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Abstract

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DYSLEXIA: A Case Study

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Robert Mans did his undergraduate work at Washington State University. He graduated with a Bachelors of Science in both Biology and Microbiology. He also has a minor in Zoology. He attended Pacific University where he will receive his degree of Doctor of Optometry in May of 1994.

After graduation Robert will take an associate position in a clinic on the Oregon coast where he will practice primary care and vision therapy.

Julie Kittock

Julie Kittock completed her prerequisites for Optometry School in her hometown of Billings, MT at Eastern Montana College. She then attended Pacific University College of Optometry and received her Bachelor of Science in Visual Science and a Doctorate in Optometry in May 1994.

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Abstract: Dyslexia is a diagnosis commonly used to categorize many of the learning disabilities a child may have. Tests including the Wechsler Adult Intelligent Scale-Revised (WAIS-R), Woodcock-Johnson Psychoeducational Battery-Revised (the WJ-R), Dyslexia Determination Test and the Dyslexia Screener are used to isolate those thought to have dyslexia. Although a treatment for dyslexia is not available, optometrists can use vision therapy to increase the efficiency and stamina of the visual system. The goal of vision therapy is to refine those skills a patient does have to better compensate for the problems associated with dyslexia.

Key Words: dyslexia, Wechsler Adult Intelligent Scale-Revised, Dyslexia Determination Test, vision therapy

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INTRODUCTION

Dyslexia is a diagnosis commonly used to categorize many types of learning disabilities a child may have. This misuse of the term has led to some confusion as to what specifically the symptoms of dyslexia are, and what tests can be used to diagnose it. As optometrists, we not only need to be able to correctly diagnose an individual with dyslexia, but we must also have an understanding what being dyslexic means. Simply telling a patient that they are dyslexic often adds to the frustration already being dealt with in their lives.

When a child begins to have difficulties in school, many parents consult an optometrist with the belief that glasses will cure their child's learning problems to an end. A new pair of glasses could very well give the child better acuity, but any learning disability could still exist within the child. Dyslexia is one such disorder that even today has not been completely defined. Those who experience the problem often go through life avoiding reading situations that cause both embarrassment and confusion. Simply defining a patient as dyslexic should not be the end of an exam but rather a starting point for further exploration and possible treatment.

Definition of Dyslexia

Many sub-types of dyslexia have been identified and this suggests that there is probably no such thing as "dyslexia." Some of the sub-types that have been described include: acquired, developmental, visual, phonological, peripheral, central, neglect, attentional, and letter-by-letter dyslexia. Increasing the complications of the disability, many histories reveal that patients don't always display the expected symptoms associated with their sub-type of dyslexia. There is just not one particular symptom that characterizes dyslexics as a group, but rather a syndrome of associated disorders.

However, one well accepted definition of dyslexia developed by G.T. Pavlidis, author of *Eye Movements in Dyslexia*[1] is as follows:

1. "Performance or verbal IQ at least of an average level (90 or above)."
2. "At least 1.5 years retarded in reading if below 10 years and at least 2 years retarded in reading if age > 10 years (reading retardation assessed relative to chronological age)."
3. "Normal or corrected vision, excluding children with nystagmus."
4. "Normal hearing."
5. "Subjects came from an upper-middle socioeconomic background with English being the language spoken at home."
6. "Adequate educational opportunities, quantified according to the following criteria:
   a). They did not have more than two school changes (excluding normal transfer from nursery to primary to secondary).
   b). They were not absent more than 2 weeks per term or did not have more than average absenteeism occurring in the educational area from which the dyslexics and controls were drawn."
7. "They did not have any overt physical handicaps that could account for their reading problems, such as brain injury and/or tumor."
8. "They did not have any overt emotional problems before beginning reading."

The requirements may seem rigid, and, even if the patient meets them, the origin or process of dyslexia is still difficult to determine. Different theories have been offered describing dyslexia and more will evolve as interest in dyslexia increases.

Current Theories

One theory of dyslexia deals with saccadic suppression. When a person reads along a line of print, a few words are seen clearly in foveal vision and at the same time there are other words seen in the periphery. Bruno Breitmeyer (University of Houston)[2] has investigated the interrelated mechanisms underlying this perceptual experience. One of his main discoveries is that there are two anatomically and functionally distinct visual mechanisms involved in reading: a mechanism that operates duration fixation, and a mechanism that operates during eye movements. These are known as sustained and transient mechanisms, respectively. The sustained mechanism is active when looking directly at small details for relatively long time periods. The transient mechanism is active during the short periods of time when the eyes are in motion and are being guided by peripheral information.

