Learning disabilities, dyslexia, and vision: a subject review

A rebuttal, literature review, and commentary

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Background: In 1998, the American Academy of Pediatrics, the American Academy of Ophthalmology, and the American Association of Pediatric Ophthalmology and Strabismus (AAP/AAO/AAPOS) published a position paper entitled "Learning Disabilities, Dyslexia And Vision: A Subject Review," intended to support their assertion that there is no relationship between learning disabilities, dyslexia, and vision. The paper presents an unsupported opinion that optometrists (by implication) have said that vision problems cause learning disabilities and/or dyslexia and that visual therapy cures the conditions. The 1998 position paper follows two very similar and discredited papers published in 1972 and 1981.

Method: This article critically reviews and comments on the many problems of scholarship, the inconsistencies, and the false allegations the position paper presents. Perhaps the foremost problem is that the authoring committee has ignored a veritable mountain of relevant literature that strongly argues against their assertion that vision does not relate to academic performance. It is for this reason that an overview, drawn from more than 1,400 identified references from Medline and other database sources and pertinent texts that were reviewed, is incorporated into this current article. The AAP/AAO/AAPOS paper is also examined for the Levels of Evidence that their references offer in support of their position.

Conclusion: The AAP/AAO/AAPOS paper contains errors and internal inconsistencies. Through highly selective reference choices, it misrepresents the great body of evidence from the literature that supports a relationship between visual and perceptual problems as they contribute to classroom difficulties. The 1998 paper should be retracted because of the errors, bias, and disinformation it presents. The public assigns great trust to authorities for accurate, intellectually honest guidance, which is lacking in this AAP/AAO/AAPOS position paper.

Key Words: AAO, AAP, AAPOS, dyslexia, learning disabilities, perceptual therapy, reading, vision, visual therapy.

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I. Introduction

In 1998, the American Academy of Pediatrics, the American Academy of Ophthalmology, and the American Association of Pediatric Ophthalmology and Strabismus (AAP/AAO/AAPOS) jointly published a position paper titled "Learning Disabilities, Dyslexia And Vision: A Subject Review."[1] This was an updated statement of their understanding of the role of vision in learning disabilities and dyslexia (*see* Appendix). The new position paper followed two comparable published papers—"The Eye and Learning Disabilities"[2] (1972) and "Learning Disabilities, Dyslexia And Vision"[3] (1981)—that drew the same conclusions: that visual therapy, lenses, prisms, and filters do not treat specific learning disabilities. [*Author's note*: it should be noted that the American Academy of Pediatrics was not a signator to the 1981 paper, but has rejoined to sign the 1998 paper.]

Unfortunately, the 1972 and 1981 position papers suffered from a lack of integrity in their scholarship. Each was studied and thoroughly discredited in papers published in a peer-reviewed journal[4,5] for their corrupted use of references. Neither of these critical reviews was rebutted. The 1972 and 1981 position papers ignored the role of collateral visual and visual processing difficulties that the 1998 paper now acknowledges. However, the authors of the 1998 paper have failed to use this information in any constructive way for public and professional guidance. The literature review provided in this critical review and commentary refutes their unfounded charge that the literature fails to support a relationship between the visual process and learning.

The 1972, 1981, and 1998 position papers appear to represent a high degree of subjectivity more than any objec-

tive consideration of the huge body of evidence. It is dismaying that the organizations offered no formal response nor any other answer to the charges of scientific abuse made in the two previous critiques by Flax and by Flax et al; e.g.:

> "*The dissemination of this statement* [the 1972 position paper]*...does a disservice to the public and represents an affront to the academic community*"; "...[the paper shows] *gross distortion and inaccuracies in the use of the reference material*"; "*The distorted utilization of reference material is monumental*"; "[The paper]*...offers absolutely no supporting material for (its) conclusion*"; and "*This policy statement* [the 1981 paper]*...does the public a disservice... The references offered are misconstrued, non-applicable, and grossly distorted*."[4,5]

All of the references used negatively in the earlier position papers actually support a vision-learning link, according to the critics.

The 1998 AAP/AAO/AAPOS position paper has the same pivotal problem as its two predecessors: the assumption that optometrists* believe that visual problems are in some way responsible for dyslexia. This is not—and has never been—the position of any responsible organization within optometry.[6-10] Optometrists, as a profession, have never held that learning disabilities or dyslexia are caused solely by vision or visual functioning difficulties. Quite to the contrary, and consistent with the literature, optometrists recognize that reading and learning problems are multifactoral in origin.[8-17] Experts from other disciplines also agree that reading problems in the classroom are diverse in etiology[18-30] and follow two broad types: visual-spatial and phonologically-related problems. Visual functioning and visual processing difficulties often co-exist with and contribute to learning problems, but they are probably not causative.

