

## Vision, Learning Problems and Dyslexia: Part 1

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First Part of the comments on, and rebuttals of, the article: « *Various vision-based treatment procedures and vision therapy for learning disabilities: what are the scientific evidences?* » By optometrists Amélie and Isabelle Ganivet Denault, and ophthalmologists Rosanne Superstein and Nicole Fallaha article published in the Canadian Journal of Optometry in December 2014.

## Abstract

The article we wish to refute comes to a somewhat distorted conclusion since it relies on a partial and an incomplete review of the scientific literature. Unfortunately, a number of recent publications concluding to the efficacy of vision therapy were omitted; furthermore some of the articles in reference were quoted with a conclusion other than that of the authors of the said articles. The authors also drew extensively from the writing of several American medical organizations, ignoring those of their optometric counterparts. From the conclusions of this article, one could infer wrongly that optometrists who diagnose and treat vision problems linked to academic difficulties are offering their patients a therapy that is scientifically unsound, yielding little more results than a placebo effect. This raises serious questions that have far reaching consequences.

Yet, even an incomplete review could have tried to balance the scales; we feel that this was not attempted, since the article has not mentioned any references to the contrary of their belief, although a number of recent articles to that effect are readily available.

Also the article seems to imply that optometrists who provide visual training claim they can cure dyslexia. They also wrongfully affirm that the dyslexic population does not have any more vision problems than the general pediatric population and that the overall optometric practice regarding kids with learning problems has no scientific basis.

We claim the opposite and we argue that ethics and the precautionary principle should entail any optometrist who is not comfortable with the assessment or treatment of visual problems related to learning disabilities to refer his patient to an optometrist more specialized in this area. We also assert that these principles imply that health or education professionals should not deprive a child from therapy that may be beneficial on the grounds that the scientific validation is incomplete. Again, the precautionary principle in the Socratic oath speaks loud and clear. Given the magnitude of scientific literature, we argue that it would be in the interest of all that the school of optometry of the University de Montréal opens up to the study, research and teaching of this optometric speciality in Québec.

## Preamble: about the title of the article:

*“Various vision-based treatment procedures and vision therapy for learning disabilities: what are the scientific evidences?”*

First, the title implies that optometrists apply visual therapies in order to treat learning disabilities (LD). This false claim has been stated over and over by the ophthalmological and pediatric organizations for a long time in various writings hereinafter referred to as «*Joint Statement*». These assertions have repeatedly been refuted by optometric organizations and several authors like Bowan:

*« 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[1] »*

When the 2009 «*Joint Statement*» was published, renowned American neurologists Dr. Fernette and Brock Eide, specializing in learning difficulties, expressed that [2]:

*« Although the authors of the recent consensus statement on Vision and Dyslexia were trying to clarify the most effective approach to diagnosing and treating visual processing issues in dyslexia, **their statement is more likely to misinform than inform.** [...] **Both in our clinical experience and in published research data, children with such symptoms will often show benefits from visual therapy.**[...] That's why it is important not to limit interventions to simply addressing phonological processing challenges when children show other important challenges. When visual problems are present in individuals with dyslexia, and they commonly are, these individuals can be greatly helped by interventions that directly address their visual challenges. »*

Optometrists who treat visual, motor and perceptual problems for children with learning difficulties do not claim to treat dyslexia (DYS), or some other learning disability (LD) as dyspraxia, dysphasia, etc. Like all professionals in the field of rehabilitation and education (speech therapist, occupational therapist, teacher, neuropsychologist, etc.) they pretty well know that there is no cure for DYS.

But we must understand that whatever the condition diagnosed regarding school performance, these children have two eyes and possible visual problems!

No professional claims to treat DYS and we know that visual and perceptual problems that are diagnosed do not cause DYS or LD. All caregivers work to solve the problems interfering or exacerbating difficulties in school, for the best comfort and success of the child. Various optometric organizations have also been clear on this issue. [3] Here is the position of the American Optometric Association:

*« The expected outcome of optometric intervention is an improvement in visual function with the alleviation of associated signs and symptoms. Optometric intervention for people with learning-related vision problems consists of lenses, prisms, and vision therapy. **Vision therapy does not directly treat learning disabilities or dyslexia** [4] »*

Yet, this false claim is repeated over 23 times in the text; the authors want to make sure we get their message!

*“Various vision-based treatment procedures and vision therapy for learning disabilities: what are the scientific evidences?”*

Concerning LD, we must assert the following distinctions: LD is a neurological disorder that causes multifactorial problems in learning like DYS, dyscalculia, dyspraxia, dysphasia, disorder of attention, nonverbal syndrome disorder and the autism spectrum disorder. Some professionals can help manage or minimize the effects of such disorders, but do not cure them, even with educational or phonological processing. A child may

also have school learning problems (LP) without necessarily having LD.

