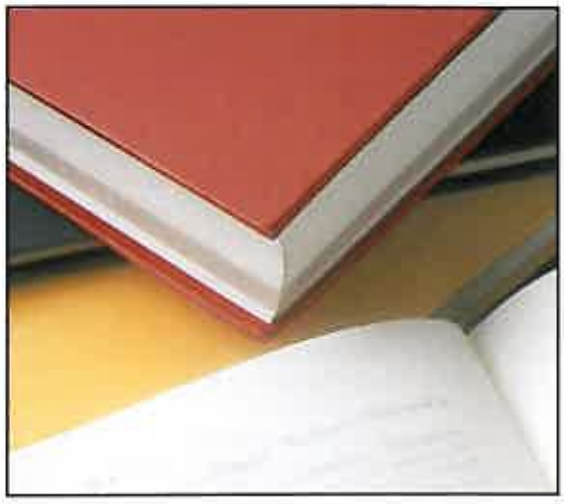
THE OPTOMETRIC EVALUATION OF ADULT FEMALES WHO ARE PARTICIPATING IN A REMEDIAL READING PROGRAM



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Abstract

A group of 14 adult female subjects were administered a comprehensive battery of optometric tests. These test results were then compared to clinical norms. The percentage failure for four major visual anomaly groups is reported and the failure rates are compared to a similar study which has recently been published.

Key Words

refractive error, oculomotor dysfunction, binocular dysfunctions, academic problems, accommodative dysfunctions, literacy programs

Both education and optometry have long sought to determine the effect of visual skills on academic skills.[1-20] Optometric literature generally supports the notion that vision does indeed affect reading. Ophthalmological literature, for the most part, presents a contrary view.[21-25] Several literature reviews have demonstrated that visual skills cannot be ruled out as a factor in academic achievement.[26-31]

An area of research which has received attention recently has been the interaction of the transient and sustained visual systems. Evidence exists which indicates that an abnormal interaction of these parallel visual processing systems is associated with reading difficulties.[32-37] The abnormality appears to have been isolated to a dysfunction of the transient system.

A condition termed "scotopic sensitivity syndrome" has been proposed by Irlen.[38,39] She claims that many "dyslexics" are afflicted with scotopic sensitivity dysfunction and that if an individual has good acuity, other visual factors do not affect the reading process.[38-41] It is Irlen's contention that the treatment of choice for this condition is specially tinted lenses. Scheiman, et al reported that many (95%) of the Irlen filter candidates in their sample had undetected vision problems.[41,42] Binocular vision problems were discovered in 57% of Scheiman, et al's subjects. Thirty-four percent exhibited accommodative problems, 26% oculomotor dysfunctions, and 29% were found to exhibit miscellaneous ocular/visual conditions, including uncorrected refractive error, presbyopia and hysterical amblyopia.

In light of Scheiman, et al's report, we sought to determine whether these comparable percentages of visual problems exist in a similar adult population who had been unsuccessful in school.

A literacy center was contacted to furnish subjects for this study. We chose to study adult females who were educationally diagnosed as having academic difficulties. The subjects were clients of a local social service program and were enrolled at a literacy center as part of their individual social service package.

We informed the administrators of the literacy center that the goals of this study were to perform a complete visual evaluation of these subjects, analyze the findings and to compare this data to the Scheiman, et al study.[41] We emphasized that a major benefit to the subjects would be that the examination would allow the clinician to write an optical prescription if needed.

Methods

One clinician (LH) collected all the data. Table 1 lists the diagnostic procedures which were administered. We chose to add pupil evaluation, tonometry, external examination and an internal ocular examination to Scheiman, et al's battery of tests. The protocol for each test is found in Appendix A (page 92). The Scheiman, et al article listed eight questions which were

Table 1
Tests Administered In Study

(See Appendix A for each test protocol)

