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Educating teachers on vision and reading: A source packet for the community-minded optometrist

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EDUCATING TEACHERS ON VISION AND READING: A SOURCE PACKET FOR THE COMMUNITY-MINDED OPTOMETRIST

By

ROCHELLE R. MOSES

A thesis submitted to the faculty of the College of Optometry Pacific University Forest Grove, Oregon for the degree of Doctor of Optometry May, 1995

Adviser:

Scott C. Cooper
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About the Author

During her optometric education, Rochelle also completed a Master's of Education, specializing in the visual function in learning. With the O.D. and the M.Ed., she plans to work in a vision therapy practice with students who have difficulty in school. Her long-range goal is to start a multi-disciplinary clinic for these students. This clinic will include such disciplines as psychology, audiology, physical and occupational therapy, and speech and language therapy. The establishment of such a close-knit network will provide interdisciplinary communication in order to help each student reach his full potential.
Abstract

In order to promote the recognition of visual dysfunction in the classroom, a presentation has been designed for optometrists to give to educators in a lecture and slide format with demonstrations. The behavioral definition of vision is the basis of the presentation, which also includes a discussion on vision development, visual symptoms in the classroom, vision screenings, and vision therapy. Extensive research is cited to support each point made. Slides and hand-outs will follow in another thesis project.
Acknowledgments

Compiling the research for this thesis project required the efforts of more than one person. Special thanks go to Dr. W. Bleything for sharing his goldmine of information on behavioral optometry. Reviewing the extensive amount of behavioral information available and keeping the presentation simple was a difficult task. Dr. S. Cooper gave excellent advice in this area. The time that he spent proofreading the presentation produced some invaluable hints that helped to keep the project on track. Thanks also go to my mother, who first spurred my interest in this area and provided good advice on what teachers would benefit from hearing about vision and reading.
Educating Teachers on Vision and Reading

It is of utmost importance that educators understand the link between vision and reading performance. Many students may not receive the vision therapy that could help them to succeed in school because educators are not aware of this relationship. This source packet is designed to aid optometrists in speaking to educators on vision and reading. Because there is so much literature covering this topic, a detailed presentation outline has been compiled covering research that will stress the importance of recognizing students with visual deficits in the classroom.

Extensive Presentation Outline #1 is meant to familiarize the speaker with the points of the presentation. The presentation is based on the idea that vision is a learned skill and that when it is not properly developed, it will prevent the student from reaching his full scholastic potential. The bulleted sentences are information to back up each lettered point. In order to further impress upon the educator the important link between reading performance and vision, slides and hand-out will be produced in the near future, as a second thesis project. These slides and hand-outs, along with the demonstrations explained within the outline, make the information easier to understand and remember. Research was done on all subjects included in the presentation and is noted throughout the outline for quick reference purposes. Condensed Presentation Outline #2 is provided as a refresher for the speaker, to review before the presentation is made. It covers only the broad points, leaving out the details.

The presentation was meant to be tailored to various listening audiences as the speaker feels appropriate. Some audiences may be more interested in the visual perception aspects of the presentation, while others may be more interested in what symptoms to look for in the classroom and what type of professional to refer students to. Therefore, points may be dropped or added as the presenter wishes. Changes are left to the liberty of the speaker but it is desired that the presentation be used to relay the fact the vision is developed and
the level of development affects the reading process. The literature references provided may give the optometrist new ideas on how to present the developmental and functional theories.

By compiling the extensive developmental and behavioral optometric research in the form of an organized source packet, a comprehensive yet understandable presentation on vision and reading performance for educators should not be as overwhelming a project as it may initially appear. As more and more educators are made aware of the effect that vision has on education, more students will be properly referred. Students will be more likely to meet their educational potential as the result of educators and optometrists working together.
EXTENSIVE OUTLINE #1
I. Introduction

A. Personal Information
   • Educational background of speaker
   • Scope of speaker's practice
   • Personal interest in vision and reading