In the case of DYS, we know that the diagnosis is made only after the child is at least 2 years behind in reading, which means that it is often in the 3rd or 4th grade that a true diagnosis can be made. Fighting against dropouts, educational caregivers must intervene without waiting for a specific diagnosis, and must ascertain if LD are present. In this case, optometrists are asked to assess these children before an accurate diagnosis is issued. As for attention disorders, it is still, despite advances in neuroscience, a diagnosis of exclusion and it is essential for the child that we may systematically exclude the existence of any visual problem. We will see that there is scientifically proven clinical evidence, both by optometrists as well as several ophthalmologists about the harmful effects of many visual conditions on a child's attentional ability.

*"Various vision-based treatment procedures and vision therapy for learning disabilities: what are the **scientific evidences**?"*

When tackling any controversial issue, it is necessary, in order to be credible and intellectually honest, to present both sides of the coin objectively; this article falls short in this respect: the text is not a systematic review of all the available literature on the subject. Authors are entitled to have a professional opinion and a philosophy of practice, but they should not conceal clinical evidence and facts by a restrictive choice of references or by misinterpreting conclusions. If some items seem controversial or uncertain although plausible, then an open and scientific mind should conclude to the need for additional research and certainly not reject the entire issue. In the most contentious cases, it is not only relevant but essential to apply the "precautionary principle" to health care. One should question whether our intervention, or lack thereof, violates the ethical principles dear to health care providers. First, *primum no nocere* (do no harm), second, the principle of non-nuisance (do not interfere) and thirdly the principle of beneficence (act for the good of the patient), which is usually interpreted as: "do not refrain from a potentially beneficial therapy simply because it is not yet entirely proven". We will see these principles and concepts in more detail in the second part of this article.

By a limited review of the literature that includes, without differentiation, scholarly opinions, personal views of individuals, clinical case studies and more

advanced clinical research, the article attempts to demonstrate that the absence of a high prevalence of visual problems in children with DYS, denies any value to optometric therapeutic interventions. They assimilate optometric interventions to near quackery [5], if not fraud or malpractice. [6] Yet many diagnosed visual problems [7] to which the article refers are widely known to impair the visual comfort and efficiency of "normal" readers [8], even more so in children who have difficulties in school! Furthermore, and we will come back to this later, the article ignores the investigation of problems related to the processing of visual information [9] also known to interfere with learning. All this stems from the initial bias to the effect that some optometrists view visual problems as the cause of the DYS and claim to treat DYS.

On the other hand, the article specifies that it will mainly discuss DYS, stating that dyslexia represents more than 80% of LD! This figure of 80% of LD, according to some, would have been poorly reported in the text of the *«Joint Statement»* [10]. Since the definition of DYS or LD is not the same for all authors, it is difficult to substantiate this figure and this is not our goal. But let's make it clear that of the 68 references quoted in the article, only 17 are research designed with a population of DYS (of which only 9 had a control population), 7 refer to a population of poor readers (with and without control population) and 6 to normal readers. The cited authors therefore also appear to have had some difficulty in isolating the population of DYS as they would have wanted. We will come back to this in the second part of this article about "evidence based medicine" (EBM) which sets forth the validity criteria used in health sciences. Suffice it to say that the article restricts EBM to only double-blind studies with placebo. But this argument cuts both ways: if an obvious fact cannot be asserted in the absence of references from EBM in the strict sense, one cannot prove the opposite by references that do not use the same standards. STALEMATE: the only possible conclusion is that of Granet [11] and other authors: more research!

A number of quality scientific articles have been ignored this review. Yet optometry has an abundance of prominent professors, researchers and clinicians who have produced over the years hundreds of studies on this topic. And when we speak of vision and visual problems, optometry is first in line [12]; optometry has all the sources and resources to resolve the issue in a scientific way. We will seek to present a comprehensive

review of the literature providing an overview of the scientific evidence justifying the intervention of Optometrists both diagnostically and therapeutically for children with learning difficulties. Please remember that we do not claim to treat LD and DYS as the article suggests or that everything has been said on the subject. Instead, the door remains open to questioning and research. Curiosity and openness should be the core values of any scientific mind.

In this first part of this article we will discuss the scientific evidence regarding visual problems related to LD (which included as we saw the DYS) which are negated by the authors. In a second part, we will discuss more specifically the epidemiology and causal assumptions of DYS, which are constantly evolving subjects and that have been poorly reported by the article. We will expand on visual information processing problems among these children. Then we will see on what sound foundation clinical decisions are made and available treatments proposed. We demystify the issue of scientific validity and EBM. Contrary to what the article suggests, EBM is not based solely on randomized controlled double-blind studies with placebo, and by far.

## Visual-oculo-motor dysfunctions and their treatment pilloried

While we consider the premises of the article biased, we nevertheless reviewed the claims and pretensions of the article to inform the reader about this debate. We consulted all the cited references and a great number of other articles from the years 2000 to 2014, without going further back in time in our systematic review of all literature: we are primarily clinicians in our own private offices and certainly not academic researchers. We have attempted to identify and bring together the different elements by topics discussed and developed by the authors in order to properly trim the whole.