1. Case history questionnaire
2. Oral interview
3. Distance visual acuity
4. Near visual acuity
5. Nearpoint of accommodation
6. Nearpoint of convergence
7. Pupils
8. Accommodative Rock Test
9. Developmental Eye Movement Test
10. MEM Retinoscopy
11. Phorometric Tests
    a. Subjective (maximum plus to 20/20)
    b. Subjective (maximum plus to BVA)
    c. Induced phoria at distance
    d. Adduction (distance base-out blur)
    e. Convergence (distance base-out break and recovery)
    f. Abduction (distance base-in break and recovery)
    g. Induced phoria at near
    h. Positive relative convergence
    i. Positive fusional reserve (break and recovery)
    j. Negative relative convergence
    k. Negative fusional reserve (break and recovery)
    l. Positive relative accommodation
    m. Negative relative accommodation
12. Tonometry
13. External ocular examination
14. Internal ocular examination

presented to each subject.[41] The same questions were administered to the subjects in our study (see Appendix B page 92).

Scheiman, et al's diagnostic criteria and syndromes were adopted in order to compare our data directly with their's. The syndromes fell under the following categories: binocular, accommodative, ocular motility and miscellaneous disorders (refractive errors). Table 2 contains these syndromes. It should be noted that an individual was not required to fail all the diagnostic criteria in a particular syndrome to be so categorized.

Because the precise numerical criteria for the various tests used by Scheiman, et al were not made available, we adopted findings that are generally accepted to be indicative of less than adequate performance.[44-47] These numeric values are found in Table 3. Although we administered other tests, this paper will report only those findings which are referenced in Table 3.

In addition to the Case History Questionnaire (Appendix B, page 92), each subject was given a specific interview to further evaluate the possibility of visually-related symptoms.

Table 2
Scheiman et al's[41] Diagnostic Criteria for Binocular Accommodative and Ocular Motility Disorders

Convergence insufficiency
- -receded nearpoint of convergence
- -exophoria greater at near than at distance
- -reduced positive fusional vergence at near
- -low NRA
- -difficulty clearing plus lenses on binocular accommodative facility testing
- -low MEM retinoscopy finding

Convergence excess
- -esophoria greater at near than at distance
- -reduced negative fusional vergence at near
- -low PRA
- -difficulty clearing minus lenses on binocular accommodative facility testing
- -high MEM retinoscopy finding

Fusional vergence disfunction
- -usually low exophoria or esophoria
- -reduced positive and negative fusional vergence at near
- -low NRA and PRA
- -difficulty clearing both plus and minus lenses on binocular accommodative facility testing

Accommodative insufficiency
- -reduced amplitude of accommodation
- -low PRA
- -difficulty with minus lenses on monocular accommodative facility testing
- -high MEM finding

Accommodative excess
- -low NRA
- -difficulty with plus lenses on monocular accommodative facility testing
- -low MEM finding

Accommodative infacility
- -low NRA and PRA
- -difficulty with plus minus lenses on monocular accommodative facility testing
- -low MEM finding

Oculomotor dysfunction
- -ratio score below the 15th percentile on the Developmental Eye Movement Test

Basic esophoria
- -equal esophoria at distance and at near
- -low negative fusional vergence at distance and at near
- -low PRA
- -difficulty clearing minus lenses on binocular accommodative facility testing
- -high MEM retinoscopy finding

Basic exophoria
- -equal exophoria at near and distance (both greater than normal expected findings)
- -reduced positive fusional vergence at distance and near
- -low NRA
- -difficulty clearing plus lenses on binocular accommodative facility testing
- -low MEM retinoscopy finding