Most importantly, when one system turns on, it simultaneously turns off the other system. This type of mutual inhibition is widespread throughout the brain, and is essential to its efficient functioning. Failure or relative weakness of the transient mechanism (i.e., lack of saccadic suppression) may be what underlies the perceptual confusion experienced by dyslexics when they read.

The transient and sustained neural fibers extend from the retina, along the visual pathway, into the cortical and subcortical areas of the brain where they interconnect with many other neurons. A disorder in the development of the central portions of the brain could selectively impair either the sustained or transient mechanisms early in life. And, indeed, there is evidence from neurological research that dyslexics have in fact suffered microscopic damage to central brain tissue before birth.[2]

Examination of ten brains of male and female dyslexics (mostly male) revealed several types of anomalies: clumps of immature neurons near the surface (ectopias), neurons arranged irregularly (dysplasia), tiny enfolding in the brain that shouldn't be there (micropolygyria), tiny congenital tumors (oligodendrogliomas), and scars which may have blocked blood vessels (fibromyelin

plaques). These anomalies are numerous (from 30-40 per dyslexic brain) and are most often localized in the left hemisphere. The left hemisphere is typically responsible for linguistics such as speech and writing and for analytical computation. On the other hand, the right hemisphere is typically nonverbal and is responsible for musical, holistic, and, stereognostic (the ability to recognize an object from the sense of touch) abilities.[2]

It is known that anomalies arise from "errors" during particular phases of prenatal brain growth. Between the eighteenth and twenty-fourth week of gestation, certain brain cells develop in a lower area of the brain and then migrate to other areas, where they form regular arrays. Some of the errors in dyslexic brains could result from misplacement of neurons. These errors might arise from many possible sources. In the case of dyslexia, they might be caused by factors associated with autoimmunological disorders that might also cause asthma, allergies, diabetes, and, rheumatoid arthritis. These disorders are often associated with dyslexia and both kinds of disorders run in the same families. There is also a possibility that substances manufactured in connection with autoimmunological disorders cause tiny fetal brain injuries that result in dyslexia.[3]

Current Research

Recent research, on the cause of dyslexia that was conducted by Albert Galaburda[2], focused on the architecture of the visual system: the magnocellular and the parvocellular pathways. The neurons in the magnocellular pathway project to the parietal cortex and have transient responses, large fields, and no color discrimination ability. This is referred to as the "where" pathway (where an object is in time and space). Lesions in this pathway reduce the ability to detect motion and to follow a moving object with the eyes. Neurons in the parvocellular pathway are located in the inferior temporal cortex and have tonic responses, small fields, and color sensitivity. This pathway is known as the "what" pathway because the cells convey information about what an object is and

possibly about depth perception. Lesions in this pathway reduce the ability to detect motion and to follow a moving object with the eyes.

In a recent study, five dyslexic subjects were shown a 36-rectangle checkerboard. The squares were reversed under varying speeds and under conditions of high and low contrast. When high contrast was used, both the magno and parvo systems are active and the subjects showed normal responses to the reversing checkerboards. Under low contrast when only the magno system is active, a significant decrease in response was seen suggesting a deficit in this system.[4]

These parvo and magno cells are most easily distinguished in the lateral geniculate nucleus (LGN). Galaburda microscopically examined sections of the LGN in a sample of brains of dyslexic and non-dyslexic persons. He found that the magnocellular layers (which are responsible for the eyes' ability to follow an object and to detect motion) were more disorganized in the dyslexic's brains and the cell bodies appeared 27% smaller.[4] This decrease in size is likely to cause slower conduction resulting in a "sluggish" system. That could account for the fact that in dyslexia, the magnocellular (transient) system doesn't do an effective job of wiping the slate clean, i.e., saccadic suppression.

Psychological Study

Dyslexia never exists as an isolated reading problem. It is always accompanied by associated and/or secondary complications and affects the whole person. Increasing the complications of the disability, case histories reveal that patients don't always display the expected symptoms. There is just not one particular symptom which characterizes dyslexics as a group, but rather a syndrome of associated disorders. The dyslexic, if not identified early in life, gets caught in a vicious circle leading from learning to behavior problems and from behavior problems to increased learning disability. It is a particularly unfortunate problem because its major symptom is failure. In a study done by Davenport[5], 40 dyslexic males were interviewed about their diagnosis, the ways

which they coped with literacy requirements, stressors associated with academic requirements, and their overall social adaptation. The study revealed that 27 of the individuals accepted their diagnosis and used it to account for their academic failure.