Binocular vision (BV) problems and problems of accommodation, ocular motor and visual information processing are very common in the pediatric population in general, LD having been diagnosed or not. Several authors agree that nearly 20% of children have learning difficulties (of all categories) [13], other authors state that nearly 20% of school-age children suffer from vision problems or cognition problems connected to a visual process [14], and finally some argue, like Langis Michaud, that nearly 20% of children with learning problems suffer from these problems or of visual

cognition. [15] It must be noted that these figures remain impressive even though the epidemiology of visual problems related to the DYS and LP is unclear.

Going against the optometric literature [9,16,17], the article argues that "*children with dyslexia or LD show no more abnormalities in their visual function and their ocular health,*" and this without distinguishing between cases of DYS and LD which is heavily confusing and completely invalidates their conclusions. Eye health has never been at stake here.

Yet we have identified a number of studies about which the ophthalmological literature as well as the authors remains silent. Many writings confirm the coexistence of symptoms (physical or functional symptoms of discomfort) with visual problems (refractive problems, accommodation, convergence, eye motility or processing information - specifically, visuospatial organization and visuo-attentional capacity) and their negative impact on school performance [18,19,20]. Let's add a very recent study, the CITT [20,26] study confirms the high prevalence of convergence insufficiency problems in the population of ADD / ADHD. This had been already confirmed by Granet in Strabismus in 2005 [18]. In his 2010 article, Lack [10] had already refuted these allegations from the most recent «*Joint Statement*» entitled "Learning disabilities, Dyslexia and Vision" published in 2009. There is also a lot of research that shows positive results for vision therapy [21,22,23,24,25]. We will include about twenty others in as our analysis. This being said, once again we stress that we do not imply causation but significant visual interference.

## About visual acuity and refractive problems

We agree that visual acuity is not a condition that can predict LD, but it must also be admitted that it is not a sign of a normal and efficient visual system [27]. It is simplistic to consider visual acuity without mentioning the effort of the accommodation of fusional vergence systems that the visual system of a child must provide to maintain a good level of visual acuity and stereoscopic acuity. Physiological, functional and psychological impacts are not considered in the article.

Consider the case of a young "moderate" hyperopic [28], 6 YO of 4.00 D, who would have a "normal" AC / A of 5/1: at a distance of 33 cm, this child will produce an accommodative effort 7.00 D. He will become

consistently more esophoric by 20<sup>Δ</sup>, which will require of him a fusional vergence capacity of at least 40<sup>Δ</sup> base in for any sustained reading and writing task. This effort will also ask of him accommodative flexibility and consistent and significant divergences to support near/far/near. Even with normal accommodative amplitude, this child will have issues of visual perception and of speed and endurance to prolonged activities. He will also lose, in all likelihood, his oculomotor fluency that is not yet developed to respond automatically to various stimuli [29-30]. In addition, he will have a very strong tendency to unduly pull in his visual tasks, so doing restricting his visual span, thus putting at odds visual decoding [31,32]. Even "normal" visual acuity and stereo will probably be fluctuating [28,33,34]. This is a likely functional portrait of a child with a "moderate" hyperopia of 4 diopters. However, according to ophthalmological literature, this is not a case at risk for amblyopia and it is commonly believed that the child can "compensate" for his farsightedness.

The article argues that generally the accommodative function in children 6 to 10 y.o., is 12.00 D. Please note that the authors speak only of that part of accommodation which is enhanced by the convergence (measured by push up method) while the true measure of accommodation is done without using any mechanism with concave lenses in the phoropter. In addition, the accommodative function is wider and includes the accommodative lag, accommodative flexibility and the accommodation-convergence relationship. Any approach that tends to trivialize the correction of hyperopia without regard to all of the functional condition of a young patient is based on the "a priori"; clinical evidence demonstrated by Duane in 1912. The article quotes Palomo Alvarez et al. [35] and Sterner et al. [36] to confirm this fact while quite to the contrary, the content of their research has clearly cast doubt on this claim by showing that there were significant differences between monocular amplitudes of accommodation capacities (AA) in children 6 to 12 years, in addition to finding lower results than expected for their age.

*«Consequently, we conclude that **it cannot be assumed** that the amplitude of accommodation is in the expected amplitude range for all children of these ages »*

A perfect example of the ravages of this persistent prejudice is provided by ophthalmologist Donahue in 2007:

*"Healthy children in their first decade of life typically possess 12 D or more of accommodative function. Accordingly, even moderate uncorrected hypermetropia does not degrade acuity in young children. As a result, there is minimal need to correct moderate hyperopia, except when it is associated with strabismus. [37] »*

Furthermore hyperopia, myopia and the presence of astigmatism can clearly affect visual acuity. Depending on the location of the child in relationship to the blackboard, according to grade level and the need to take notes, more or less abundantly or fast, the level to which visual acuity can be affected can not be generalized; no rule of thumb will determine an acceptable prescription. We must also take into account new technologies in school environments: interactive whiteboards for distance vision and the growing use of tablets in the classroom and laptops for children in difficulty. It is important to change our reference criteria in functions of these new technologies and to ensure that vision is **adequate, effective and functional** throughout the day for various visual demands such as: allowing the transcription of teacher's notes and facilitating feedback. About myopia, the authors allude to myopia control techniques by visual correction: the object of this article is not to debate the best way to control the progression of myopia, we will refrain from comment: this in itself is a whole other area of investigation for which many publications and much research is still ongoing.

