Binocularity, Productivity and Learning:

The Link Between Alignment and Reading Speed

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On behalf of Vision Expo, we sincerely thank you for being with us this year.

Vision Expo Has Gone Green!

We have eliminated all paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended! Your feedback is important to us as our Education Planning Committee considers content and speakers for future meetings to provide you with the best education possible.

Dr. Montecalvo

- 35 years of specialized certification in optometric vision therapy
- Highly sought-after practitioner, lecturer and author
- Past-President of the Ohio Optometric Association and Neuro-Optometric Rehabilitation Association, Past-Chair of the AOA Vision Rehabilitation Section
- Instructor of The Vision Aces Academy and Author of ***Visual Secrets for School Success***

Disclosures

- Neurolens Advisory Board member
- Committee member for AOA InfantSEE
- AOA Vision Therapy Task Force
- All financial relationships have been mitigated

Binocularity & Visual Health

Binocular Conflict

- Eyestrain
- Blur
- Diplopia
- Fatigue
- Light sensitive
- Headaches

Patients are more symptomatic than ever.

Convergence Insufficiency and weak positive fusional reserve at near has a significant effect on academic performance.

Descriptive cross-sectional study-Qassim University, May 2018.

- Good vision and binocularity are important for achieving high academic performance.
- Students with good vision and binocularity perform better in learning.
- Therefore, good visual functions are cornerstone for students in all learning stages to achieve good academic performances.

Scheiman M, Rouse MW. Optometric management of learning-related vision problems. Elsevier Health Sciences; 2006.

Not Only A Problem for Students…

Millions of adults are suffering from binocular problems.

Patients are more symptomatic than ever

Average screen time up to **13+** hours per day*

94% of eye doctors are concerned

78% of employers are concerned

Increasing stress and strain for adults and kids

Patients don't realize ECPs can help

"People report more headaches and migraines during Covid-19."

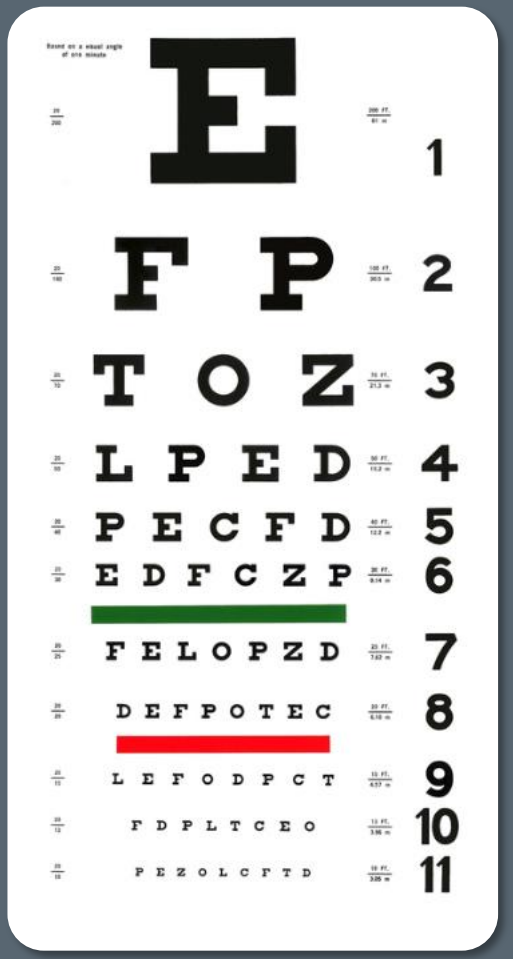
-Forbes, March 2, 2021

*Eyesafe, 2020, https://eyesafe.com/covid-19-screen-time-spike-to-over-13-hours-per-day

Shin Related Symptoms Binocularity to Performance

He found a significant relationship between symptomatic children with binocular vision problems and their scores in every academic area (reading, mathematics, social science, and science).

Also the study to assess the effect of distance visual acuity on the academic achievements of children, concluded that the distance visual acuity did not play a significant role in predicting school performance



Addressing an Epidemic

80% of adults experience the painful symptoms of eye misalignment:

- Headaches
- Eye Strain
- Neck & Shoulder Pain
- Motion Sickness
- Dry Eye Sensation
- Light Sensitivity