Acceptance of the diagnosis was shown to be associated with healthy adaptation to a learning disability. Those that accepted the diagnosis of dyslexia were found to place more emphasis on problem-focused coping than those that rejected the diagnosis. Those that rejected the diagnosis were found to obtain help from adults to attempt to master difficult material, and to emphasize the value of social support. It was determined that the subjects who accepted a diagnosis of dyslexia had substantially higher educational goals than those who did not. Davenport concluded that "diagnostic acceptance involves understanding the diagnosis, acceptance of responsibility for working hard, and resolution of grief over loss of status and opportunity."

Case Report

Patient History

The subject, JJ, was a 26 year old optometry student. While in the second grade, he was tested by a school psychologist for dyslexia and other learning disabilities. An early diagnosis of dyslexia was made following this battery of testing. Workbooks called "The Developmental Program in Visual Perception: Pictures and Patterns" by Marianne Frostig were used to help with JJ's learning disabilities. Reading has always been difficult for JJ. New or large words as well as skipping lines while reading made comprehension very difficult. Information received aurally is currently the method by which he does the majority of his learning. Spelling is at a third grade level so most of his writing is dictated to someone else who types his work for him. This method has allowed the subject to excel in college and eventually enter optometry school.

Psychological Findings

JJ was retested in 1991 by a clinical psychologist using the Wechsler Adult Intelligent Scale-Revised (WAIS-R), and tests of academic skills and achievement from the Woodcock-Johnson Psychoeducational Battery-Revised (the WJ-R).[6] The results from this testing showed that the pattern of JJ's performance confirmed a reading disability. It was also concluded that the subject suffered from a specific disability for written language. JJ's IQ scores were in the high average to superior range of intellectual skills.

Other problems described by JJ include ocular fatigue and difficulty with typing and writing. His history includes speech therapy until grade 5, problems distinguishing left from right, and reversal of letters such a "b's and d's" and "p's and q's." The subject reported that words were spelled more through memorization rather than phonetically. He also reported that reading problems have manifested on his mother's side of the family including his aunt and cousins.

Optometric Findings

A comprehensive exam yielded 20/10 acuity OD, OS, OU at distance and 20/20 acuity at near with no correction necessary. Ocular health was unremarkable.

Induced phorias were 2 eso at distance and 3 exo at near. Far testing yielded the following results: true adduction 12 BI, convergence 16/12, abduction 6/4, vertical phoria ortho, infra and supra ductions using the left eye were both 3/0.

Near tests yielded: PRC 6, PFR 8/6, NRC 6, NFR 10/8, vertical phoria: ortho, infra and supra ductions using the left eye were both 3/1. Amplitude of accommodation was -5.00 OU, while the PRA was -4.75/-4.50 OU, -5.50/-4.75 OD, -5.50/-5.25 OS. NRA yielded +2.25/+2.00 OU, however, monocular results were +2.75/+2.50 OD and +3.00/+2.75 OS.

The findings at distance are considered normal according to the Optometric Extension Program (OEP) analytical standards.[7] The

near findings involved with convergence and divergence are considered low. OEP's "normal findings" are listed below:

PRC: 15 PFR: 21/15 NRC: 15 NFR: 22/18

Decreased findings can result in early eye fatigue and strain causing poor near work performance. All other near point findings were considered to be normal.

Pre-Vision Therapy Findings

Further testing was done to better assess the visual abilities of JJ. The results were as follows:

Near Point of Convergence (NPC)

This test is used to evaluate the subject's ability to converge while keeping an object clear and single. A receded NPC signifies a convergence insufficiency which could cause reading difficulties. An NPC of 10 cm. or greater, (the point where the object doubles), is considered suspect. Measurements are recorded when the object first doubles (break) and when the object again becomes single (recovery).

JJ's Test Results:

NPC in cm. (5 Trials)

Trial Number	Break/Recovery
1	5/10
2	7/10
3	6/10
4	6/10
5	6/9

JJ's breaks (the point where the object doubles) fall within the acceptable range mentioned above. His recoveries (the point at which the now double object can be made single again) are not considered acceptable and suggest a convergence insufficiency problem.