Concerning amblyopia, the authors cite erroneously the «*Joint Statement*» [38] of ophthalmologists to say that children with bilateral amblyopia, although will probably show slower reading level, will not suffer DYS more than other children. The reference source stated: «*In one study, microstrabismic amblyopia was associated with slower reading rates but not with dyslexia*». Reading the original study clearly states that unilateral amblyopia was studied, not bilateral amblyopia. [39] However, this error does not affect their conclusion with which we agree.

In summary, we agree again that the failure to correct a refractive problem does not cause DYS, nor does presence of eye disease. As to generalize that there is no

impact on the ability of a child to read, that's a different story.

It is counter-productive and quite unethical to state that: *"[it is] not only unnecessary, but inappropriate to prescribe small amounts of correction in order to promote the treatment of dyslexia and learning disabilities"*. "In fact, there are clinical cases of children with low refractive errors but comorbidity of visual abnormalities (esophoria, low vergences, low AA) who also suffer from LD and the level of their visual attention is affected by their visual condition [40]. These cases will largely benefit from the support of visual correction [41,42]. No studies, in spite of the claims of the article, conclude that they would not benefit from appropriate optometric intervention. On the contrary, studies show the negative impact of non-correction on the information processing skills or the visual-motor integration (subject untreated by the authors):

*«Preschoolers with uncorrected ametropia had significant reduction in visual-motor function. Wearing spectacles for 6 weeks improved Beery-Buktenica Developmental Test of Visual-Motor Integration scores to emmetropic levels [43]»*

Recognized standards for refractive error corrections for verbal preschool and school-age children do not exist [28,29,30,31,3 ,33]. Ophthalmic and optometric practices disagree with one another, which seems normal considering different goals (amblyogenic vs visual efficiency) in visual corrections [44,45,46,47,48].

The AOA gives out no diopter correction guide, but insists on the following factors that we find very relevant: visual efficiency, functional vision problems, abnormalities of BV and learning difficulties or academic problems [49]. Optometrists, who are actively working with a population of children with school problems and even with all LD including DYS, know very well that visual acuity alone or the relative magnitude of an ametropia such as hyperopia is not enough to exclude all possible visual impediments to the optimal functioning of the child.

### On saccades and fixations

There is consensus about the visual scanning process that occurs during reading. All agree on the importance of fixations during which the information is sent to the brain to allow proper decoding (lexical access). Also, the

importance of the visual span allowing readability of text has not been questioned. It is also recognized that visual span will allow the brain to determine the next sequence of saccadic eye movements allowing identification of upcoming letters and words. For example, in sub-normal vision cases, visual span is a major criterion for the best magnifying equipment. Optometrist Mylène Roy explains very well the importance and the concept of the visual span to increase reading fluency. [32] Basically, the theory of the visual scanning technique in reading is not challenged.

There has been scientific research for more than 50 years on the existence of oculomotor abnormalities in DYS such as a shorter and higher number of saccadic eye movements, along with longer fixation times. It has for long time been a controversy, but the literature now tends to admit this clinical reality since a new debate is presently open on the interpretation of these anomalies. In a literature review on the topic, Quercia reports that the interpretation of data collected seems to run into a problem:

*"Are motor disorders cause or consequence of the difficulties of deciphering or is it just an aggravating contribution of a primary disorder decoding whose origin is purely cognitive? To this day, although the cognitive sciences dominate uncompromising reflection and research on dyslexia, the answer is not clear. "[50]*

Unfortunately, the article presents an opaque picture of the current state of knowledge by focusing on outdated assertions that still deny the differences in eye movements of children with LD and LP with findings that are not related to their different references. This lack of scientific rigor leads to a regrettable confusion.

- The article claims that the saccadic eye movements of DYS **adults** are not different from those of non DYS adults. Apart from the reference to the *«Joint Statement»* of ophthalmologists and pediatricians 2009, they support their claim with 8 studies conducted mostly in the 1980s, the most recent from 1994. On the one hand this research does not affect the target population in their conclusion, and on the other hand these references are too old and no longer correspond to the current scientific views.