II. Examination of the 1998 AAP/AAO/AAPOS text

The 1998 AAP/AAO/AAPOS position paper (*see* Appendix) appears to be essentially a rehash of the earlier papers. However, in this new publication, there are only eight references from the 1990's: two of which are policy statements on visual screening,[Appendix refs. 8,9] one concerns a neurological basis for dyslexia,[Appendix ref. 6] another is a poorly referenced opinion piece with no data,[Appendix ref. 24] and the other four are on Irlen lenses.[Appendix refs. 18-20,23] One of the newer references (Solan, 1990) is used to support a negative position on "neurologic organizational training" [sic] when it addresses only Irlen lenses. In fact, the 1998 paper contains no actual research to support the allegation that there is no relationship between vision and learning. The vast majority of the body of literature *does* support a relationship; while it is relatively uncommon to find negative references, they *do* exist.

In considering academic performance and any relationship with vision, it is helpful to understand the emerging practice of ranking the validity of medical evidence via systematic assessment. The Levels of Evidence method is meant to assist practitioners in making recommendations on the basis of evaluation of the studies available. The Levels of Evidence system is quite often organized into five levels. One model, in declining strength, is as follows:

- ***Level I Evidence***—randomized, double-blinded, controlled studies of adequate size;
- ***Level II Evidence***—smaller, randomized, double-blinded, controlled studies with positive trends that may not be statistically significant;
- ***Level III Evidence***—either non-randomized controlled studies or cohort or case series studies; and
- ***Level IV Evidence***—expert opinions from acknowledged authorities.

The weakest of all is ***Level V Evidence***—opinions from those who have merely studied and dis-

* The 1972, 1981, and 1998 position papers on vision therapy and learning have carefully left out the terms "optometry" or "optometrists." However, for all practical purposes, nobody but optometrists perform visual therapy in nonstrabismic cases.[84 (p.199)] This is supported by the observation that the vast majority, if not all, literature on visual therapy and its application is found in optometric sources or is authored by optometrists. An Internet search with three large metasearch engines (*www.Dogpile.com*, *www.Ixquick.com*, and *www.Google.com*) revealed only one ophthalmological practice that notes doing orthoptic visual therapy in the scope of their multidisciplinary practice. For these reasons, there is little cause to doubt that when the AAP/AAO/AAPOS position papers indict the use of visual therapy in learning applications, that the subject methods they censure are used only by optometry and optometrists.

cussed the literature. This is the model used in this critique for examination of the data.†

Background

Starting with the *Background* statement, let us examine the AAP/AAO/AAPOS position paper: "*Many educators, psychologists, and medical specialists concur that individuals who have learning disabilities should…avoid remedies involving eye exercises, filters, tinted lenses, or other optical devices that have no known scientific proof of efficacy*." This statement is actually scientifically vague, lacking citations to support it. Because of the way it is worded, it implies that no eye exercises, filters, tinted lenses, and optical devices have any efficacy and that vision does not relate to learning, the historic position in all three papers.[1-3] This does not represent what the literature reports. Since it is unattributed, it may not even represent any knowledgeable opinion (*Level V Evidence*, the weakest level). Respected authorities in education have long found that efficient visual functioning and visual perception are a necessary component of satisfactory learning and have been addressed in research.[31-67] Other research that existed at the time of this paper's publication also contradicts the statement.[12, 68-100]

Evaluation and Management

The authors make a statement that is inconsistent with the premise of the 1998 AAP/AAO/AAPOS paper: "*Sometimes children also may have treatable visual difficulties along with their primary reading or learning dysfunction*." It is important to point out that those treatable problems, in fact, may indeed require eye exercises, lenses, prisms, and filters, which were dismissed in the *Background* statement. This inconsistency escapes the authors. Their explanation goes on to state that visual acuity needs to be ruled in or out as a factor. However, this is generally a fruitless gesture in relation to reading retardation, since researchers and clinicians have long known that studies show an inverse relationship between visual acuity and academic performance. That is to say, reduced sight is often due to myopia, and myopia is frequently associated with above-average academic achievement and educational level.[76,101-105] On the other hand, low-to-moderate farsightedness rarely causes visual acuity problems, yet has been associated with visual perception and vision function anomalies. These children will pass vision screenings and yet may have academic difficulty.[74,76,106-108]

Role of the Eyes

The authors assert in an undocumented statement that: "*some vision care practitioners incorrectly attribute reading difficulties to one or more subtle ocular or visual abnormalities*." Besides the lack of supporting citations from expert sources which might raise this statement to Level V evidence, problems of definition arise. Who do the authors mean by "some vision care practitioners"? What do the authors mean by the nebulous term "subtle ocular or visual abnormalities"? Do they mean suppression? Suppression can be a co-existent visual abnormality in retarded readers, according to Benton (a pediatric ophthalmologist)[109] and Safra.[110]