Table 3
Specific Diagnostic Criteria Employed in Present Study

1. Far and near monocular and binocular visual acuity--any acuity less than 20/20
2. Amplitude of accommodation--blur point and/or recovery point greater than 6 inches from the patient and recovery greater than 8 inches
3. Amplitude of convergence--break point greater than 5 inches and recovery greater than 7 inches
4. Far and near Von Graefe phorias--distance phorias greater than 3 exo or 2 eso
5. Far and near fusional vergences--findings below these numerical values were considered failure: Far: adduction 5 pd, 11 pd, break and recovery 6 pd; abduction 4 pd break, 2 pd recovery; Near: positive relative convergence 12 pd, positive fusional reserve 15 pd, recovery 4 pd; negative relative convergence 9 pd, negative fusional reserve 17 pd, recovery 8 pd.
6. Negative relative and positive relative accommodation-- findings below +1.50 D and - 1.50 D respectively were considered failure.
7. Monocular and binocular accommodative facility (+/-2.00 D)-- findings less than 11 cycles/min. in the better eye, with not more than 2 cycles difference between the two eyes, and less than 8 cycles/min. binocularly were considered failure.
8. MEM retinoscopy--less than 0.25 or greater than 0.75 lag
9. Refractive error--greater than +1.00 for hyperopia, -0.50 for myopia or 0.50 cylind correction for astigmatism
10. DEM ratio score--greater than 1.24
11. Any evidence of ocular pathology

Results

A total of 14 adult females enrolled in a literacy program were given an extensive optometric evaluation. All had ceased formal education before high school graduation and all were currently enrolled in a state social service program. The ages ranged from 17 to 34 years. The mean age was 27.8 years. The age of 34 years was chosen as the upper limit for the subjects to insure that presbyopia was not a significant variable in the findings. An extensive case history and educational test scores had been obtained by a reading specialist. It had been determined independently by the reading specialist that each subject would benefit from a remedial reading program.

No pathology was detected upon external or internal examination. Neither were there any pupil abnormalities noted. One individual did exhibit borderline intraocular pressure (20 mg Hg; OD, OS). Her anterior chamber angles were open

Table 4
Summary of the Various Categories of Vision Disorders Found in this Sample

Type of Disorder	# of Subjects	% of Subjects
Binocular Vision Problems (Failure far or near on fusional vergences)	14	100%
Far failure	12	86%
Near failure	9	64%
Both far and near failure	7	50%
Accommodative Problems	12	86%
Monocular accommodative infacility	8	57%
Binocular accommodative infacility	8	57%
Both monocular and binocular infacility	5	36%
Insufficiency (amplitude of accommodation)	3	21%
MEM	9	65%
Relative accommodation findings	7	50%
Both insufficiency and infacility	6	43%
Oculomotor Dysfunction	6	43%
Miscellaneous, including: uncorrected or improperly corrected refractive error, uncorrected presbyopia, and hysterical amblyopia	9	64%

Table 5
Summary of Subjects Falling into One or More Categories N = 14 (All subjects failed at least two categories)

Subject	Binocular	Accommodative	Oculomotor	Miscellaneous
1	X	X	X	X
2	X	X		X
3	X	X		X
4	X		X	X
5	X			X
6	X	X		
7	X	X		
8	X	X		X
9	X	X	X	X
10	X	X	X	X
11	X	X		
12	X	X	X	
13	X	X	X	
14	X	X		X

Types of Disorders Failed (The number in parentheses indicates the number of categories failed.)		Number failing
Binocular, accommodative, oculomotor and miscellaneous	(4)	3
Binocular, accommodative and miscellaneous	(3)	4
Binocular, oculomotor and miscellaneous	(3)	1
Binocular, accommodative and oculomotor	(3)	2
Binocular and accommodative	(2)	3

and the cup/disk relationship was normal in each eye. The recommendation was made that she should have tonometry and fields evaluation performed on a three-month basis.

With regard to the questionnaire, 12 of the 14 subjects reported a significant number of symptoms which might be related to the eyes and vision. Two subjects reported only slight symptoms. One of these described only occasional headaches while the other reported trouble focusing upon objects when changing fixation from near to far or far to near. This same individual also complained of vague asthenopic symptoms. All the remaining subjects had a significant number of symptoms which are often associated with visual problems.

All 14 (100%) failed some portion of the binocular vision aspect of the examination (see Table 4). Most of these failures included low fusional vergences either at distance (12/14) or near (9/14) or both distance and near (7/14). A receded near-point of convergence was the least noted aspect to be failed in the binocular aspect of this data. Only five of the 14 individuals (36%) failed this particular test.