- Yet the article asserts, in the same breath, that children with LD (let us remember that not all are DYS) have indeed jerky eye movements and fixation difficulties and are less accurate than children of the same age, but that differences in jerky eye movements fade away when comparing DYS children with children of the same level of literacy regardless of age. The article concluded that the direction of causality between reading difficulties and eye movement abnormalities is not clearly established. They fail to discuss that the process of maturation of eye movements could explain the similarity of discrepancy between the normal-younger players and older DYS. [29]
- The article refers to four articles to assert that *"the majority of individuals with a disorder of either motilities or eye movements showed normal reading and comprehension."* Yet none of these references allow these conclusions or their prior claims. [51] the fact that some individuals with significant strabismus problems, nystagmus [52] or two children with a disease affecting eye movements [53] showed academic achievement and excellent levels of reading, and that albinos manage to read with adequate support [54], do not justify their conclusion. These intellectual shortcuts mislead the reader.
- It cites a research from Palomo Alvarez et al to leads us to question the use of a standardized psychometric test, the Developmental Eye Movement test (or DEM). [55] The DEM test notably allows differentiating certain types of language problems from oculomotor problems. But the test was not applied as it should have been since a full sequence of the procedure has been left out. [56] What is more, the level of literacy of the sampling was not stated clearly. One can not conclude that bad eye movements are a consequence of poor reading levels, from a conclusive experience on a small sample of five Arab adults. In summary, the test was used for purposes other than those for which it was designed, and we can not draw any conclusions from this experience.
- Finally, the article unilaterally adopts the theory that difficulties of oculomotor saccades and fixations would be created by reading disorders, not the reverse. Assuming that the phonological deficit is

the most widely accepted hypothesis to explain DYS, the authors agree that reading difficulties related to language disorders cause problems in saccades and fixations rather than accept the idea of comorbidity which could amplify the difficulties of DYS child. Four articles are quoted to prove their conclusions [57,58,59,60].

1. There also seems to be a free interpretation of a study published in the journal Neuron [57]: the have article states that: *"a training based on phonology not only improves reading skills but also visual functions"*. However, research has not investigated the various visual functions (such as eye movements, accommodation, convergence or visuo-attentional focus) or a rehabilitative intervention of these functions. The article also interpret that *"sometimes mentioned visual abnormalities are a consequence of learning disability and not the cause."* This is not the conclusion of the study that rather refers to an abnormality of the magnocellular system. Finally, the article expands their false conclusion on all cases of LD while the study refers only to a DYS population. We'll go into more detail on the causal hypothesis posed by this article in the second part of our article.

2. Olitsky et al, in 2003, once again wantonly and wrongly claim that visual therapies are put foreword to "treat dyslexia": they simply assert that the DYS is not caused by vision problems and that we should refrain from proposing visual therapies for DYS...

3. As to the research by Bucci quoted in support of the findings, it mostly confirms the existence of oculomotor difficulties in DYS children and does not confirm the hypothesis of reverse causation advanced by the authors. Moreover, Bucci confirms the relevance of vision therapy!

*« The atypical eye movement's patterns observed in dyslexic children suggest a deficiency in the visual attentional processing as well as an immaturity of the ocular motor saccade and vergence systems interaction »*

4. In the last study quoted, Biscaldi and Fisher also confirmed the existence of oculomotor problems in DYS children

engaging in various non-cognitive tasks that is to say without the impact of reading. This very obviously does not prove the hypothesis of the authors.

*«In general, in the standard tasks the dyslexic subjects had poorer fixation quality; failed more often to hit the target at once, had smaller primary saccades, and had shorter reaction times to the left as compared with the control group.»*

To conclude on the topic of saccades and fixations, the article states that: *"As a result, training based on phonemics would improve visual function by improving the reading level. Thus, the noted visual disturbances, due to a lack of reading experience, would be the consequence and not the cause of dyslexia."*

It is with deep perplexity that one reads this conclusion when one reads carefully the article by Bucci [59] that was quoted. Bucci's research rather confirms the significant presence of abnormal eye movements (saccades and fixations) independently of the visual tasks performed, suggesting a deficiency and immaturity between the coordination of oculomotor saccades and vergence. The tasks performed in reading and visual search, also require the same level of visual-perceptual attention skill and spatial information processing. In other words, Bucci says that a problem of oculomotor function and visuoattentional processing exists even when the cognitive process of reading is not involved. Moreover, it confirms the importance of addressing these problems through visual rehabilitation:

*«We believe that orthoptic vergence training, together with specific visual attentional training and reading tasks, could be useful tools in dyslexic children to improve visual attentional span, vergence capabilities as well as saccade yoking.»*

Any objective scientist who is keen on the advancement of knowledge will not distort the conclusions of authors quoted nor block the avenues for future research, but rather agree with the words of Bucci et al. recommending further research in this area. Fortunately, research is continuing. Let us quote for instance the conclusion of a placebo-controlled study published this year in Clinical Pediatrics. [61]

*«Conclusion: Saccadic training can significantly improve reading fluency. We hypothesize that this improvement in reading fluency is a result of rigorous practice of eye movements and shifting visuospatial attention, which are vital to the act of reading.»*