B. Vision and Education
   • The classroom demands an efficient visual system.\(^1\)
     - precise eye movements for reading
     - accurate aiming of eyes at object of interest
     - sustained and accurate focusing ability for desk work
     - flexible focusing system for tasks such as copying from the chalkboard
   • A correlation can be shown between the developmental level of a student's visual skills and his/her school performance.\(^2\)-\(^35\)
     - Disagreement on this point stems from the various definitions of vision utilized by different researchers, various criteria used to classify students as reading impaired, various sampling techniques, and various methods used to analyze data.\(^36\)-\(^40\)
   • There are several common visual limitations of the learning disabled population. These have been discovered through several studies.\(^41\)
   • Illiterate adults exhibit deficient visual skills that graduate students don't show.\(^42\)-\(^43\)
     - 74\% of illiterate adults in one study failed the vision screening given to them. The graduate students that participated in the same study had better near acuity and tracking skills.\(^42\)
   • There is also a correlation between visual deficiencies and juvenile delinquency.\(^44\)-\(^47\)

C. Early Recognition of Visual Deficits
   • It is in the best interest of each student to recognize his/her visual deficits and correct them as early as possible so that the student may reach his/her full potential.
   • Teachers and parents are often the first to recognize vision problems that interfere with school success.\(^35\), \(^49\)
D. Vision is a Learned and Developed Skill

- Using the basic tools that most of us are born with, the finely-tuned skills that are necessary for reading can be developed. Not all students have these necessary highly developed visual skills when reading instruction begins.
- Just as a toddler holds a crayon with his/her full fist and later holds a pencil with his/her fingers using very fine motor skills to write, an infant uses very gross eye movements to view his surroundings and later develops fine and accurate eye movements, which are conducive to good reading skills.
- Poorly developed visual skills can be improved or corrected with appropriate intervention. An effective way to improve these visual skills is through vision therapy.
- An improvement in these skills leads to a more efficient visual system and more comfortable vision. Several studies report more easily attainable success in school following vision therapy. Some published literature doesn't agree based on the same variables discussed above.

II. What Is The Difference Between Sight And Vision?

Purpose: A simplistic explanation of ocular anatomy and definitions associated with reading.

A. Sight

- The "alerting response" is present in infants. An infant will turn his/her eyes toward a light or brightness contrast, and somewhat focus.
- 20/20 acuity - The ability to see clearly at 20 feet the same letters that the average person can see at 20 feet. (20/40, etc.)

[Demo: eye chart]
- Far-sighted vs. near-sighted definitions.
  - Hyperopes will pass the basic visual acuity test more often than myopes, but are more commonly the less skilled readers of the two groups.
  - Astigmatism - Differing powers needed in different areas of the corrective lens.

- Literature is mixed as to whether or not this affects reading ability.
• Although refractive error does affect reading ability\(^{58-64}\), vision has a very large impact on reading and it is often overlooked.

B. The Components of Vision
• Extra-ocular Muscles and Vergence Ability
  - Convergence - The two eyes turn in to view a close object.
  - Divergence - The two eyes turn out to a parallel position in order to view an object in the distance.
  - Fusion - Two eyes looking at one object results in one image seen.
  - Tropia - Two eyes looking at two different objects results in double vision, and usually suppression.
  - If the two eyes don’t move a proper amount, diplopia occurs.
[Demo: In partners, one partner observes other's eyes shifting from distance to near viewing.]
  - Vergence amplitude - The range of vergence that a person has.
  - Vergence facility - The speed and accuracy in aiming the eyes.
• Extra-ocular Muscles and Eye Movements
  - Fixation - The eyes pause while words surrounding this point are read.
  - Saccade - While the eyes "jump" between fixation points, no information is taken in.
[Handout: Comparison of s & f across a page of reading for beginning and advanced readers.]
  - Pursuit - A smooth motion of the eyes. For example, that used to follow a moving target.
• Cornea
  - A fixed amount of power to focus light onto the retina.
[Demo: focus light onto wall through a magnifying glass.]
• Lens
  - Accommodation - A muscular activity providing adjustable focus meant for near work.
  - Accommodative amplitude - The amount of focusing power that the student has, which decreases with age.
  - Accommodative facility - The ease and accuracy of adjusting focus for various distances.
  - If the lens isn't focused properly, what the student sees will be blurry.
• Retina
  - Receives what the eyes focus and converts this light message to neural signals to be sent to the brain.
• Optic Nerve
  - Carries neural messages to the brain.
• Brain
  - Combines what the two eyes see into one image ...usually. [Demo: Physiological diplopia with fingers]
  - While using the eyes, each center in the brain receives a certain type of message (focusing, saccades, fixations, processing, etc.). These centers interpret their messages independently and the brain then combines these interpretations, resulting in each person's own perception of a scene or page. This activity results in the reading process.65

III. How Does Vision Develop?
Purpose: To convey the messages of expected developmental levels, the learning of visual skills, and the plasticity of the vision system.