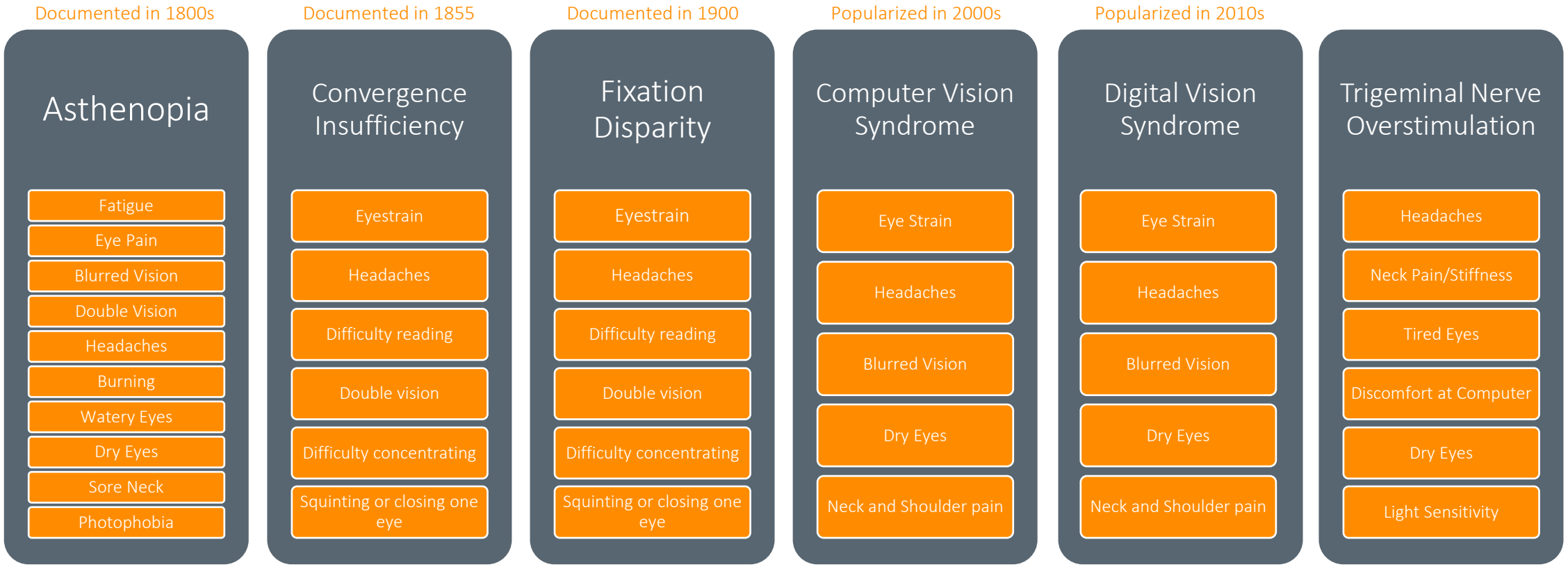
YET ONLY 1 out of 10

report their symptoms to their Eye Doctor.