#### **About accommodation**

On the subject of accommodation and its dysfunctions, the article asserts various very questionable statements and eventually come to the conclusion that: *"Therefore, any therapy to decrease accommodative effort of a child with LD under the pretext that this disorder is the cause of LD is not scientifically based."*

Yet many authors recently pronounced themselves very positively on approaches to corrections lenses and vision therapy for children with attention deficit problems or accommodative flexibility and relevance to continue research in this direction. [41,62,63,64,65,66]. Comorbidity of accommodative problems with several visual dysfunctions such as convergence insufficiency [67] and BV problems [68] is recognized. The set of symptoms related to accommodative problems is better known [69,70,71,72]. Clinical research even reports on close ties between the accommodative problems and symptoms related to attention deficit [20]. All of these widely warrant optometric intervention. Unfortunately, the article insinuates wantonly that optometrists who work with DYS or children with learning difficulties (confusing systematically DYS and LD) are neither more nor less than impostors who suggest to their patients that they treat DYS.

#### **About the amplitude of accommodation (AA) and accommodation insufficiency (AI)**

Again, the article mentions a false premise that children under the age of 10 have a maximum AA and then assert that the AI is rare in children. Contrary to their claim, Cacho Martinez et al. point out a systematic review of the literature [63], as numerous articles confirm the extent of this problem. They raise the disparity in diagnostic criteria for all non-strabismic dysfunction of accommodation and BV, a disparity offsets the results of prevalence found in the literature, which explains the lack of scientific consensus.

The authors argue that *"there is no significant difference between the accommodative ability of patients with a reading disorder and that of normal readers"* Yet the sources quoted clearly state significant differences in AA

measures [26,73]. Although parts of these sources consider that the measures are still in so-called normal limits Olitsky [74] raises many doubts about the reliability of the same "old" standards:

*« Absolute values of accommodation amplitude are based on data from old studies, and the reliability of these data has been questioned. Moreover, accommodative amplitude is assumed to be full-scale at a young age, and is frequently not examined. [...] Our findings suggest that poor readers show a lower than normal monocular accommodative amplitude and binocular accommodative facility. »*

Rather than arbitrarily condemning interventions as does the article, Alvarez-Palomo et al. suggest continuing research to analyze the impact of accommodative dysfunction (amplitude and flexibility) on struggling readers:

*« One clinical implication of these findings is that monocular accommodative amplitude and binocular accommodative facility should be assessed by an optometric clinician in children whose reading level is poor. However, more studies are needed to investigate the effects of accommodative treatments in young poor readers to determine whether these may improve reading performance [62]. »*

#### **Use of bifocals, convex lenses and reading efficiency**

Without quoting any references, the article mentions that optometrists use bifocals to offset accommodative weakness but fail to explain the basis of this clinical decision as if this practice was frivolous and arbitrary. Yet it is a useful practice and supported by the literature, in cases of accommodative problems (deficiency, spasms, poor flexibility) that coexist with vergence problems and with typical visual asthenopia. [28,33,40,64,75].

In the same vein, regarding the correction of AI, the article comments on an incomplete study of Abdi [76] on twelve children, normal readers probably, the majority of which improved their accommodative AA after treatment with the add of + 1.00 D and seven (7) improved their reading fluency. Abdi agreed that he was unable to establish a positive correlation between

improved AA and fluency of reading, but does not dismiss the idea that:

*« Accommodative insufficiency (AI) has been reported to be a common cause of asthenopia in schoolchildren between eight and 15 years of age. Asthenopia could be a significant handicap to learning as the symptoms are specifically related to near visual work [...]. The inability to concentrate for long periods during near visual work may create frustration, which might impede the learning process »*

Extrapolating the results of the study, the authors conclude falsely that there is no scientific evidence that increasing magnification increases the efficiency of reading. This assertion is nowhere in the article suggesting instead that a +1.00 add can improve the efficiency of reading, which would support other studies [41]. Abdi even says:

*“Despite the dispersed finding, the authors stress the importance of treating subjects with AI for reduced near visual problems to improve reading performance.”*

Finally, the article ignores all other accommodative type of problems such as difficulties of accommodative flexibility that affect the quality of BV and penalize both visual comfort and speed of visual decoding both at near and far [68,70], or those of a high accommodative lag that creates significant visual fatigue [65,77]. They also forget to mention accommodative spasm problems that create pseudomyopia in children of school age and who very often mask a problem of moderate latent hyperopia.

#### **About binocular vision**

BV in respect to ocular alignment skills and fusional vergence skills that involve both amplitude, ease and flexibility. These skills, however, can not be dissociated from the accommodative capacity or from refractive conditions that have significant impacts on their performance. Quaid [40] suggests that like many colleagues, optometrists add to the assessment a comprehensive review of BV and refraction under cycloplegia in children with DYS. Without these results, we can not conclude to the absence of significant visual abnormalities or to absence of a link with LD or LP. Several studies have confirmed significant differences in

convergence capabilities and fusional divergence [19,40] between children with LD and normal readers. It is the same with convergence insufficiency problems (CI) whose diagnosis is not limited to the simple measure of a nearpoint of convergence test [78,79].