A. Period of Greatest Plasticity
• At birth, very basic visual reflexes exist.66
• Exposure to a normal visual environment refines these reflexes to finely tuned skills.67-71
• 0-6 years of age is the most sensitive period to learn visual skills.67, 72-73 However, visual skills can be taught throughout life via vision therapy, contrary to previous beliefs.
• It is more difficult to pick up new visual skills later on and they may not be corrected to the level that they could have been if intervention would have taken place earlier.74-78
• School work requires finely-tuned visual skills in order for the student to succeed. If the development of visual skills is delayed or altered, the student may not be ready to meet the visual demands of the classroom.
B. **Binocularity**
- Develops in the area where the child pays the most attention, serving to localize the area of involvement.\(^{67, 83}\)
- At age 4-6 months, depth perception is somewhat developed. The infant is able to more accurately grasp objects.\(^{67, 68}\)
- Poor binocular fusion interferes with reading tasks, especially sustained reading. It can cause asthenopic symptoms or lack of comprehension. \(^{2, 3, 5, 6, 7, 8, 10, 14-19, 21, 26, 26-29, 32-36, 53, 87-89}\) (Conflicting studies\(^{90, 37}\))

C. **Eye Movements**
- Infants have very little oculomotor control until age 3 months.\(^{23, 67, 79, 82}\) At age 3 months, the eyes begin to aim together consistently with the proper visual stimulation.\(^{23, 67}\)
- At age 6-7 years, with proper visual stimulation and adequate development, smooth eye movements with no midline jump can be expected. This is the point when most students are ready to read.\(^{83}\)
- Children with coordinated and skillful oculomotor abilities begin reading instruction with an academic advantage over children with less developed oculomotor abilities.\(^{84}\) Some students' eye movements are sophisticated enough for earlier reading instruction, some are delayed enough that they are not ready for reading instruction at age 6-7.
- Inaccurate eye movements affect reading ability.\(^{8, 10, 13, 15, 17, 35, 81, 85, 86}\)

D. **Accommodation**
- By 3 - 4 months, with proper visual stimulation, accommodation is nearly adult-like and becomes still more accurate with age.\(^{63, 90}\)
- Poor accommodative skills affect reading ability, especially smaller print.\(^{8, 10, 14-15, 19-20, 22, 79-81}\)

E. **Color Vision**
- Color vision at birth is similar to wearing dark glasses.\(^{92}\)
- At age 2 months, the infant sees with "rudimentary trichromacy."\(^{92}\)
F. Vision Perception

- The development of vision perception begins with the sensory systems reinforcing one another. Reinforcement is shown in the infant by mouthing, touching, and visually examining a new toy.\(^57, 66\) The sensory systems dissociate as the conclusions that the infant draws from each sense become more reliable.\(^10\) Vision can then give the child the full meaning about an object or word as though it was touched, heard, or spoken. The student knows how to interpret and react to a situation due to his visual perception skills.\(^57, 66, 68, 83\)

- shielding face from oncoming baseball
- judging size of object far away
- shifting gaze to follow a tennis ball

- Visual perceptual skills allow the student to recognize letters, their associated sounds, and their collective meanings. Laterality, visual memory, figure-ground, and visual discrimination are all visual perception skills involved in reading. There is a significant relationship between the developmental level of perceptual skills and reading achievement.\(^68, 93-98\)

- Studies show that students who undergo perceptual training have improved perceptual scores.\(^99-100\)
- Students with high perception scores at the end of kindergarten also have better than average reading readiness scores.\(^65, 101-103\)
- There is a relationship between reading vocabulary and perceptual skill.\(^104-105\)
- Visual spatial skill levels also correlate to math abilities.\(^106\)

- One of the most common perceptual deficits that optometrists see is letter reversal difficulties.\(^10, 15, 107-109\) Vision therapy has been shown to remediate reversal and laterality problems in many cases.\(^95, 97, 107, 109\)
IV. What Are The Visual Symptoms That A Teacher May See?