Vision Council Report, 2022

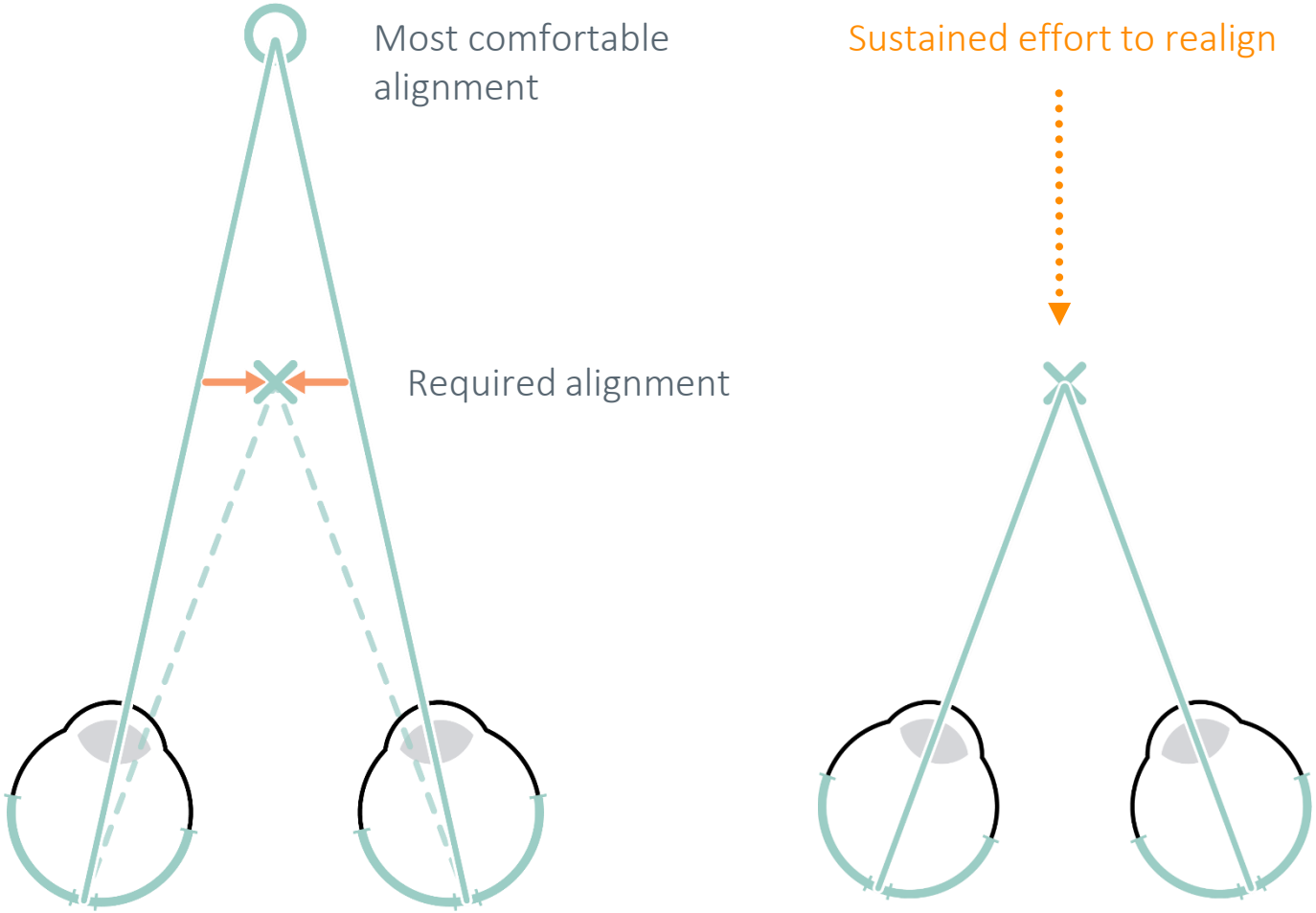
Vision Council Report, 2022

A Big Problem with Many Names



Neurological Mechanism of Trigeminal Nerve Pain

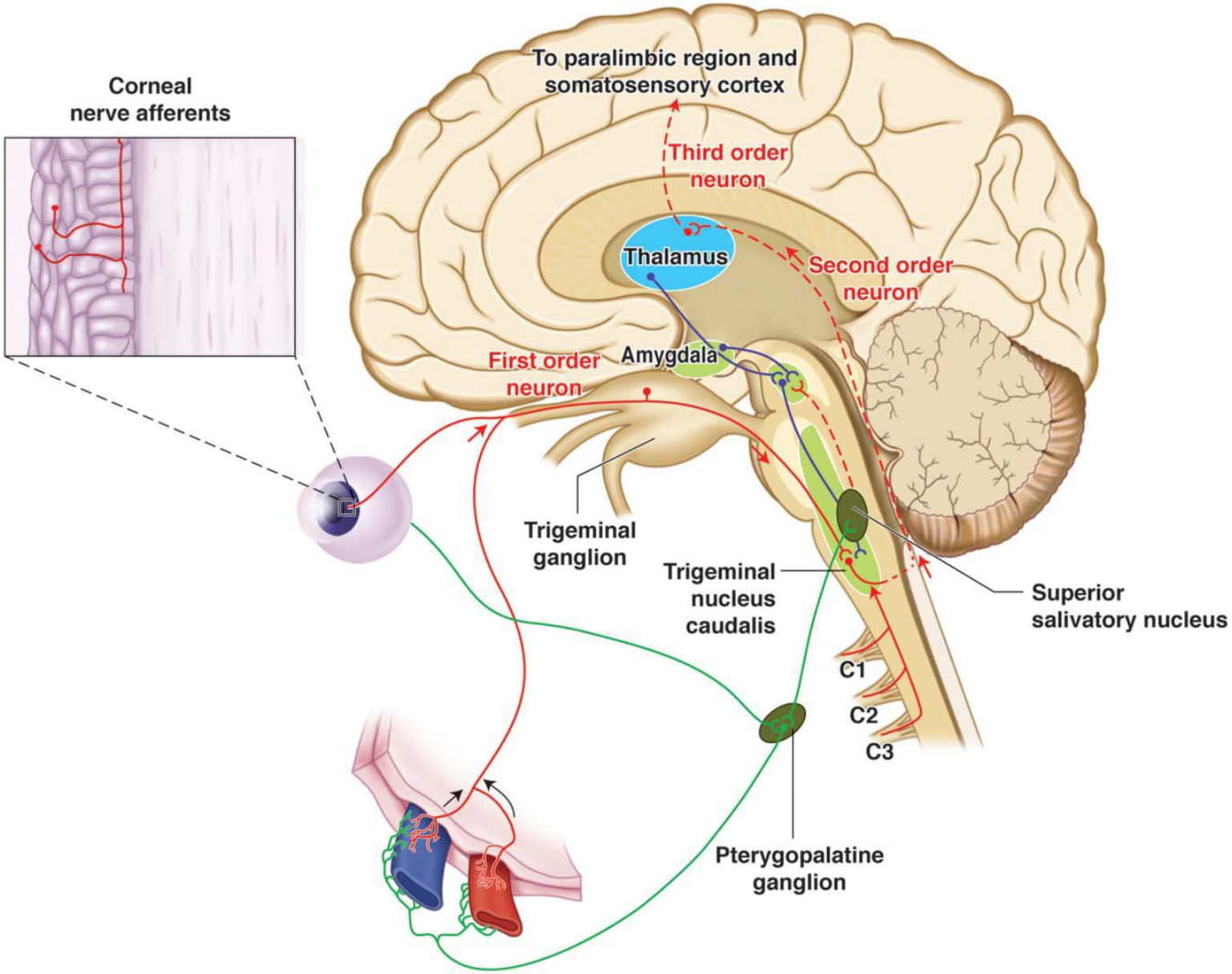
Misalignment → Compensation → Impacts



Symptoms, such as headaches, neck pain, eye strain, dry eye sensation and motion sickness

Loss of visual clarity, sharpness

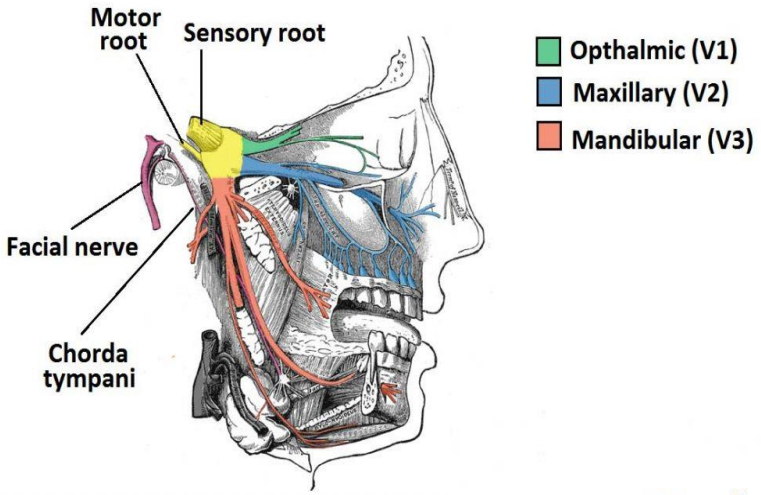
Impact to reading and other visual activities

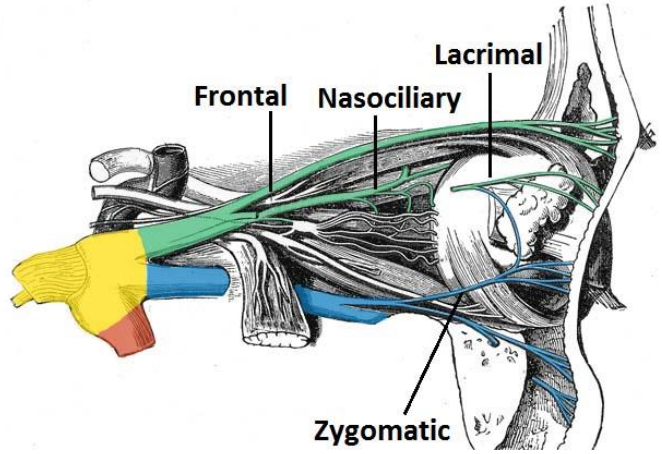


Digre K. A Case-Based Guide to Eye Pain: Perspectives From Ophthalmology and Neurology. New York, NY: Springer, 2018.