Accommodative Facility

+2.00/-2.00 flippers were used to evaluate JJ's ability to clear a row of letters at 40 cm. He was instructed to flip the lenses once the row of letters could be seen clearly. The smallest row of letters that could be seen was used as the stimulus. The number of cycles was recorded every 30 seconds for two minutes. One cycle was defined as clearing both the +2.00 and -2.00 lenses. The norm for this test as described by Griffin et al.[8] is as follows:

±2.00D: 17 cycles per minute, monocular
13 cycles per minute, binocular

JJ's Test Results:

Accommodative Facility

		30	60	90	120 (sec)
# of cycles	OD	9	3	4	4
	OS	3	4	3	4
	OU	5	4	4	3

These findings show that his ability to stimulate and relax his accommodative system was not at an acceptable level. The low number of cycles signifies that with prolonged stress his eyes would fatigue rapidly decreasing performance.

Vergence Facility

8 BI/ 8 BO flippers were used to evaluate JJ's ability to clear a row of letters at 40 cm. He was instructed to flip the lenses as soon as the row of letters could be seen clearly. The smallest row of letters that the subject could see was used as a stimulus and the number of cycles was recorded every 30 seconds for two minutes. One cycle was defined as clearing both the 8 BI and 8 BO lenses. The norm for this test as described by Stuckle and Rouse[9] is as follows:

8 B.I. and 8 B.O., approx. 7 cycles/min. (Mean for 6th graders)

The norms for adults as described by Pacific University[10] is as follows:

8 B.I. and 8 B.O.	Mean/sd
30 sec.	14 7
30-60 sec.	11 7
1 min.	25 flips
2 min.	45 22

JJ's Test Results:

8 B.I. and 8 B.O.	30	60	90	120 (sec)
# cycles	6	11	16	22

JJ's performance for this test reveals that the ability to converge and diverge his eyes is almost normal for six graders. The number of flips were added together, therefore at the end of 120 seconds a total of 22 flips was completed. These findings give the examiner a clue as to the cause of possible near point problems including eye strain, pain, poor stamina, and headaches. Reduced vergence ranges can cause all of these symptoms.

MKM Monocular and Binocular Reading Test

The MKM is used to detect reading problems which may be associated with poor binocular coordination and/or macular suppression. This test can be utilized to determine monocular and binocular reading ability and can give an indication as to the student's basic sight word inventory.[11]

Six stereoscopic cards are used with the Brewster stereoscope to determine both monocular and binocular findings. This test was designed to be utilized with first and second grade children.

JJ's MKM Results: **OD** grade 6 **OS** grade 4 **OU** grade 5

Stereopsis

The level of stereopsis determines the subjects binocular status in most cases. If a subject is found to have good stereopsis, then the binocular status is good. However, a subject can exhibit

poor stereopsis findings yet have normal binocularity in all other respects. If a patient does not appreciate the depth produced during testing there may be an indication that suppression has occurred.

JJ's Stereopsis Results:

Distance	Finding	Test Used
6m	21 arc sec	Aviator
40cm	20 arc sec	Randot

These findings show that JJ has good stereopsis, with no suppression present.

Eye Movements

JJ's eye movement performance was evaluated with the Developmental Eye Movement (DEM) Test and the Visigraph Computerized Eye Movement Test. The DEM tested JJ's ability to read both rows and columns. The tests consists of a series of numbers and the subject calls them out verbally with the time and number of errors being recorded. This test has norms for individuals up to the age of 13 years.

The Visigraph objectively measures eye movements and reading comprehension. The subject is timed as a short story on a computer screen is read. Questions are then asked about events in the story to check comprehension of the material read. Inefficient eye movement ability below age expected norms was found. The ability to make rapid movements of the eyes from one target to another, referred to as saccades, was found to be moderately inaccurate with some head movements. There were no obvious limitations in the direction or extent of eye movements with the eyes.

Awareness of directionality and laterality were tested using the Gardner Left-Right Reversal Frequency Test in which JJ's performance was significantly less than expected for an adult. The Beery Visual Motor Test (VMI), also yielded a less than expected performance. The VMI uses various form matching or form reproductive tasks to test the extent to which the individual uses vision to organize his environment.

The Test of Visual Perceptual Skills (TVPS) found the patient had adequate skills in the areas of visual memory, visual sequential memory, figure ground, visual closure, visual form constancy, visual-spatial relationships, and visual discrimination.