Purpose: Educators may easily recognize students with visual deficiencies in their classrooms if they know what to look for.

[Handout: Educator's Checklist]

A. Complaints at Desk
- Binocular dysfunction subjects have more visual symptoms than binocularly adequate subjects in one study.
- Symptoms increase during reading, causing a slower reading rate. Most symptomatic patients have decreased vocabulary and comprehension scores.
- Headache in forehead or temples
- Burning or itching while reading
- Blurry print
- Diplopia
- Fatigue
- Comprehension

B. Physical Appearance
- Eye turn
- Red or tearing eyes
- Blocks one eye while doing desk work

C. Eye Teaming
- Problems catching a ball or other playground activities
- Squints one eye
- Tilts head consistently to one side or gross postural
- Car Sickness/Can't read in the car (vertical phoria)

D. Eye Movements
- Head turns across page
- Finger or marker needed to keep place
- Omits or re-reads lines without knowing
- Orients drawing or printing on page poorly

E. Accommodation and Refractive Status
- Mistakes like letters ('e' for 'o', etc.)
- Blinks a lot while reading or looking far to near or near to far
- Closes one eye while reading or copying
- Book held too close to eyes
- Blur in distance (i.e. chalkboard) after desk work
F. **Eye-Hand Coordination**
   - Writes crooked, even with lined paper
   - Needs finger to keep place or to put space in printing
   - Eyes don't steer hands - lack of orientation
   - Left - right confusion

G. **Visual Form Perception**
   - Mistakes words with similar beginnings
   - Letter reversal
   - Whispers to self while reading
   - Traces letters or pictures with fingers to recognize similarities and differences

H. **Significant Medical History**
   - Medications
   - Sinus or dental infections

V. **What Should A Vision Screening Include?**
   **Purpose:** Educators should be aware of the components of a quality vision screening in order to incorporate them into their own student health programs.

   A. **Snellen Acuity - Near and Far**
      - If only distance acuities are checked, those students who statistically do better in school (near-sighted students) or those with astigmatism are the only students singled out.
      - Defective distance visual acuities are rarely related to reading ability.

   B. **Ocular Motilities and Near Point of Convergence**
      - Because of the complexity of activities such as these, it is best to have a trained vision professional assessing such areas.

   C. **Stereo Vision/Cover Test**
      - The quality of the binocular system can be assessed with these two types of tests.

   D. **Color Vision**
E. **Retinoscopy**
   - Will show any missed far-sightedness and estimate level of refractive error more precisely.4

F. **Ophthalmoscopy**
   - Ophthalmoscopy is necessary to assess the health of the posterior segment of the eye.4

VI. **What Can Be Done For The Student With A Visual Deficiency?**

**Purpose:** The options available to reading-disabled students should be understood by educators in order for proper referrals and consistent reinforcement.

A. **Glasses/Contacts**
   - A far-sighted student may claim that he doesn't need glasses to see clearly. His glasses relieve stress so that he may read more comfortably.
   - **[Demo: muscles & brick analogy]**
   - Bifocals may be used for myopia prevention and tropia therapy in students.117-120
   - It is best to find out from the student's parent or doctor when the student should be wearing his/her glasses. Optometrists would be glad to answer any questions.

B. **Vision Therapy**
   - Vision therapy is the training process for the improvement of visual perception and/or the coordination of the two eyes for efficient and comfortable binocular vision.122
   - It teaches the student how to refine his visual skills.14, 50-51, 54-55, 121-124 This in turn helps students to meet the demands of school.16, 25, 47, 50-51, 55, 81, 123, 125-127 It is not a cure-all, but simply removes the visual barriers to scholastic success.128-130
   - More and more medical research supports vision therapy.14 Medical rebuttals to research proving success in vision therapy typically analyze research design. Perfect control groups are never possible or ethical in many cases.
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• More and more medical research supports vision therapy.14 Medical rebuttals to research proving success in vision therapy typically analyze research design. Perfect control groups are never possible or ethical in many cases.
• Vision therapy is not a replacement for reading instruction, although reading tasks are often included in therapy in order to ensure that visual skills can be transferred to real-world activities. Tutoring is still needed to catch up on school work.65

C. Surgery
• Surgery should be considered after the possible benefits of vision therapy have been evaluated.80,131
• The most surgical efficacy is realized when it is done in conjunction with vision therapy.

