% failed tests to assess binocular functioning. Lastly, 12% failed distance refraction tests and 10% failed the ocular health assessment. Previously, Zaba and Johnson found that 74% of an illiterate adult population failed one or more parts of their vision screening. Zaba and Johnson used trained volunteers, as opposed to optometrists, to screen illiterate adults.[3] This limited research suggests that much continues to be unknown about the complex relationship between vision and illiteracy.

Thus, there is a need to extend Thau's[2] and Zaba and Johnson's[3] studies by including a control group to compare the incidences of visual problems of illiterate adults with their literate counterparts. Comparing the two groups of subjects on specific visual measures such as fusion and convergence may yield clues to the etiology of illiteracy. Therefore, the present study compared the extent of specific visual problems of a population of illiterate adults with a population of graduate students.

METHODS

Subjects

Subjects included 54 illiterate adults and 54 graduate students. Of the 54 illiterate adults, 31 were males and 23 were females, while 26 were African-American, 25 Caucasian, two Oriental, and one was Hispanic. The illiterate adults ranged in age from 20 to 75, with 27 being the median age. Based on occupational titles, most held unskilled jobs, while a few were unemployed or disabled. Twelve of the 54 subjects completed high school or passed the high school equivalency examination; twenty classified as special education students, and the other 22 dropped out of school before completing high school. Records revealed that seven subjects read below the first grade level, 13 read between the first and second grade, seven between the second and fourth grade, 17 between the fourth and sixth grade, and 10 above the sixth grade level.

The 54 graduate students, volunteers from four graduate courses, ranged in age from 23 to 50, with a median age of 27. Nine of the graduate students were male, while 45 were female; four were African-American, while 50 were Caucasian.

Screening Procedures

The Tidewater Virginia Literacy Council, located in Chesapeake, Norfolk, Portsmouth, and Virginia Beach, Virginia, is a nonprofit organization which tutors illiterate adults one-on-one basis. Three hundred students are tutored by 280 volunteers who have participated in 12 hours of literacy. Each tutor received additional in-service training and had frequent contact with area coordinators.

A VISTA (Volunteers in Service to America) volunteer was trained by an optometrist to use the New York State Optometric Association Vision Screening Battery (NYSOA).[4] The VISTA volunteer screened the illiterate and the literate subjects. Furthermore, a relationship between the VISTA volunteer and the area optometric associations provided for students failing the vision screening to be referred for appropriate visual care. The VISTA volunteer incorporated training about vision problems into the tutor training workshop, and designed a paper-based program to record the results of the visual screening.

The New York State Optometric Association Vision Screening Battery (NYSOA), utilized in the screening procedures, included the following eight subtests:4

1. Tracking--The ability of the eyes to move across a printed page
2. Fusion--The ability to integrate two separate images into one
3. Acuity-Distance--Distance visual acuity at 20 feet
4. Stereopsis--Binocular depth perception
5. Acuity-Near--Visual acuity for reading distance
6. Convergence--The ability of the eyes to appropriately triangulate
7. Hyperopia--A refractive problem that can make it difficult to focus, especially at near viewing distances
8. Color vision

Lieberman, Cohen, Stolzberg, and Ritty[5] gave support for the reliability and validity of the NYSOA in an article in the *American Journal of Optometry and Physiological Optics*. A consensus method for determining a diagnosis, developed with a double-blind design, validated the screening battery. The double-blind design meant neither the examiner nor the subjects knew the results of the visual screening. No diagnosis was given at the time of the screening. At a later time, the students who had been tested were informed whether or not they had passed the visual screening.

RESULTS

Table 1 shows the failure rate of illiterate adults compared with graduate students on the NYSOA subtests. As can be seen, 61% of the illiterates failed the Tracking subtest, while all graduate students passed. In addition, more illiterates than graduate students failed the Acuity-Distance, Acuity-Near, Convergence, and Hyperopia subtests. On the other hand, more graduate students failed the Fusion and the Stereopsis subtests. One of each group failed the Color Blind subtest.