Test Results:

TEST	PERFORMANCE AGE/GRADE EQUIVALENT
Berry VMI	14-15 years
TVPS[11]	>11-12 years
Gardner[13]	8 years
Visigraph[14]	2.5 grade equivalent
DEM[12]	>13 years
Groffman[15]	8 years

These findings, excluding the TVPS and DEM, show that JJ had decreased eye movement abilities which could cause decreased near point work performance. The TVPS[12] and DEM[13] are only normed to the age level that the subject reached. These tests give an idea as to what areas needed the most improvement and give a starting point for vision therapy.

Additionally, both the Dyslexia Screener and the Dyslexia Determination Test indicated mild to moderate dysphonedesia.[17,18] Dysphonedesia is a combination of two types of dyslexia in which the individual has difficulty with whole-world visual gestalts, matching of visual and auditory gestalts, and decreased phonetic word analysis and synthesis skills. They are unable to phonetically sound out a word appropriately when attempting to recognize it. Dysphonedesia often results in non-phonetic word equivalents and reading errors, such as substitutions. This type of dyslexia is known to affect certain cortical areas of the brain, specifically Wernicke's area. These findings imply that JJ was having difficulty with some of the primary skills necessary in reading and word processing.

Vision Therapy Initiation

Analysis of JJ's findings indicated that a series of vision therapy sessions could help improve some areas of weakness and possibly decrease the symptoms involved with reading and writing. A 15 week vision therapy program was initiated using the following techniques and exercises:

Week 1-6 w/ increasing difficulty
Accommodative Rocks +2.00/-2.00
Brock String
Column Saccades
Groffman Pursuits
Vectograph w/ Topper & Clown
Prism flips w/ polaroid bar reader

Week 7-11 w/ increasing difficulty
Brewster Stereoscope w/ BI cards
Mental Minus
Eye movements w/o reader
+2.00/-2.00 w/ bar reader
Stereoscope (BI/ BO)
Vu Mate
Figure Ground Training
Guided Reader

Week 12-15 w/ increasing difficulty
BI ductions 6BI (smooth and jumps)
Guided Reader---later w/balance board
Stereoscope
Mental Minus
Aperture Rule
Column Saccades w +2.00/-2.00

The first six weeks of training were focused on improving JJ's eye movement skills and decreasing the amount of ocular fatigue he experienced. These training tasks were chosen because the patient

was able to perform them without too much difficulty. At each session three tasks were performed and as the weeks progressed the tests were changed as seen necessary by the examiners. As improvement was seen, tasks were given with increasing difficulty. In some cases a familiar task was performed with an added stressor in order to increase difficulty. In order to ensure that the subject was properly performing the tasks, suppression controls were used. Methods of suppression control included the use of polaroid or red/green glasses. It was important to select a battery of tests initially that the subject could perform so to prevent him from getting discouraged. Tasks were also given as homework for 15 minutes per day between visits.

Each week JJ was retested and questioned as to how he felt the tasks were effecting his reading and everyday life. As expected he found that they caused some visual discomfort and were difficult in the beginning. The BI portion of the prism flips proved stressful as did the saccade and pursuit training. As the training progressed JJ reported less discomfort.

Post-Vision Therapy Findings

Following this regime of visual exercises, JJ was retested in the same manner used prior to vision therapy. Those findings that changed are listed below.

Far testing: true adduction 18 BI, convergence 20/6, abduction 8/6, vertical phoria ortho, infra and supra ductions using the left eye were both 3/0.

Near testing: PRC x, PFR 23/10, NRC x, NFR 20/11. The PRA was -4.50/-4.25 OU, -4.25/-4.00 OD, -6.25/-6.00 OS. NRA yielded +2.00 OU, however, monocular results were +2.25 OD and +2.00 OS.

These findings show that improvement was made in almost all of the areas that were considered below normal. Those findings where a decrease was recorded are still above what is generally

expected. The overall increase in these test results suggests that JJ should experience more comfort and less eye strain during visually demanding tasks.

Near Point of Convergence

Test Results:

NPC in cm. (5 Trials)	Pre-VT	Post-VT
Trial Number	Break/Recovery	Break/Recovery
1	5/10	5/7
2	7/10	6/8
3	6/10	5/7
4	6/10	5/7
5	6/9	6/9

A general improvement was seen in these results and JJ felt more comfortable during near tasks.