J Neuro-Ophthalmol 2018; 38: 237-243

Innervation of the Trigeminal Nerve





The ophthalmic division of trigeminal nerve provides sensory innervation to the following structures:

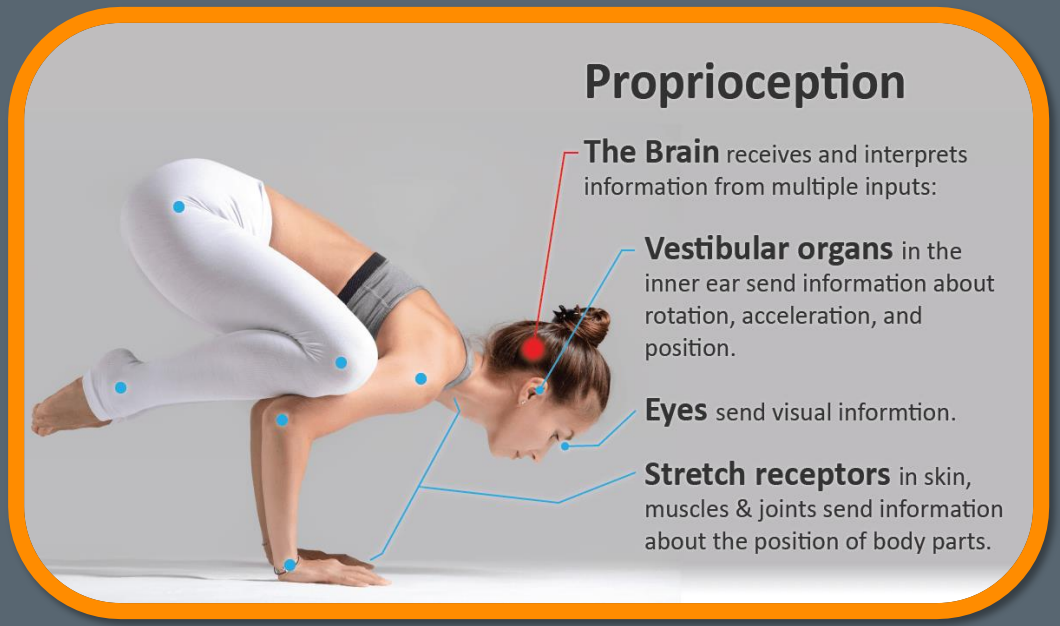
- **Forehead and scalp**
- Frontal, ethmoid and sphenoid sinuses
- Upper eyelid and its conjunctiva
- **Cornea**
- Dorsum of the nose
- **Lacrimal gland**

What is Proprioception?

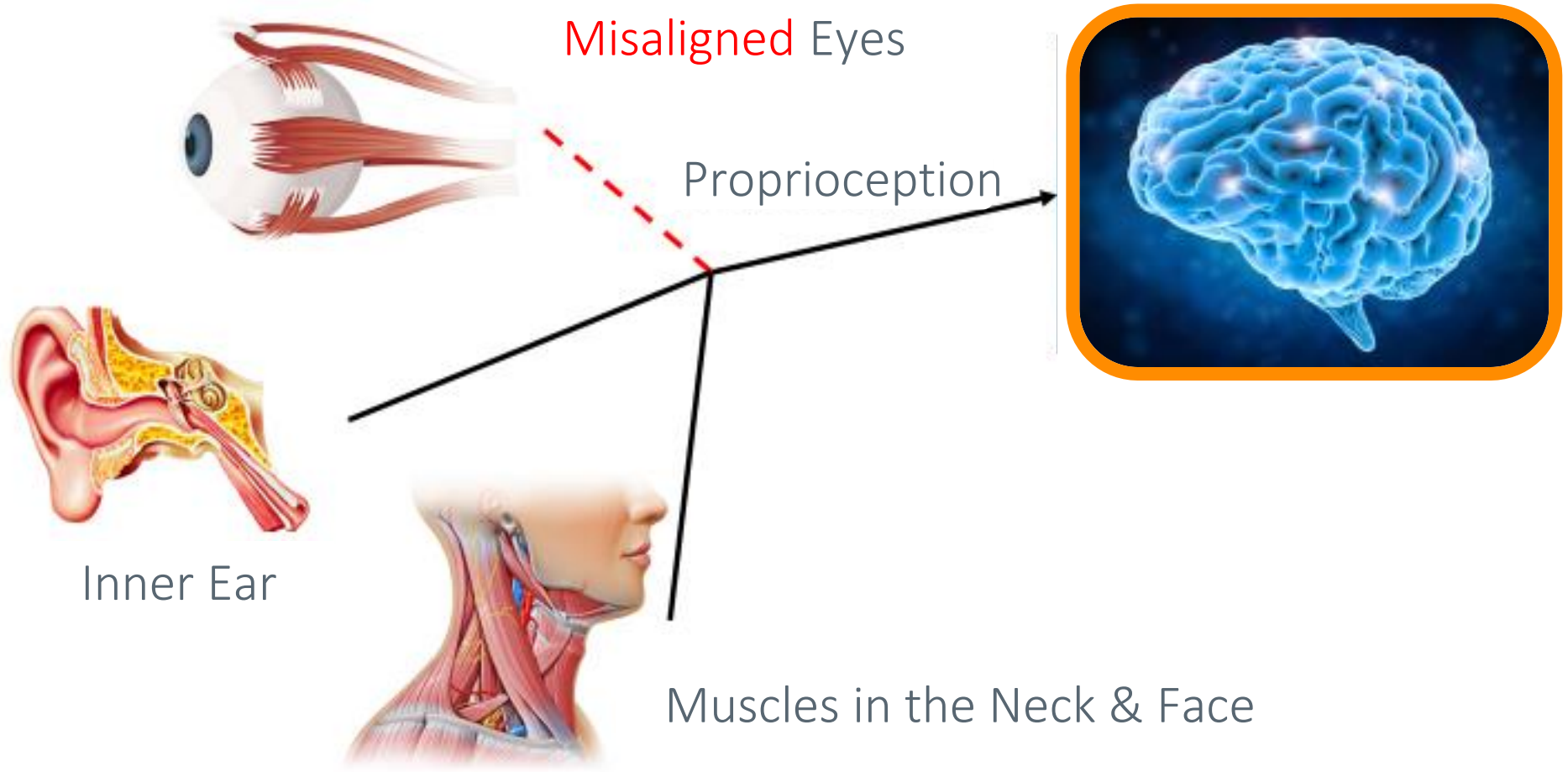
It is the sense of self-motion, force and body position in real world