Accommodative anomalies were detected in 12 of the subjects (86%). Accommodative failures included a low accommodative amplitude (3/12), low accommodative facility (8/12), low negative relative accommodation (6/12), high accommodative lag as measured by MEM retinoscopy (9/12), and a low positive relative accommodation (1/12). Monocular and binocular accommodative facility was failed over half the time (monocular 9/14, binocular 8/14).

The category least failed was oculomotor dysfunction. Six of the total sample of 14 (43%) failed the ratio portion of the Developmental Eye Movement Test.[48,a]

Of the 14 subjects, nine (64%) required some type of distance and/or near lens prescription (miscellaneous category). Four of these presently wore prescription lenses and none of these prescriptions, according to our examination, needed to be modified. Four other individuals reported that they had previously worn lenses and had either lost or broken them, or had discontinued the use of the prescription and therefore did not regularly use any ophthalmic device. Prescriptions were written for each of these individuals. They included myopia (1/4), hyperopia (1/4), mixed astigmatism (2/4), and one exclusively for near vision.

It is interesting to note that this sample as a rule failed more than one aspect of the four major areas (see Table 5). Three of the group failed all four categories. Seven were deficient in three of the categories, while three individuals failed in two areas. None of the individuals failed in only one area.

Discussion

It is clear that this sample has significant visual problems. Scheiman, et al reported that 95% of the candidates identified for Irlen Filter therapy had significant and readily identifiable vision anomalies.[41]

Table 6
Comparison between Scheiman, et al Study and the Present One

Type of Disorder	Scheiman	Present Study
Binocular	57%	100%
Accommodative	34%	86%
Oculomotor	26%	43%
Miscellaneous	29%	64%

Using essentially the same criteria, we have found that all our subjects (100%) also had significant problems. Table 6 gives a clear comparison between these two studies. In each category the present study contains more failures than does the Scheiman study. A possible explanation for this is that the present samples were aware of their visual symptoms, but for various reasons, financial being a major aspect, had not obtained care from an optometrist. The Scheiman, et al study, on the other hand, reported that over half of their sample had been examined by an eye or vision specialist within the previous year.

The binocular aspect was failed by all individuals in this study. It is worthy to note that the great majority of these failures were documented in more than one test area, which adds credibility to the identification of a visual dysfunction in this sample. A similar condition is present when the accommodative failures are scrutinized. It was the rule in this study that more than one accommodative test result

was found deficient for all subjects who failed this area. Basically, the ocular motor failures used only one criterion, the Developmental Eye Movement ratio score and refractive error was the failure criterion under the heading of miscellaneous.

Conclusions

Untold numbers of resources, both in man hours and finances, are spent each year on remedial education. Many of these individuals who are performing below their expected level in reading are also suffering from significant refractive, binocular, accommodative or ocular motility disorders. The foremost problem which was indicated in this study was that at least some individuals enrolled in such educational programs probably have undetected visual dysfunctions which inhibit the students' ability to perform up to their potential. Common sense dictates that society should not spend the time, effort and money in an attempt to educate these individuals until the basic visual problem which is present with a significant number of these students has been addressed.

Sources

a. Developmental Eye Movement Test (DEM), Bernell Corporation, 750 Lincolnway East, PO Box 4637, South Bend, IN 46634

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APPENDIX A
PROTOCOL FOR TESTING

All testing was performed through the habitual prescription.

Distance Visual Acuity

Each eye was tested starting with the right eye, then the left eye and then both eyes. A standard projected far chart was employed. Recording was by standard Snellen nomenclature.

Near Visual Acuity

Each eye was tested starting with the right eye, then the left eye and then both eyes. A standard Reduced Snellen Chart was held for the patient at the 16-inch distance

Nearpoint of Accommodation

Each eye was tested in turn on this procedure, beginning with the right, then the left and lastly with both eyes. The subject brought a reduced Snellen Chart toward herself while reading the smallest row possible. The instructions were to report when it became blurry (1st blur). The chart was then moved away until the subject reported she could see the same row clearly. Both the blur and recovery findings were recorded for each eye and both eyes.