† The *Levels of Evidence* method for systematic evaluation of the validity and strength of the sources of data being reported in medical studies was generated by researchers for the Canadian Task Force on the Periodic Health Examination.[327] The concept has been promoted by the Cochrane Centre and Library, who inaugurated the Cochrane Collaboration with its Cochrane Database of Systematic Reviews, an electronic publication, as a means of publishing the results of reviewing groups. Depending on the field of study and its inherent clinical characteristics, there can be modifications of the Levels as agreed upon by each field's review groups, depending on their assessment of the field's data and practices, but the randomized, controlled (and double-blind) trial (RCT) is always the gold standard for Level I evidence. There is acknowledgment among the review groups that RCT's cannot always be designed, and some areas may resist any form of quantitative study at all. A balance must be exercised between practical and ethical issues in deciding the quality of the evidence. Customarily, there are from three to five levels (included in one example was the "Somebody once told me," level VI). Other variations occur: the separate review groups studying cancer and cardiovascular disease have agreed in their Levels, but differ from groups studying other conditions in their Level IV and Level V definitions. Some of those groups relegate case studies to Level IV and all opinion is considered Level V. The design may also include sublevels within each major level. For instance, the guidelines for the breast cancer review group out of Canada allow that when enough case studies are conducted at different times, in different sites and are consistent in their results, their credibility within that level is increased.[328] The review group studying osteoporosis has adopted the same Level descriptions as the breast cancer review group.[329] The objectives of these latter groups' model were unilaterally judged by this author as being the best fit to the nature of the literature on these vision/learning topics and why their guidelines' structure is used here.

Do they mean eye movement (saccadic) abnormalities? Deficient oculomotor abilities have been associated with reading disabled/dyslexic students.[15,68,70,111-120] Do they mean accommodative difficulties? These, too, have been shown by researchers to be associated problems in some deficient readers.[75,91,97,99,111,121-124] The omission of definitions and references is a significant difficulty.

The last sentence of this subtopic in the 1998 AAP/AAO/AAPOS paper states that children with learning problems have the same ocular health as children without such conditions. Granted, ocular health has little (if any) relationship to learning. This non-issue appears to be introduced to impress the reader with a "piling-on effect" of negative statements. It is a moot point, however, since there is very little basis for assertion that ocular health is related to learning problems.

This does offer the opportunity to examine a most-curious reference [Helveston et al., "Visual Function and Academic Performance" (Appendix ref. 11)] that the authors use in support of the non-issue of ocular health. Because of its poor scholarship and questionable methods, this paper has been thoroughly dissected in another critique.[126] Of all the 1998 AAP/AAO/AAPOS position paper's references, the Helveston et al. paper arguably offers the most-fitting opportunity to prove the thesis that vision and learning are not related, as it could present Level I evidence of their position. It is not used for that purpose, even though the authors state in their abstract: "*Evaluation of 1,910 first-, second-, and third-grade students indicated that visual function and academic performance as measured by reading were not positively related,*"Appendix ref. 11 (p. 346) The reason it is not used almost certainly has to be that the paper's statistics omit the most salient of all data tests: the researchers completely leave out testing of the central question about the relationship between vision and learning and spuriously accept the null hypothesis. Nothing in the Helveston et al. paper supports the claim in their abstract.[126]

Paradoxically, in the very midst of that potentially critical vision and learning study, and in an earlier paper based on a copying test of Helveston's creation (the "Draw a bicycle test"), the authors support educators' and optometrists' assertion that a strong relationship exists between visual-motor copying skills and academic performance.[127] Helveston et al.'s data show a highly significant relationship between the two ($p < 0.0001$). It would appear that the unstated answer to their initial question of whether visual skills and learning are related is "Yes".

Controversies

In this section the authors assert there is no scientific support for muscle exercises and "'*training' glasses (with or without bifocals or prisms*)" improving academic abilities. The lack of appropriate scholarship is reflected here, since one of the three references used to support this statement refers only to Doman–Delecato cross-patterning training.Appendix ref. 15 Their statement is in direct contradiction to reports in the literature that support the observation that convergence insufficiency and suppression are associated with learning inefficiency and can be improved with orthoptic therapy and prism glasses.[94,96,98,99,109,128-134] Most of these studies existed at the time of the publication of the 1998 AAP/AAO/AAPOS paper.

Perceptual therapy has been associated with improving academic abilities, in direct contradiction to the 1998 paper's assertion that it has not. Rosner conducted several years of basic research in this area and found a high correlation of visual and auditory analytical skills to math and reading achievement. He developed a perceptual curriculum that remediated these skills and demonstrated a transfer of the improvement into academic performance.[135-141] Most of this research was completed before the publication of the 1972 position paper.

Research supports at least some role of blue filters in assisting certain children with inefficient reading and attentional difficulties.[142-144] However, the use of Irlen lenses (based on the Scotopic Sensitivity Syndrome) has never been a general optometric intervention, and is still a matter of great controversy. The American Optometric Association has appropriately taken a cautionary position in that respect.[145] Even though the Scotopic Sensitivity Syndrome has yet to be demonstrated as a real phenomenon, the filter question is being examined, with at least some support for the validity of filters' effect on the brain—probably in the magnocellular strata of the lateral geniculate nucleus. Ongoing research may lead to clinical guidelines for the use of filters as the relationships are clarified.

The topic of expense of treatment is discussed, with the authors stating that the expense is unwarranted. This assumes that visual therapies or visual perceptual therapies are never effective. The very concept of this negative hypothesis is illogical. If parents pay tutors, psychologists, and educational specialists for assistance with their child's learning problems, there will be less than effective results when there are visual barriers to learning that contribute in significant ways.[96,99,103,108,109,117,130-132,134] Proper visual analysis and intervention need to be considered in all children with reading dysfunctions.