We agree with the exhaustive list of reported symptoms that are related to CI. We are particularly pleased that the authors are joining us on CI threatening visual efficiency: *"[CI] can cause various symptoms of visual discomfort such as eyestrain, headaches, blurred vision reading diplopia in near vision, difficulty concentrating for long periods of work upwind, [...] As much difficulty that an accommodative convergence insufficiency can interfere with the comfort of reading."*

The article seeks once again to prove the absence of a link between visual function such as BV and DYS. Yet one of their sources confirms this time a specific link:

*"Here, we report a significant correlation between flicker threshold and binocular instability, thus linking sensory and motor visual correlates of dyslexia [80]."*

Also, some more recent studies show a link between academic success and the presence of these anomalies and their treatment [18,21,81,82,83,84]. Thus, Hoy, Shin et al. claimed in 2009:

*« Another major finding was the significant relationship between general binocular dysfunctions and academic achievement for primary school children. Children with both accommodative dysfunctions, and a combination of accommodative and vergence dysfunctions, had significantly lower academic scores in three out of four academic areas than the comparison group [81] »*

This supports what Granet already stated in 2005:

*« Non-strabismic accommodative and/or vergence dysfunctions were common among primary school children aged 9-13 years. In general, these binocular dysfunctions were significantly associated with impaired academic performance. [18] »*

The authors mainly rely on figures from the *«Joint Statement»* to establish the prevalence of CI: they suggest a prevalence of 3 to 5% of the population. According to other data, the prevalence of the CI would be much higher ranging from 7% to 25% depending on the definition and diagnostic criteria [8,85].

We are also very pleased that this article, although not considering an existent causal link, agrees this time: *"These vision problems should be treated if they are recognized as problematic according to the criteria for the general population. Therefore, the treatment of convergence insufficiency can help in the comfort of reading and near vision work by allowing easier prolonged reading."* Paradoxically, however, they say in the same breath that if the reading difficulties are secondary to abnormal accommodation or convergence, treatment of the problem will improve reading skills and comprehension except for the DYS; as if these problems could not be concurrent or could not exacerbate symptoms of DYS! No research is quoted in support of that denial, although our research of the literature, as we have stated above, has led us to conclude the matter differently. A quote from Granet again who positively considers the treatment of accommodative anomalies, for instance:

*« Because visual skills, especially accommodative functions, are closely related to academic achievement, it is conceivable that improving these visual skills will have positive impacts on children school performance.[18] »*

Quaid, like other authors [20] adds to the importance of treating BV anomalies considering the consistency of many symptoms between IC and ADD / ADHD:

*"When one also looks at research confirming an overlap in symptoms between attentional disorders and binocular vision dysfunction, the importance of detecting and treating binocular vision dysfunction again becomes apparent. It should be noted that five out of the nine DSM-IV criteria for ADHD overlap with the symptoms of convergence insufficiency"[40]*

The article finishes off the theme of BV on an unreferenced and unsupported assertion that comes, like many other statements, from free hand translation of

the «*Joint Statement*» of the American Academy of Ophthalmologists and that of pediatric ophthalmologists.

*« Many children with reading disabilities enjoy playing video games, including handheld games, for prolonged periods. **Playing video games requires concentration, visual perception, visual processing, eye movements, and eye-hand coordination.** Convergence and accommodation are also required for handheld games. Thus, if visual deficits were a major cause of reading disabilities, children with such disabilities would reject this vision intensive activity. [86] »*

Obviously we cannot agree to such generalities that are not worthy of serious scientific thinking. The authors and their sources do not reflect the major differences between video games and reading. Never mind the psychological elements linked to pleasure and challenge of the game and retain the various distances and stimulants items related to the color of the targets and the constant movement of the images to the fact that these targets do not appeal to the lexical or phonological decoding. We are confident that the reader might lengthen somewhat the list.

We must still emphasize that the authors, as their ophthalmological and pediatric sources accept that different visual perception and visual-motor skills useful in the processing of visual information are involved in video games and reading. In a way that we find rather amusing, Franceschini et al [87] also commented on this claim about DYS and video games. In an article published in 2013, they report that the practice of video games improves reading skills more than the traditional reading treatments.

*« However, it has been shown that playing action video games improves reading skills of dyslexic children more than traditional reading treatments, possibly because action video games improve attentional abilities.»*

Finally, could the practice of various visual motor skills, perception and visual information processing skills via video games be the key to success in the treatment of LP and LD?

### About lenses and colored filters

Although in Quebec, optometrists have paid little attention to the color filters for a lack of scientific evidence and are not, so to speak, versed on this topic, but the article concludes that the use of colored filters in DYS is not justified clinically because of a lack of consensus on their effectiveness. Before discussing the filters themselves, it would have been interesting that the authors first explain the theory underlying their use, namely the possible existence of a visual stress disorder with specific symptoms. The color filters are used to relieve symptoms and allow better visual attention. We would not make the assertion that these would be used to "treat DYS". We do not settle here the basic theoretical issues, but rather question the final recommendation of the authors.