It is essential for motor coordination of the body

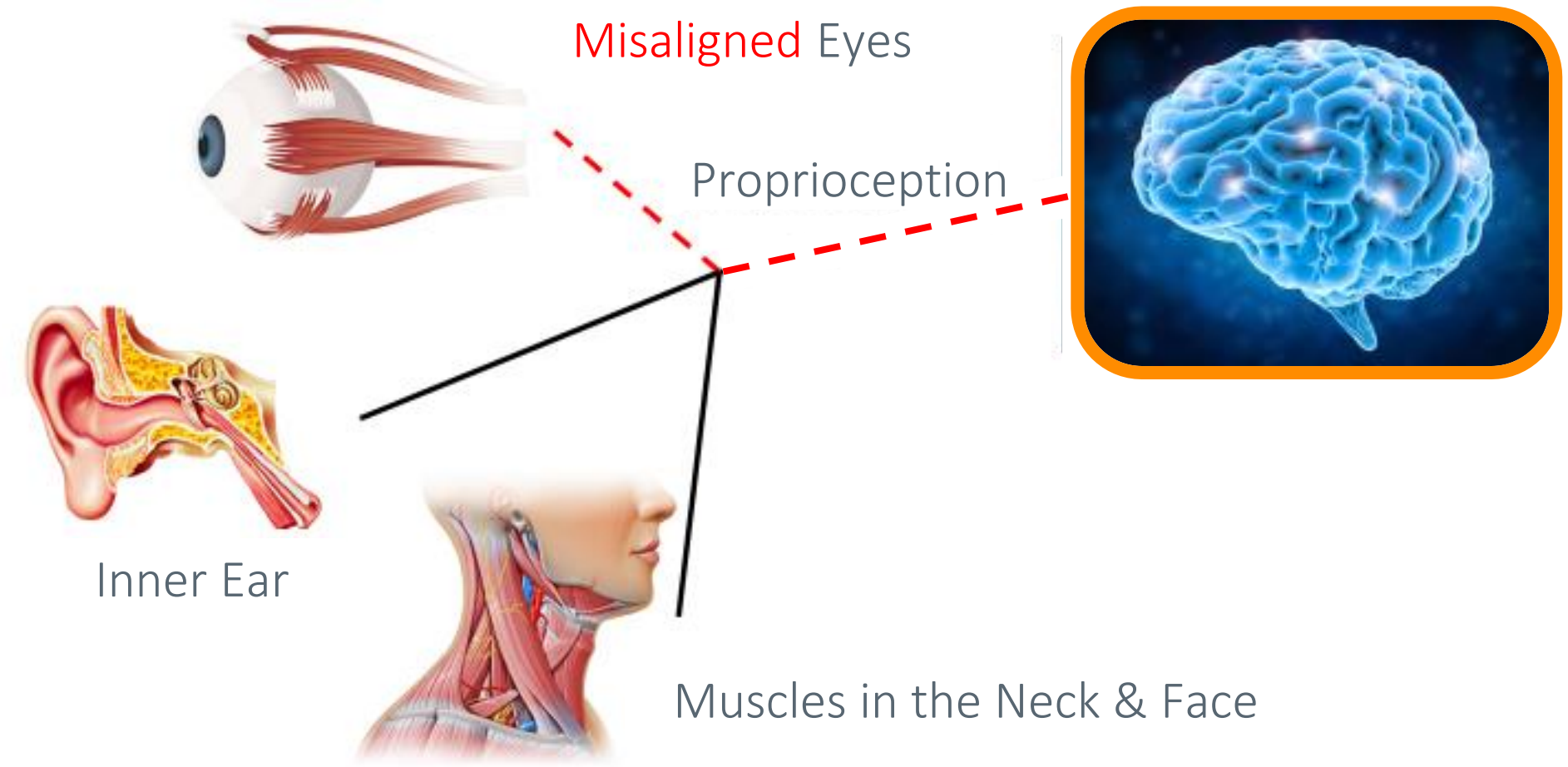
Accurate eye movements in different gazes to foveate the object of interest



Proprioception (Neural Conflict)