We often clinically see children with visual performance-related headaches subjected to extensive medical and neurological tests of great sophistication to reveal only normal results. A proper diagnostic protocol could potentially save parents and insurance companies great amounts of unneeded expense. (Atzmon et al. found that, while both experimental groups improved in reading ability in their study, reading-disabled children who received visual therapy had a decrease in headache symptoms, but children who were only tutored actually had an increase of headache symptoms. Their impression was that the tutored-only children were reading more, and this resulted in greater visual distress.[128])

Further, taxpayers support special education programs that are populated by children with clinically significant visual function and visual processing problems.[17,24,43,94,97,98] Learning support programs cannot effectively address children with the types of problems we are discussing here. The cost to society is additionally increased not only by these ineffectual attempts at rehabilitation, but—over time—by lost lifetime income,[146] a greater incidence of crime in learning dysfunctional students (studies of juvenile delinquents and adult prisoners have shown that many are 'retarded' in reading[146-150]), and therapy for emotional sequellae.[146] We would expect that any moneys productively spent in rehabilitating retarded readers by valid methods will potentially have great economic effect on any society.

Appropriate Educational Measures

The suggestion that "appropriate educational measures" be used in lieu of visual interventions is not as helpful as it might seem in the management of most of these cases. Children who are referred for visual and perceptual remediation (whether by psychologists, educators, or merely family friends) have often had years of public school and private tutoring for their problems. Clinical experience reveals that these children are often hardcore dysfunctional readers of many years' standing, whose parents and schools have invested enormously in educational and medical interventions to little avail. They have been referred for visual evaluation only as a last resort, not as a first option. As an example of this, Solan et al. reported on therapies that were directed at remediating 31 deficient readers with long-standing reading problems. These students had been addressed by traditional means for five years, but at the end of the trial, had improved their learning rate (achievement divided by time on task) from a previous annual rate of 60% to 400% in 24 weeks—in spite of the many years of previous remedial interventions.[151]

Educational measures—intelligence, achievement, and related tests—fail to indicate what the teacher should do to assist children with learning skills problems: they merely reveal that a problem exists. Rosner demonstrated that if children have a visual-motor skills problem, they will often have math, spelling (sight-words), and writing difficulties. Children with auditory-motor skills problems often will have reading, language arts, and phonetic spelling difficulties.[135] As mentioned previously, Rosner also proved that the perceptual skills deficiencies were remediable and transferred into classroom skills. "Teaching kids harder" without addressing learning skills barriers is an inefficient use of the teacher's time and resources when a child is experiencing visual-motor or auditory-motor skills problems. This frequently will increase the chances that children with learning problems will develop anxieties and depression over the learning experience,[152-156] which further frustrates the child, the teacher, and the parents. Unfortunately, the most common ways educators apply psychometric information is to adapt lessons, or to water down the content, or teach to the strengths. In a metastudy of this last method, not one of the 15 papers that were considered provided a positive outcome.[157] So, the AAP/AAO/AAPOS position paper's recommendation to consult educators is less than useful, for all practical purposes. For pragmatic reasons, application of what is currently known from the body of neurobiological and neuropsychological

research is not on the near horizon in the classrooms of America, unfortunately. Teachers are not yet trained as diagnosticians and clinicians, which presents a significant problem, since diagnostic skills are needed to address the differing learning styles and sensorimotor problems children bring into classrooms.[64]

At present, education has little to offer therapeutically to a student with perceptual and motor deficiencies, although individual teachers may take the remediation of students' specific problems upon themselves. The Bradley reference(Appendix ref. 21) has no data to support the assertion that the "*reported benefits can be explained by the traditional educational remedial techniques with which [training techniques and interventions] are usually combined*." This is one educator's opinion and—at very best—is no more than Level IV evidence. The Solan et al. study is primary evidence—of at least Level III quality—that nontraditional therapy can bring success to students when traditional educational remedial methods had failed (for five previous years).[151]

By inference, the 1998 AAP/AAO/AAPOS policy statement allows that even when physicians have no concrete suggestions, evaluation on a case-by-case basis for visual processing problems is a waste of time. Proper visual analysis needs to be considered in all children with reading dysfunctions.

Early detection

This section raises a significant problem of definition. In the past, the word "*dyslexia*" referred to the inability to read due to known pathological or traumatic insult of the brain.[77 (p. 2)] That is no longer the case, as dyslexia has now become a layman's catchword for "learning disability." The authors have separated the two concepts in the very title of the paper ("Learning Disabilities, Dyslexia, and Vision"), yet now blend the two into one, and combine both with a third—Attention Deficit Disorder (ADD). Dyslexia, attention deficit disorder, and the most common learning disabilities are three separate entities of symptoms with some crossover areas and need to be addressed as such. The authors seem to wish to merge them in an apparent attempt to gain synergy for their efforts to ignore and discredit optometric therapeutic interventions. The literature shows that ADD is only modestly related to academic difficulties.[64 (pp. 151-192), 67, 158-160] However, Attention-Deficit Hyperactivity Disorder (ADHD) may have a vision connection in at least some cases: convergence insufficiency has been related to ADHD in one study.[161]