In a recent article in July 2014 [88], Uccula et al, list the many articles and studies that demonstrate the extent to which this subject has yet to be investigated, both theoretically as to the existence of the syndrome itself and also clinically as to the value of the means (color filters) to reduce the symptoms. For some, since it is still being investigated, this means that we are navigating in full controversy, while for others it means that the subject is of definite interest and we should learn to understand and use better. Question of perspective and perhaps also of interest that will have one lean in one direction or the other.

### About prisms

The functional approach of optometry promotes visual rehabilitation treatment addressing both the problem phoria, fusional reserves useful to compensate for it and other visual components involved as accommodation, flexibility of vergences and spatial localization to name a few. A measurement of heterophoria can not be considered in isolation in the visual analysis of a patient. The American Association of Optometrists aptly describes the desirable approach in its various clinical guidelines "[8,9,89].

The article reports a phoria correction technique consisting in prescribing the full the amount of prism corresponding to the measured deviation. They quote 2 studies by the same author dating back 1992 and 1993, which seems a very thin literature review and on the other hand does not match the reality of clinical practice, whether the clinician provides vision therapy or not. We

have identified recent literature that rather advocates the use of successful rehabilitation techniques, with which we agree [63,90,91]. One ophthalmologist, Abdi, seems to refer to the use of prisms in the treatment of heterophoria and visual exercises for convergence problems. [92] He reported the elimination of visual symptoms.

In vision therapy and visual rehabilitation, prisms can be used in many ways in conjunction with visual exercises for the treatment of BV problems. They are not used to directly address a problem of LD or LP, but to improve a problematic visual condition. They can be used sparingly in the initial phase of treatment to reduce demand on the BV or at the end of therapy if there are persistent visual symptoms [93]. They can also be recommended when the visual rehabilitation is impossible, either because of poor cooperation, lack of motivation or age of patient.

## Preliminary discussions

Ophthalmologist Olitsky explains very well the medical position taken by the authors to discredit the involvement of optometrists in monitoring children with LD and LP:

*« Because current available evidence has failed to implicate visual disorders as a cause of reading problems, and because no scientific evidence validates vision therapy as a way of treating these problems, the Academy of Pediatrics, the American Academy of Ophthalmology, and the American Association for Pediatric Ophthalmology and Strabismus do not recognize vision therapy as a treatment option for reading disorders [58] »*

Any disagreement between ophthalmologists and optometrists rise from misinterpretations of the former about the work of the later, as triggered by their wrong premise. Having never claimed that vision and vision problems cause DYS, we assert loud and clear that vision and its various anomalies can be extensively involved in some learning difficulties. We understand the words of Langis Michaud who goes further by saying that:

*"Visual tests should be included in the multidisciplinary approach to learning problems because they can be the cause, or more often add to other deficient*

*psychological functions, multiplying the symptoms and hamper the individual in their learning. "[15]*

For example, here is an excerpt from a text of the American Academy of Optometry for educators and parents [94]:

*« Vision problems can affect students with learning disabilities, language-based dyslexia, or ADHD as well as students without these conditions. Students with learning, reading, or attention problems typically have several factors that impact school performance. Vision problems may be one of these factors and should be treated in these students. Treatment of the vision condition is not intended to cure the learning disability, ADHD, or dyslexia. Instead, the treatment is designed to remove obstacles to efficient learning »*

In joint statement of AAO and AOA, the American Association of Optometrists and the American Academy [4] state:

*« The goal of optometric intervention is to improve visual function and alleviate associated signs and symptoms ».*

## Preliminary conclusion

Overall, it seems to us that the authors of this article have resorted to a biased and incomplete review of the literature, not using it faithfully in order to discredit a professional field of practice, the basis and goals of which they don't seem to grasp at all. Clearly, the authors want to exclude optometrists from a multidisciplinary field of intervention for children with learning difficulties on the pretext that some of these children suffer from original DYS probably phonological. They hide the whole issue of comorbidity and that of visual inefficiency related to many abnormalities in the visual process. According to them, visual therapies that treat symptomatic vision anomalies can not in any case have a positive influence on the academic performance of a child.

(1) The article claims that children with a learning disability are not more likely to be affected by

visual problems than the pediatric population in general. This statement is false and denied by many studies.

- (2) The article relies on the fact that visual problems are not the cause of the DYS (which is not disputed) and then discredit the idea of treating visual problems in children affected by the DYS, LD and LP. Even if it were true that visual dysfunctions are not the cause of the disorder in question, it is clear that they can seriously hamper children's learning when they are found in comorbidity. Would they deny the optometrist any role, as any possibility to treat any visual problem found? What nonsense!

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