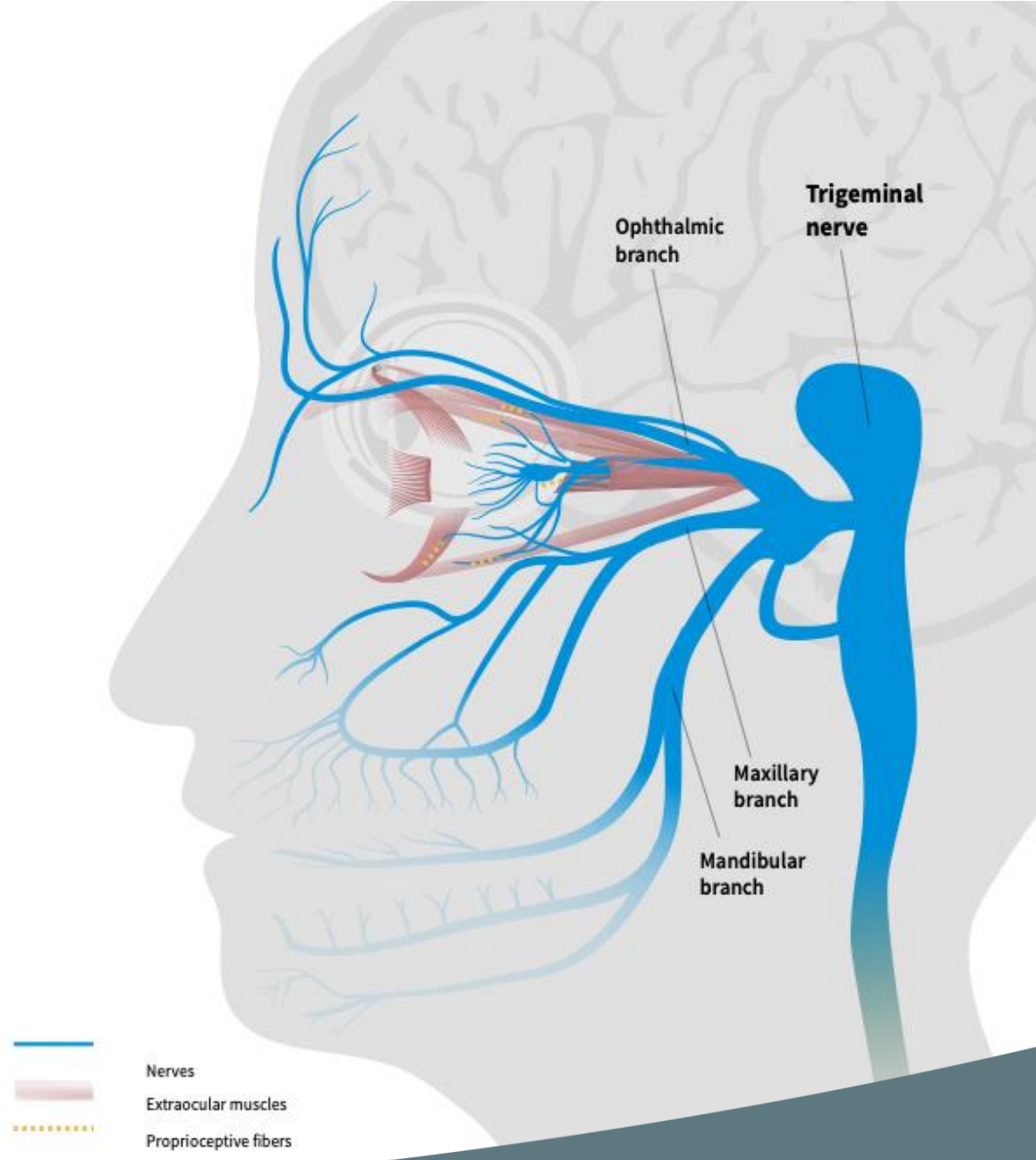


Misaligned Eyes (Neural Conflict)



Summary Impact

- Proprioceptive fibers innervating the extraocular muscles provide afferent feedback to the brain about the location of each eye.
- This feedback is required to avoid binocular misalignments.
- These proprioceptive signals are transmitted through the ophthalmic branch of the trigeminal nerve, which is responsible for detecting sensation and reporting pain.
- It appears that these signals play a large role in the stimulation of the trigeminal nerve, resulting in symptoms associated with this overstimulation.



American Optometric Association (AOA Clinical Care Group). The Effects of Computer Use on Eye Health and Vision. April 1997.
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Weir, C., Journal of Neuro-Ophthalmology. Proprioception in Extraocular Muscles. Vol. 26, No. 2. 2006.
The Vision Council. Digital Eye Strain. Accessed April 2018.
J Neuro-Ophthalmol 2018; 38: 237-243

Resulting Symptoms

- Headache and neck pain
- Constant pressure or ache
- Dry eye sensation
- Fatigue
- Light sensitive
- Worse with increased usage of digital devices

Clinically Addressing Binocular Vision Disorders

ORIGINAL ARTICLE

Effect of Binocular Vision Problems on Childhood Academic Performance and Teachers' Perspectives

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ABSTRACT

Purpose: To see the effect of binocular vision problems on childhood academic performance and to record the teacher's perspectives about childhood eye care in Khartoum State of Sudan.

Place and Duration of Study: A descriptive cross-sectional study done among the school going children in the Khartoum State of Sudan from February to May, 2018.

Study Design: Descriptive cross sectional study.

Material and Methods: Three hundred and forty (340) primary school children were recruited for study by convenient sampling technique during the academic year 2018. After relevant history, ocular examination was performed. It included visual acuity measurement, assessment of refractive errors and binocular function tests. Academic performance of the children was recorded from academic records of the children. Finally, the qualitative data was derived from teachers' perspectives about childhood eye care.

Results: Mean age of the participants was 11.96 ± 1.63 years. The findings revealed that (78.6%) of children achieved poor academic performances with decompensated exophoria at near. 52.7% children with poor academic performances had weak positive fusion reserve at near P = 0.04. 37.2% of the poor performers had convergence insufficiency. Forty-eight percent of females with ocular complaints achieved poor academic performances P = 0.034. With regard to teacher's perspectives about childhood eye care, 98.8%believed that the vision problems had effect on the academic record of the children. Seventy percent of the teachers reported that the students did not undergo eye examinations before joining school.

Conclusion: Convergence Insufficiency and weak positive fusional reserve at near has a significant effect on academic performances.

Key Words: Convergence Insufficiency, Binocular vision, Exophoria.