Role of the physician

The recommendations here are largely ineffective, since the direct instruction is for pediatricians to refer refractive errors, focusing deficiencies, eye muscle imbalance, and motor-fusion deficiencies to ophthalmologists. At face value, this is not a bad recommendation, if we ignore the obvious inconsistency of this recommendation with their *Background Statement*, because the problems mentioned generally require the use of lenses, prisms, and training they had recommended to be avoided. However that may be, few pediatricians are in a position to detect these problems in a routine evaluation, and few parents will seek out the pediatrician for a medical opinion when a child is referred from the school for a learning disability.[162]

It may be that the authors of the 1998 AAP/AAO/AAPOS paper intend something other than the most common understanding of "ocular defects" when they use that term. The authors, in this 'Role of the Physician' section, assure the reader there really are visual problems that need to be addressed. However, all vision care specialists will appreciate that focusing deficiencies, eye muscle imbalance, and motor-fusion deficiencies are not "ocular defects," *ipso facto*. Therefore, the statement, "*If no ocular defect is found, the child needs no further vision care or treatment…*"—taken literally—is remiss, based on the findings of Helveston et al.,[127] Atzmon et al.,[128] Rosner,[135-141] many others previously cited, and the very recommendations in the opening of the 'Role of the Physician' section. The authors of this 1998 AAP/AAO/AAPOS text almost seem to wish to rush to close the door on any consideration of their admission that there are functional factors in the relationships of vision, visual processing, perception, and learning problems.

Multidisciplinary approach

All optometric practitioners who deal with learning disabled children would agree with the observation in the sections 'Multidisciplinary Approach' and 'The Role of Education' that a mul-

tidisciplinary interventional strategy is needed for dealing with learning disabilities. To that end, many optometrists work closely with reading specialists, speech therapists, and occupational therapists. Psychologists are important at the outset, to determine the presence of adequate intelligence and the level of achievement. They also can provide reassurance and counsel to the anxious, depressed child who has lost confidence and views the classroom as an unfriendly, embarrassing, even hostile environment.

The 1998 AAP/AAO/AAPOS position paper points to the neurobiological research that has found some correlates of learning problems to brain function and brain structure, but does not take into consideration that there may very well be an essential error: there is an assumption that these are the *causes* of the academic problems and not just the *result* of physiological and emotional disorders. Brain changes from environmental etiologies may be a significant source of factors altering the brain performance and structure in learning problems. Research has demonstrated that experience and stress affect brain structure and function.[163-170] We will not be certain for some time which comes first—the learning problems or the brain changes.[171] This question certainly needs to be studied. However, it is premature to conclude that the etiological road only goes one way—as the 1998 AAP/AAO/AAPOS paper appears to assume.

Recommendations

The visual screenings that the 1998 AAP/AAO/AAPOS paper recommends do not take into account a child's ability to *sustain* single, clear, comfortable, and efficient binocular vision on desktop tasks, like reading and writing. Indeed, there are very few adequate nonprofessional screening techniques that accurately reveal learning-related vision problems.[172] Rosner and Rosner[74,103] demonstrated that far-sighted children are more likely to have visual perceptual problems and it is well known that these children will pass most visual screenings. The 'Recommendations' go on to say that when the child with a vision problem is referred, the screener is directed to refer the child to an *ophthalmologist*, which presents a problem of ethics because of the suggested constraint of free choice. In light of the evidence presented here, it would be more appropriate to use the term "a functional vision specialist"—or perhaps just "eye care practitioner."

Summary

The authors assert once again in the 'Summary' that there is no known visual cause for these learning difficulties and no known effective visual treatment. In support of this statement, they cite a non-issue—Irlen lenses, a controversial and seldom used optometric method of treatment. They also cite an opinion piece by Silver,[Appendix ref. 24] a child psychiatrist who has historically maintained a consistent attitude of negativity against visual and perceptual therapy in his books and papers.[173-176] He has done this, though, without data-related support for his position that is representative of the body of literature. However, Silver (with Keys) published at least one opinion piece[84] that does support the type of interventions that optometrists and the 1998 AAP/AAO/AAPOS position paper obliquely recommends. They affirm that eye muscle functioning must be assessed because, "*Vision problems can interfere with the process of learning.*"[84 (p.194)] It may be that an overdue change in awareness is looming on the ophthalmological horizon, but the 1998 AAP/AAO/AAPOS position paper remains essentially a barrier to scientific and clinical progress.