Accommodative Facility (±2.00D)

The norm for this test as described by Griffin et al.[8] is as follows:

±2.00D: 17 cycles per minute, monocular
13 cycles per minute, binocular

JJ's Test Results:

Accommodative Facility		Pre-VT				Post-VT			
(Sec)		30	60	90	120	30	60	90	120
# cycles	OD	9	3	4	4	12	12	11	12
	OS	3	4	3	4	13	13	12	12
	OU	5	4	4	3	13	12	13	13

Although the monocular findings still do not meet the norms, they are better than the first findings taken. The binocular results now meet the norms. This increase in facility should increase the subject's stamina during near point tasks.

Vergence Facility

The norm for this test, as described by Stuckle and Rouse[9], is as follows:

8 B.I. and 8 B.O., approx. 7 cyl./min. (Mean for 6th graders)

The norms for adults as described by Pacific University[10] is as follows:

8 B.I. and 8 B.O.	Mean/sd
30 sec.	14 7
30-60 sec.	11 7
1 min.	25 flips
2 min.	45 22

JJ's Test Results:

	Pre-VT				Post-VT			
8 B.I. & 8 B.O.	30	60	90	120	30	60	90	120
# cycles	6	5	5	6	12	11	11	10

An improvement in ranges was found which should result in a larger comfort zone during near and far point tasks.

JJ's MKM Results:

		Pre-VT	
	OD grade 6	**OS** grade 4	**OU** grade 5
		Post-VT	
	OD grade 6	**OS** grade 6	**OU** grade 6

A small improvement was seen with the MKM showing that the JJ's monocular and binocular performance are now more efficient.

Below is a chart showing the test results prior to vision therapy and after vision therapy:

TEST	PERFORMANCE AGE/GRADE EQUIVALENT	
	Pre-VT	Post-VT
Berry VMI	14-15 years	14-15 years
TVPS[12]	>11-12 years	>11-12 years
Gardner[14]	8 years	7 years
Visigraph[15]	2.5 grade equivalent	8.5 grade equivalent
DEM[13]	>13 years	>13 years
Groffman[16]	8 years	>12 years

Improvement was found in almost all areas tested. A decrease in the Gardner test may have been caused by fatigue because several tests were administered during the same session. This test also contains two sections which only grade performance up to 7 years of age. JJ performed well on two of the three portions of this test and was only one point from equaling his previous measure of 8 years. During the test JJ reported that he was less stressed when reading. He also felt that the problems with his dyslexia did not seem to manifest as quickly due to increased comfort and comprehension. His reading time also increased, showing that his ability to move his two eyes together improved. Significant improvement was found with the Visigraph; an increase from a 2.5 grade equivalent reading skill to one of 8.5 grade equivalent. This was encouraging for JJ because it was one of his main concerns at the beginning of the vision therapy session.

JJ felt that the guided reader helped him increase his reading ability and comprehension. The tests which proved most successful for him were those he could get immediate feedback on as to whether he was doing them right or wrong. He also felt that trying to do more than three tasks each day at home became too time consuming as well as resulting in increased eye strain and fatigue.

The attitude of the subject was good which increased the probability of a successful vision therapy session. The vision therapy tasks were more accepted than the tests used to check his progress because many of the tests used to check either progress or grade equivalency are designed for children. This makes it difficult to evaluate an older patient with mild symptoms due to many of the tests grading only to 13 years of age. JJ also mentioned that these tests seemed child-like which could have decreased his interest and their effectiveness. Since many reading problems are picked up in early childhood these tests are more than effective in determining if a problem exists, however it would beneficial to increase the age ranges so that adult responses could be analyzed.

Discussion

Dyslexia is a difficult problem to treat because experts are still trying to define what it is. Nearly 100 years of research have done nothing to diminish the significance of dyslexia. The highly developed, mechanized, and specialized society that we live in requires more and more knowledge and skills. Children have more to learn, and reading has become the most important method of learning whether it be from a computer or a book.

Vision therapy can not be considered as a cure for dyslexia, but the results of this study suggest that it can make an overall improvement in the dyslexic's comfort and abilities. It is important that the patient is encouraged to use their new skills in order to maintain the benefits of vision therapy. As primary care practitioners, it is the responsibility of the doctor to know the complications involved with dyslexia and the areas that can and cannot be improved in the symptomatic patient.

If the doctor does not practice vision therapy, it is in the best interest of the patient to refer them to someone who does. Any degree of reading disability today has grave consequences, not only for the dyslexic, but for society as a whole, and therefore deserves all possible effort in terms of research as well as better understanding and treatment measures.

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