How to Cite this Article: Alrasheed SH, Elmadina AEM. The Effect of Binocular Vision Problems on Childhood Academic Performance and Teachers' Perspectives. Pak J Ophthalmol. 2020, **36 (2):** 163-168.
Doi: 10.36351/pjo.v36i2.896

INTRODUCTION

Childhood vision problems are different in nature and severity, ranging from mild refractive errors to binocular anomalies and vision impairment. Many vision problems lead to a variety of symptoms that greatly affect skills of learning[1]. The most common vision problems are uncorrected refractive errors that impair vision at distance (myopia) or at near (hypermetropia); these are often treatable with spectacles or contact lenses. Other important vision problems include astigmatism, strabismus (latent or manifest), amblyopia (lazy eye), problems with

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Poll: When do you prescribe prism?

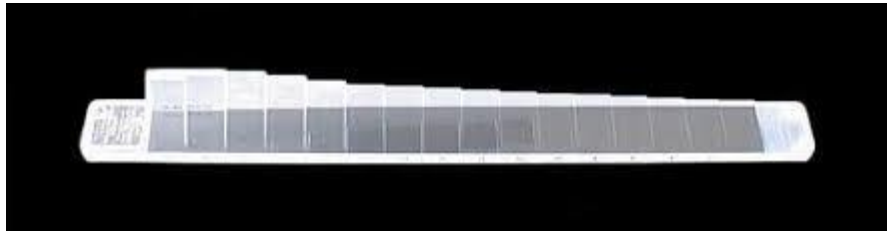
1. Mostly when patients have diplopic complaints or issues
2. If the patient complains and I measure large amounts of phoria
3. Only if they have a vertical imbalance and have matching complaints
4. Sometimes if they have headaches, and I think their eyes are a contributing factor
5. Never

Poll: Why isn't prism prescribed more?

1. Prism can be addictive and can cause prism creep
2. I don't see the need for my patient base
3. Prescribing prism is guesswork: sometimes it works, sometimes it doesn't
4. Prescribing prism is problematic and complicated
5. I love prism and prescribe it to many of my patients

Common methods to measure and calculate Prism

- Cover test
- Phorias
- Fixation Disparity
- Percival's Criteria
- Sheard’s Criteria
- Maddox Rod
- Loose prism trials



Emerging Technologies

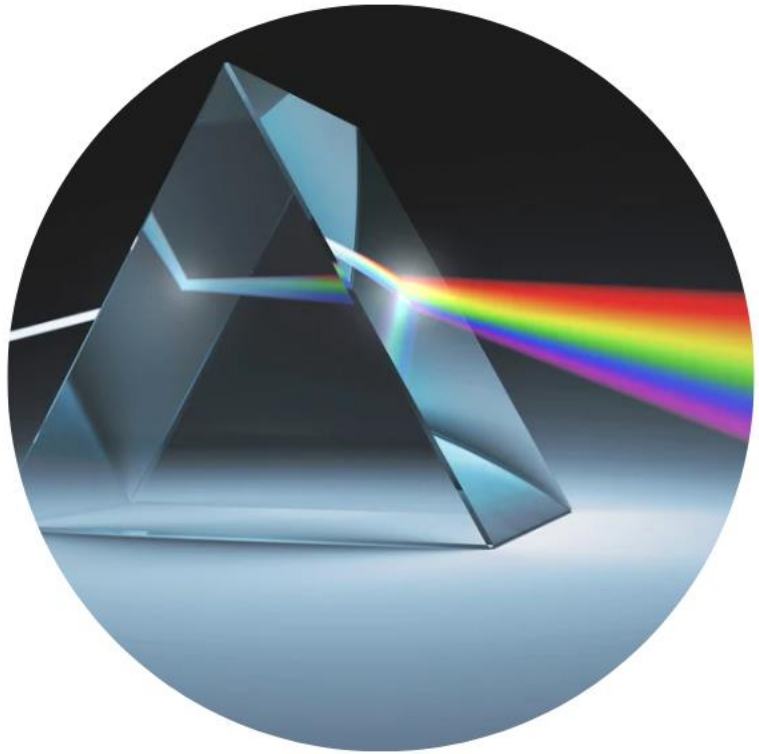
Real-time measurement of Binocular Vision, considering:

- Heterophoria
- Vergence conditioning
- Binocular peripheral fusion
- Fixation disparity
- Accommodative convergence response
- Alternating monocular central fixation

Peripheral and central vision measured at both near (50 centimeters) and far (6 meters, simulating optical infinity).

Prism Relieves Symptoms

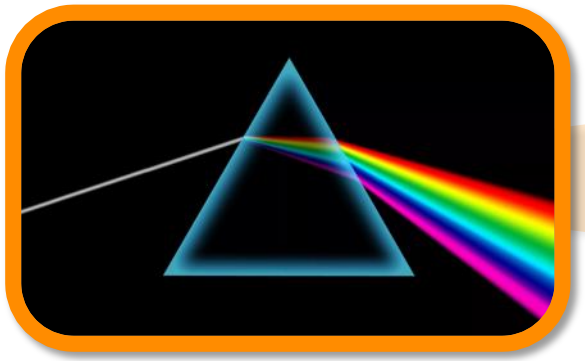
The base-in prism reduced symptoms in young adults with convergence insufficiency.



Nabovati, Ophthalmic Physiol Opt Jan. 2020

The Evolution of Prism

Standard Prism



Slab-off Prism

Contoured Prism

90% of people have a larger misalignment at near, so linear prism simply doesn't make sense for today's wearer.

Chronic Headache Study

93%

of patients have had a positive response to wearing contoured prism

82%

of patients suffering from chronic daily headaches reported their symptoms were substantially reduced or “basically gone” after wearing contoured prism for 90 days.

Miles, C, Krall, J, Thompson, V, Colvard, M. A New Treatment for Refractory Chronic Daily Headache; MD Neurology HA Clinic (n=179)

Contoured Prism Specificity

Can small prism corrections improve visual comfort? Yes! Here is why.