III. Summary of the Position Papers

1. In the first position paper, *The Eye and Learning Disabilities*,[2] the references that were used actually upheld a vision-learning link, but appear to have been deliberately cited to support a negative argument. Flax dissected the paper's use of references to show the poor scholarship and gross errors in their application.[4] The committee members who wrote that position statement also tried to assert that optometric therapies depended on Doman–Delecato cross-crawling and cross-creeping. This was a major error based in ignorance of actual optometric thinking, practice, and methodology.
2. In the second paper,[3] the new committee repeated much from the first paper, including most of the optometric references, but—perhaps aware of the first critique's charges about Doman–Delecato patterning—changed emphasis from cross-patterning training to the use of Irlen lenses, a non-optometric method not currently supported by the American Optometric Association.[145] Flax et al. detailed the errors in the paper, repeating once again that many of the citations that were based in actual research *supported* a

role for the relationship of vision to reading and of the effectiveness of therapy in aiding children with vision-related learning problems.[5]

3. In the current position paper,[1] the imagined relationship of Irlen lenses and Doman–Delecato methods to optometric visual and developmental training is maintained. The immense body of supportive literature is ignored and, once again, literature that contains no measures of vision (other than eye dominance) is used to support the non-argument about eye defects and learning.[Appendix ref. 10] The following review of the literature shows there is voluminous support for a vision-learning link, in direct contradiction to the position paper's assertion that, "*Currently, no scientific evidence supports the view that correction of subtle visual defects can alter the brain's processing of visual stimuli…*"

IV. Support from the Literature

There is a constellation of visual functioning and visual processing problems that relate to academic performance difficulties and learning problems, mostly as co-existent, contributing factors. The literature available at the time of the writing of the 1998 paper and that has been published since affirms a positive relationship between the following:

1. Saccadic skills and learning.[15,68,70,111-120]
2. Convergence insufficiency and learning.[80,96,98,128,132,134,177-193]
3. Use of prisms and spectacle lenses and learning.[98,130,191,193,194]
4. Suppression and learning.[109,110,195,196]
5. Binocular vision and learning.[20,80,86,93,97,99,109-111,123,197-212]
6. Visual motor skills and learning.[68-70,81,84,86,111-113,116,124,144,204,213-222]
7. Auditory perception and learning.[76,77,82,212,223-228]
8. Hyperopia and learning.[74,96,102,103,106,229,230]
9. Amblyopia and learning.[105,196,211]
10. Visual processing and learning.[6,24,27,29,68,88,95,118,144,154,224,231-271]

A great deal of this has been reviewed before in at least one literature search and was in existence at the time of the 1998 AAP/AAO/AAPOS publication.[272] Much of the body of literature suggests that a significant portion of learning dysfunctional/dyslexic individuals have a low-threshold neurophysiology that is intolerant of what would ordinarily be considered subclinical vision problems (by most practices). The literature shows that visual therapy techniques, lenses, prisms, and some filters have positive effects on the following conditions that the above citations support as being co-existent problems to reading dysfunctions:

1. Accommodative disorders.[273-283]
2. Amblyopia.[284-293]
3. Convergence insufficiency.[132,180,183,187,294-300]
4. Intermittent exotropia.[188,301-317]

The literature also reflects nonsupportive references, a few of which were found to refer to: saccadic abilities,[318, 319] convergence insufficiency,[320] prism spectacles,[321] binocular vision,[320, 322; 323] visual-motor skills,[324] auditory perception,[325] and visual processing.[326]

V. Conclusion

Over the past 30 years, the three AAP/AAO/AAPOS policy papers[1-3] concerning vision and learning have been widely disseminated. None of the papers properly represented what was known from the body of literature at the time. The impact of the three papers' publication does a disservice to physicians, educators, psychologists, and the public.

As evidenced by the types of changes that were made in each subsequent policy paper following the 1972 statement, the committees that authored them demonstrated their awareness of the existing critiques. The only substantive change made in the 1998 paper was to omit all the optometric references that were so poorly used in both of the first two position papers. There are absolutely no optometric references to the methods these papers condemn, which makes this 1998 paper an even more-questionable review. If the intent was to actually present a subject review in a scholarly way, one would expect that the paper would incorporate the addressing of actual optometric methods and management of learning-related vision problems.

The most-central problem with the arguments of this current paper is the same as that of its two predecessors: there is an assumption that optometrists believe vision is in some way solely responsible for dyslexia and learning disabilities. This is not—and has never been—the position of

any responsible organization within optometry.[6-10] Repeating the assertion does not make it any more true.

VI. Commentary

In light of the apparently known existence of critiques of the original papers, it is a puzzle why the parent agencies did not provide more oversight in the drafting of this 1998 position paper before they approved it. Disturbingly, in light of the paper's serious academic shortcomings, it appears that the peer-review process has been compromised. This point also extends to the Helveston et al. paper[(Appendix ref. 11)], which either proved nothing or proved that vision and learning are indeed related. Both of these papers set out to argue that there is no relationship between visual function and learning, but no actual research data are presented to that effect. In the 1998 paper, much of the evidence presented is either unattributed, or of the weak, Level V Evidence variety. None of their evidence rises above Level IV (at the very best). The 1998 paper perpetuates the spurious allegation of the original position papers[2,3] that, "*No known scientific evidence [exists] supporting claims for improving the academic abilities of dyslexic or learning disabled children…with treatment based on [visual interventions]*." As this critique has demonstrated—and by their paper's own advice—this statement is patently false whenever co-existing visual, perceptual, and visual processing problems are providing barriers to learning.