VII. So I Suspect That I Have A Student With A Visual Problem...Who Is Most Qualified To Help My Student?

A. The Importance of Selecting a Qualified Vision Specialist
• Only 20% of visual, visual perceptual, or refractive error problems that handicap school performance can be detected by routine refractive procedures.111
• Early optometric involvement leads to students with higher developmental test scores.117

B. Optician
• Fitting spectacles and grinding lenses are the focus of the optician's education.

C. Ophthalmologist
• An ophthalmologist attends four years of general medical school, followed by two years of residency, specializing in ocular surgery and disease. Even pediatric ophthalmologists may limit their practice to disease and structure, not emphasizing developmental and functional vision.37
D. **Optometrist**

- An optometrist attends four years of optometry school, following the completion of a bachelor's degree, studying the dynamics of ocular refraction and disease, as well as the development of vision, and the most efficient use of functional vision. He is trained and licensed to practice vision therapy.

- The appropriate optometrist to deal with a student's visual problems:
  - realizes the relationship between under-developed visual function and poor reading performance,
  - considers all tasks that the student's visual system is required for, including visual perception,
  - provides vision therapy for student with visual system deficiencies,
  - recognizes that vision therapy isn't a cure-all in many cases, but removes barriers to educational progress,
  - is willing to consult with other professionals in order to help the student achieve his/her full potential.

These include the student's teachers, educational psychologist, occupational therapist, physical therapist, chiropractor, counseling services, medical doctor or any other relevant professional,

- is willing to provide a written explanation of diagnosis and therapy will be provided for teacher and parents.

**VII. Conclusion**

A. The visual system develops as the child ages and is "plastic" throughout life, but especially so in the developmental years. There are expected developmental levels of visual skills and vision perception.

B. Shortcomings in the visual system affect reading performance, especially binocular performance and saccadic eye movements.

C. Deficits in the visual system may be improved with vision therapy.

D. Any child having difficulty reading should be evaluated by an optometrist who describes himself as developmentally behaviorally, or functionally oriented.
CONDENSED OUTLINE #2
I. Introduction

A. Personal Information
B. Vision and Education
   • efficient visual system required in the classroom
   • correlation between visual skills and school performance
   • common visual limitations of learning disabled population
   • graduate students have better visual skills than illiterate adults
   • correlation between visual deficiencies and juvenile delinquents
C. Recognizing Visual Deficiencies Early
D. Vision is a Learned and Developed Skill
   • innate basic tools lead to visual skills associated with reading when properly developed
   • vision therapy intervention is related to improved school success

II. What Is The Difference Between Sight And Vision?

A. Sight
   • Innate reflex
   [Demo]
   • Refractive definitions
B. The Components of Vision
   • Extra-ocular muscles and vergence ability
   • Extra-ocular muscles and eye movements
   [Handout]
   • Cornea
   [Demo]
   • Lens
   • Retina
   • Optic Nerve
   • Brain
   [Demo]
III. How Does Vision Develop?

A. Period of Greatest Plasticity
B. Binocularity
C. Eye Movements
D. Accommodation
E. Color Vision
F. Vision Perception
   • Development of the sensory systems, their dependence and independence
   • Vision perception and reading

IV. What Are The Signs Of Vision Problems In The Classroom?
[Handout]

A. Complaints at Desk
B. Physical Appearance
C. Eye Movements
D. Eye Teaming
E. Accommodation and Refractive Status
F. Eye-Hand Coordination
G. Visual Form Perception
H. Significant Medical History

V. What Should A Vision Screening Include?

A. Snellen Acuity
B. Ocular Motilities and Near Point of Convergence
C. Stereo Vision and Cover Test
D. Color Vision
E. Retinoscopy
F. Ophthalmoscopy
VI. What Can Be Done For The Student With A Visual Deficiency?

A. Glasses/Contacts
   • hyperopes
   • bifocals
B. Vision Therapy
C. Surgery

VII. Who Is Most Qualified To Help A Student With A Vision Problem?

A. The Importance of Selecting a Qualified Vision Specialist
B. Optician
C. Ophthalmologist
D. Optometrist

VIII. Conclusion
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