Nearpoint of Convergence

A small polished sphere (1/2 cm in diameter) was held on the midline of the subject's body at 16 inches. It was moved forward and the subject was instructed to report when the sphere became two balls. The sphere was then moved away until the subject reported one. Both break and recovery findings were recorded.

Pupils

Direct, indirect, consensual and accommodative pupil responses were tested with a penlight. The pupil responses noted were equality, roundness, reactive ability to light by direct, indirect and accommodative stimulation.

Accommodative Rock Test

A Correct-Eye-Scope with the flipper head was used to test the accommodative facility. The Reduced Snellen Transparent Plate (VO-16) was placed 16 inches from the head. The lenses placed in the lens well were +2.00 spheres. Minus 4.00 spheres were placed in the flipper apparatus. Both monocular and binocular accommodative flexibility were tested. A patch was used to occlude the eye not being tested, under the monocular conditions. The right eye was always tested first, the left eye second and binocular testing was always last. Suppression was not monitored. The subject was instructed to flip the lenses as soon as any of the bottom row was readable. The number of flips per 30 seconds were counted and converted into cycles per minute. If a slower phase (-/+) was noted, then this was also recorded.

DEM

The Developmental Eye Movement Test was performed as suggested by the manufacturer.[9]

MEM Retinoscopy

The MEM retinoscopy was performed monocularly through the habitual prescription. An estimate was made of the reflex as the subject viewed words around an aperture in the MEM Card, which was held at 16 inches. A spherical lens was briefly introduced over one eye and an estimate of retinoscopic motion was again made. This procedure was repeated until neutrality was achieved in each eye. The lens which neutralized the eye was recorded.

Phorometric Tests

All phorometric tests were performed according to standard Optometric Extension Program Foundation instructions.[49]

Tonometry

Tonometry was performed using a Goldmann Applanation Tonometer in the standard way. One drop of Fluress was administered to each eye before the measurement.

External Examination

A biomicroscope was utilized to observe the structure of the eye and adnexa.

Internal Examination

This examination was performed in the standard way with a direct ophthalmoscope and a Binocular Indirect Ophthalmoscope.

APPENDIX B

How long can you do near work (i.e., reading, writing, computer work, sewing, etc.) without discomfort, headaches, eye ache, burning, stinging, watering, blurring, double vision, loss of concentration or tiredness?

1. At least 3 hours
2. Up to 2 hours
3. Up to 1 hour
4. Up to 30 minutes
5. Up to 15 minutes

How often do you get headaches when you do near work?

1. Never (0 percent of the time)
2. Occasionally (about 25% of the time)
3. Often (about 50% of the time)
4. Very often (about 75% of the time)
5. Every time (100% of the time)

If you experience headaches during near work, how bothersome are these headaches (i.e., the degree to which they interfere with your normal functioning)?

1. Never (0 percent of the time)
2. Mildly bothersome
3. Moderately bothersome
4. Very bothersome
5. Extremely bothersome

Do your eyes pull, ache, or water when you do near work?

1. Never (0 percent of the time)
2. Occasionally (about 25% of the time)
3. Often (about 50% of the time)
4. Very often (about 75% of the time)
5. Every time (100% of the time)

Does the reading material ever become blurry, run together, or jump whe you do near work?

1. Never (0 percent of the time)
2. Occasionally (about 25% of the time)
3. Often (about 50% of the time)
4. Very often (about 75% of the time)
5. Every time (100% of the time)

Does the reading material ever become double when you do near work?

1. Never (0 percent of the time)
2. Occasionally (about 25% or the time)
3. Often (about 50% of the time)
4. Very often (about 75% of the time)
5. Every time (100% of the time)

Immediately following prolonged near work, do objects at distance appear blurry for a short period of time?

1. Never (0 percent of the time)
2. Occasionally (about 25% of the time)
3. Often (about 50% of the time)
4. Very often (about 75% of the time)
5. Every time (100% of the time)

Do your eyes feel tired or do you lose your place or concentration when doing near work?

1. Never (0 percent of the time)
2. Occasionally (about 25% of the time)
3. Often (about 50% of the time)
4. Very often (about 75% of the time)
5. Every time (100% of the time)