Ophthalmological critics of the vision-learning link have often used the argument that since there are superior students with visual dysfunctioning, that those problems (strabismus, suppressions, saccadic clumsiness, and so on) *never* correlate with reading or learning difficulties. The literature cited above (Benton,[109] Lennerstrand and Ygge,[125] and Silver[84]) illustrates the fallacy of such thinking [that because there are patients with strabismus (et al., per above) who do read well, that strabismus (et al.) does not associate with learning difficulties. Benton actually found that strabismus surgery *increased* the incidence of reading retardation in his 7-year study[109 (p. 150)]].

Because individuals can discover and master reading skills and mathematics abilities by several cognitive strategies, designing a proper research question to study vision and the visual process as they relate to learning in a general population may be difficult, but not impossible. Researchers may only rarely be able to rise above cohort or case series (Level III evidence) designs, and we may have to be satisfied knowing that the possibility of designing a properly randomized, controlled, double-blind large study (Level I evidence) will be elusive.†

It should be noted that—in the same manner that the citations in the original position papers were appropriately dissected—reviewers might take exception to a few of the multitude of references cited in this current critique. This is a fact of research life: no pick-proof research model was ever devised. Once that possibility is acknowledged, it must then be noted that the sheer vol-

† The *Levels of Evidence* method for systematic evaluation of the validity and strength of the sources of data being reported in medical studies was generated by researchers for the Canadian Task Force on the Periodic Health Examination.[327] The concept has been promoted by the Cochrane Centre and Library, who inaugurated the Cochrane Collaboration with its Cochrane Database of Systematic Reviews, an electronic publication, as a means of publishing the results of reviewing groups. Depending on the field of study and its inherent clinical characteristics, there can be modifications of the Levels as agreed upon by each field's review groups, depending on their assessment of the field's data and practices, but the randomized, controlled (and double-blind) trial (RCT) is always the gold standard for Level I evidence. There is acknowledgment among the review groups that RCT's cannot always be designed, and some areas may resist any form of quantitative study at all. A balance must be exercised between practical and ethical issues in deciding the quality of the evidence. Customarily, there are from three to five levels (included in one example was the "Somebody once told me," level VI). Other variations occur: the separate review groups studying cancer and cardiovascular disease have agreed in their Levels, but differ from groups studying other conditions in their Level IV and Level V definitions. Some of those groups relegate case studies to Level IV and all opinion is considered Level V. The design may also include sublevels within each major level. For instance, the guidelines for the breast cancer review group out of Canada allow that when enough case studies are conducted at different times, in different sites and are consistent in their results, their credibility within that level is increased.[328] The review group studying osteoporosis has adopted the same Level descriptions as the breast cancer review group.[329] The objectives of these latter groups' model were unilaterally judged by this author as being the best fit to the nature of the literature on these vision/learning topics and why their guidelines' structure is used here.

ume of supportive papers and paucity of truly nonsupportive papers overwhelms any critic's attempt to continue the assertion that there is no evidence of a relationship between vision and learning, or that visual therapy is not effective in addressing the vision problems known to contribute to reading and learning dysfunctions.

If the professional organizations who co-signed the monograph are to act in the public welfare, a formal retraction of the position paper is necessary. School administrators, teachers, medical, and allied professional personnel have trusted these recommendations in error and may have counseled parents against availing themselves of possible assistance from vision professionals because of AAP/AAO/AAPOS recommendations. Insurance companies must be informed of the appropriate uses and medical necessity of visual and perceptual therapy.

Productive and collegial, open-minded inquiry needs to move forward, based on what is already known and demonstrated: that vision and learning are undeniably related.

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Appendix

Position Statement:

AMERICAN ACADEMY OF PEDIATRICS

Committee on Children With Disabilities, American Academy of Pediatrics (AAP) and American Academy of Ophthalmology (AAO), American Association for Pediatric Ophthalmology and Strabismus (AAPOS)

Learning Disabilities, Dyslexia, and Vision: A Subject Review

ABSTRACT. Learning disabilities are common conditions in pediatric patients. The etiology of these difficulties is multifactorial, reflecting genetic influences and abnormalities of brain structure and function. Early recognition and referral to qualified educational professionals is critical for the best possible outcome. Visual problems are rarely responsible for learning difficulties. No scientific evidence exists for the efficacy of eye exercises ("vision therapy") or the use of special tinted lenses in the remediation of these complex pediatric developmental and neurologic conditions.

BACKGROUND

Learning disabilities have become an increasing personal and public concern. Among the spectrum of issues of concern in learning disabilities, the inability to read and comprehend is a major obstacle to learning and may have long-term educational, social, and economic implications. Family concern for the welfare of children with dyslexia and learning disabilities has led to a proliferation of diagnostic and remedial treatment procedures, many of which are controversial or without clear scientific evidence of efficacy. Many educators, psychologists, and medical specialists concur that individuals who have learning disabilities should: (1) receive early comprehensive educational, psychological, and medical assessment; (2) receive educational remediation combined with appropriate psychological and medical treatment; and (3) avoid remedies involving eye exercises, filters, tinted lenses, or other optical devices that have no known scientific proof of efficacy.