The differences in frequencies between the illiterate adults and the graduate students were subjected to a chi-square statistical analysis in order to determine whether these differences were statistically significant. The chi-square analysis confirmed that the differences in Tracking (N=33 vs. 0) and Acuity-Near (N=7 vs. 0) in favor of the graduate students were statistically significant. The chi-square value for Tracking was 31.03 with 1 degree of freedom with p less than .01, while the chi-square of Acuity-Near was 5.14 with 1 degree of freedom from p less than .05.

DISCUSSION

The most significant finding of this study was the 74% failure rate among the illiterate adults. Although the precise relationship between reading difficulty and visual functioning remains unclear, with three of four illiterate adults failing visual subtests, the nature of these failures needs to be examined. These specific visual failures can be investigated by comparing the current population of illiterate adults with Thau's illiterate population. Given the selection and ages of the two populations of illiterate subjects, it is interesting that illiterates in the current study had a higher failure rate than did Thau's illiterate adults (74% vs. 66%). Thau's illiterate adults "represented only those students who were motivated enough to travel to Manhattan midweek" and included "many subjects above the age of 40".[2] On the other hand, the illiterate adults in the current study participated as part of the literacy program and had a median age of only 27. One would think that older students sufficiently motivated to travel to downtown New York City would have had more visual difficulties than the younger, non-volunteers of the current study. However, with many visual problems, individuals may not be aware that such visual problems exist. Instead, they may think that they only have a reading problem.

Table 1
The Failure Rate of Illiterate Adults vs. Graduate Students on the NYSOA Subtests

Subtest	Illiterates		Graduate Students	
	N	%	N	%
Tracking	33	61	0	0
Fusion	15	28	24	44
Acuity-Distance	14	20	7	13
Stereopsis	10	19	11	20
Acuity-Near	7	13	0	0
Convergence	4	7	3	6
Hyperopia	3	6	0	0
Color Vision	1	2	1	2
One or more subtests	40	74	32	59
Two or more subtests	24	44	14	26

Since most people read at a working distance of between 13 to 16 inches, an individual experiencing difficulty with near visual acuity may have difficulty with reading. Since difficulty with near visual acuity can interfere with the learning process, one may expect significant differences between the illiterate subjects and the graduate students on the Acuity-Near subtest. In fact, not a single graduate student failed the Acuity-Near subtest, whereas 13% of the illiterate adults failed this subtest. This is not to suggest a causal relationship, but it does indicate the need for vision screening of the illiterate population. With Thau's population being significantly older than those in the current study and with most people needing a lens prescription for near distance after the age of 40, the higher failure rate of Thau's subjects on a near visual acuity measure was not surprising.[2]

The difference between the illiterate adults and the graduate students on the Fusion subtest was not statistically significant. However, it is interesting to note that 44% of the graduate students failed Fusion, compared to 28% of the illiterate

adults. The greater failure rate of Fusion, the ability to integrate two separate images into one image, among graduate students may relate to nearpoint stress. Forrest[6] suggests that long hours of visually centered tasks, such as intensive reading and studying, may interact with one's genetic background to cause visual problems. Thus, the many years of intensive nearpoint studying may have been a factor in the graduate students' high failure (44%) on the Fusion subtest.

Tracking, the ability of the eyes to move across a printed page, may be related to illiteracy. Students unable to track may become the illiterates of tomorrow. The current study found significant visual tracking differences between our literate and illiterate populations. Sixty-one percent of the illiterate adults in the current study failed the Tracking subtest, while 100% of the graduate students passed the Tracking subtest. Reading incorporates language acquisitions, related visual skills (including tracking skills) and the visual verbal process. If one lacks the ability to move one's eyes across a line of print, learning to read may be difficult.

Since tracking is a visual skill which can be improved, and this current study has indicated a tracking deficiency among a population of illiterate adults, programs designed to teach reading to illiterate adults should consider utilizing tracking materials in their approach.[7] Future research in the area of visual tracking should examine which specific aspects of this visual process are related to reading and whether practice in the development of tracking skills will lead to reading improvement. Testing instruments such as the Developmental Eye Movement Test (DEM) may give additional insight into this very complicated process.[8]

Educators should work closely with vision care professionals to help meet the needs of adult illiterates. Through such mutual cooperation, future researchers will be able to lend further insight into this important area and meet the challenge of illiteracy.

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Corresponding author:
Joel Zaba, M.A., O.D.
1232 W. Little Creek Road
Norfolk, VA 23505

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