EVALUATION AND MANAGEMENT

Reading involves the integration of multiple factors related to an individual's experience, ability, and neurologic functioning. Research has shown that the majority of children and adults with reading difficulties experience a variety of problems with language[1-3] that stem from altered brain function and that such difficulties are not caused by altered visual function.[4-7] In addition, a variety of secondary emotional and environmental factors may have a detrimental effect on the learning process in such children.

Sometimes children may also have treatable visual difficulty along with their primary reading or learning dysfunction. Routine vision screening examinations can identify most of those who have reduced visual acuity. Pediatricians and other primary care physicians whose pediatric patients cannot pass vision screening according to national standards[8,9] should refer these patients to an ophthalmologist who has experience in the care of children.

Role of the Eyes

Decoding of retinal images occurs in the brain after visual signals are transmitted from the eye via the visual pathways. Some vision care practitioners incorrectly attribute reading difficulties to one or more subtle ocular or visual abnormalities. Although the eyes are obviously necessary for vision, the brain performs the complex function of interpreting visual images. Currently, no scientific evidence supports the view that correction of subtle visual defects can alter the brain's processing of visual stimuli. Statistically, children with dyslexia or related learning disabilities have the same ocular health as children without such conditions.[10-12]

Controversies

Eye defects, subtle or severe, do not cause the patient to experience reversal of letters, words, or numbers. No scientific evidence supports claims that the academic abilities of children with learning disabilities can be improved with treatments that are based on (1) visual training, including muscle exercises, ocular pursuit, tracking exercises, or "training" glasses (with or without bifocals or prisms);[13-15] (2) neurologic organizational training (laterality training, crawling, balance board, perceptual training);[16-18] or (3) colored lenses.[18-20] These more controversial methods of treatment may give parents and teachers a false sense of security that a child's reading difficulties are being addressed, which may delay proper instruction or remediation. The expense of these methods is unwarranted, and they cannot be substituted for appropriate educational measures. Claims of improved reading and learning after visual training, neurologic organization training, or use of colored lenses are almost always based on poorly controlled studies that typically rely on anecdotal information. These methods are without scientific validation.[21] Their reported benefits can be explained by the traditional educational remedial techniques with which they are usually combined.

Early Detection

Pediatricians, other primary care physicians, and educational specialists may use screening techniques to detect learning disabilities in preschool-aged children, but in many cases, the learning disability is discovered after the child experiences academic difficulties. Learning disabilities can include dyslexia, problems with memory and language, and difficulty with mathematic computation. These difficulties are often complicated by attention deficit disorders. A family history of learning disabilities is common in such conditions. Children who are considered to be at risk for or suspected of having these conditions by their physician should be evaluated for more detailed study by educational and/or psychological specialists.

Role of the Physician

Ocular defects in young children should be identified as early as possible, and when they are correctable, they should be managed by an ophthalmologist who is experienced in the care of children.[22] Treatable ocular conditions among others include refractive errors, focusing deficiencies, eye muscle imbalances, and motor fusion deficiencies. When children have learning problems that are suspected to be associated with visual defects, the ophthalmologist may be consulted by the primary care pediatrician. If no ocular defect is found, the child needs no further vision care or treatment and should be referred for medical and appropriate special educational evaluation and services. Pediatricians have an important role in coordination of care between the family and other health care services provided by ophthalmologists, optometrists, and other health care professionals who may become involved in the treatment plan.

Multidisciplinary Approach

The management of a child who has learning disabilities requires a multidisciplinary approach for diagnosis and treatment that involves educators, psychologists, and physicians. Basic scientific and clinical research into the role of the brain's structure and function in learning disabilities has demonstrated a neural basis of dyslexia and other specific learning disabilities and not the result of an ocular disorder alone.[4-6]

The Role of Education

The teaching of children, adolescents, and adults with dyslexia and learning disabilities is a challenge for educators. Skilled educators use standardized educational diagnostic evaluations and professional judgment to design and monitor individualized remedial programs. Psychologists may help with educational diagnosis and classification. Physicians, including pediatricians, otolaryngologists, neurologists, ophthalmologists, mental health professionals, and other appropriate medical specialists, may assist in treating the health problems of these patients. Because remediation may be more effective during the early years, prompt diagnosis is paramount.[20,21] Educators with specialty training in learning disabilities play a key role in providing help for the learning disabled or dyslexic child or adult.

RECOMMENDATIONS

1. For all children, clinicians should perform vision screening according to national standards.[8,9]
2. Any child who cannot pass the recommended vision screening test should be referred to an ophthalmologist who has experience in the care of children.
3. Children with educational problems and normal vision screening should be referred for educational diagnostic evaluation and appropriate special educational evaluation and services.
4. Diagnostic and treatment approaches that lack objective, scientifically established efficacy should not be used.

SUMMARY

Reading difficulties and learning disabilities are complex problems that have no simple solutions. The American Academy of Pediatrics and the American Academy of Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus strongly support the need for early diagnosis and educational remediation. There is no known visual cause for these learning disabilities and no known effective visual treatment.[23,24] Recommendations for multidisciplinary evaluation and management must be based on evidence of proven effectiveness demonstrated by objective scientific methodology.[23-24] It is important that any therapy for learning disabilities be scientifically established to be valid before it can be recommended for treatment.

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