Vivek Labhishetty BSc Optometry, MSc, PhD

Background

DVS is an emerging public health concern where individuals experience a wide range of symptoms including headaches, eye strain, dry eye sensation and neck pain while navigating through their digital lives. Predictably, a growing trend in digital usage in the modern age has led to a steep acceleration of associated DVS symptomology (Rosenfield, 2016); therefore, it is critical to understand, measure and treat this problem appropriately. DVS could be caused by both ocular and extraocular anomalies. While ocular anomalies include uncorrected refractive errors, eye misalignments or dry eyes, extraocular anomalies include muscle strains due to compensating postural changes. Uncorrected refractive errors are typically corrected using prescription lenses, dry eyes are treated with therapeutics, and compensating postural habits are corrected by employing occupational therapy or better ergonomic habits.

An often-overlooked cause of DVS related symptomology is binocular vision disorders (BVD); for example, convergence insufficiency, where the patient typically presents with an eye misalignment (large exophoria at near compared to distance) coupled with other clinical signs such as reduction in near point of convergence (NPC). Typical treatment options for BVD involve prescription lenses, prisms or vision therapy (Scheiman et al., 2008). Lenses—especially plus lenses—are not commonly employed and are reserved for patients with heterophoria associated with a high AC/A. Prescription prism glasses, with horizontal and vertical relieving prisms, are offered to either patients with large phoria or in conjunction with vision therapy. The prism value prescribed is often based on fixation disparity analysis, Sheard's criterion or Percival's criterion. These glasses provide a constant prism correction to patients at all distances even though patients often present with varying amounts of misalignment at different distances.

Vision therapy is another commonly employed option for treating eye misalignment. The time course of the therapy and the treatment modality are decided based on the clinical (optometric) findings. The therapy, however, does not provide instant relief and is heavily reliant on the compliance of the patient over an extensive time course. Clinicians typically prescribe these treatment options only to symptomatic patients with large phoria. Clinicians tend to overlook patients with a smaller phoria and instead look for other causes for DVS.

There are several reasons why symptomatic patients with smaller phoria are not prescribed prisms or other corrective modalities to treat eye misalignments. One of the primary reasons is the inability to accurately measure smaller eye misalignments. As a result, only patients with a larger phoric posture are diagnosed and treated while individuals who could benefit from small prismatic corrections (less than 2PD) are overlooked. Clinicians have been testing phorias and fixation disparity subjectively for almost a century now, but it has been virtually impossible to accurately test prism in small increments of 0.10 PD for patients until the advent of the neurolens Measurement Device (nMD) in 2018. There is a need to recognize the functionality and application of small prism correction. This paper will demonstrate how prescribing small amounts of horizontal prism (less than 2PD) can relieve symptoms commonly related to DVS. So, what do we know about the relationship between small eye misalignments and DVS symptoms?

Eye Misalignment and the Severity of Symptomology

One of the common misconceptions with binocular vision disorders is that symptomatic patients tend to exhibit large phoria or fixation disparity coupled with other clinical signs. The assumption is that these large eye misalignments reflect a breakdown of the binocular vision system, especially the accommodation (focusing) and vergence (aligning) mechanisms. However, several studies have consistently reported evidence contrary to this belief.

1

No correlation between amount of misalignment and severity of symptoms. A patient with 1PD exophoria and a patient with 10PD exophoria could experience same severity of symptoms.

Small horizontal prism corrections (< 1PD) can provide significant relief in symptomatic patients.

Subjective clinical diagnostic tools limit our ability to accurately detect small eye misalignments.

Contoured Prism Stability vs. Linear Prism

After their first follow up at least one year after initial prescription, the average change in prism for Neurolens patients was less than 1/3 PD.

- *45% had no change at all.*

After their second follow up at least one year after the first follow up, the average change in prism was much lower (about 1/10th PD).

- *Almost 60% had no change at all.*

Prism Adaptation with Neurolens

Vivek Labhishetty BSc Optometry, MSc, PhD

Highlights

- Patients with no binocular vision dysfunction generally adapt to prisms, as they have a normally functioning vergence mechanism.
- Patients who are symptomatic are less likely to adapt to prism and will benefit from a prism correction.
- 6 out of 10 Neurolens wearers did not show any significant sign of prism adaptation.
- The mean change in the Neurolens prism prescription was less than 1/3rd of a prism diopter over time and the stability of the Neurolens prism prescription improved over time.

Abstract

An alignment response to an object of interest in the real world comprises of outputs from two components of the vergence mechanism, a fast (reflex) and a slow (adaptive) responding controller which have different temporal characteristics. Previous studies have reported that the strength/magnitude of the response of this slow adaptive component often correlates with the presence of symptomology in patients with binocular vision dysfunction (BVD). Patients with no binocular vision dysfunction generally adapt to prisms, as these patients tend not to be symptomatic and have a normally functioning vergence mechanism. However, patients who are symptomatic are less likely to adapt to prism and will benefit from a prism correction. The combination of inconsistent clinical practices, inability to accurately measure and represent patients' symptoms, and variability in the individual's ability to adapt to a prism would leave the clinician with a lot of unanswered questions which make them hesitant to prescribe a prismatic correction to their patient. The Neurolens process provides a simple, accurate and repeatable way to assess an individual's binocular vision which would ultimately help the clinician treat and diagnose that patient's condition with confidence. 6 out of 10 Neurolens wearers did not show any clinically significant sign of adaptation to a Neurolens correction. This is significantly lower than the adaptation frequency reported with standard prisms in the previous study (80%) implying that the Neurolens process is more stable and effective than a standard prismatic correction calculated based on the traditional prescribing guidelines. The mean change in the prism prescription was less than 1/3rd of a prism diopter over time and the stability of the prism prescription improved over time.

Vergence Mechanism and Prism Corrections

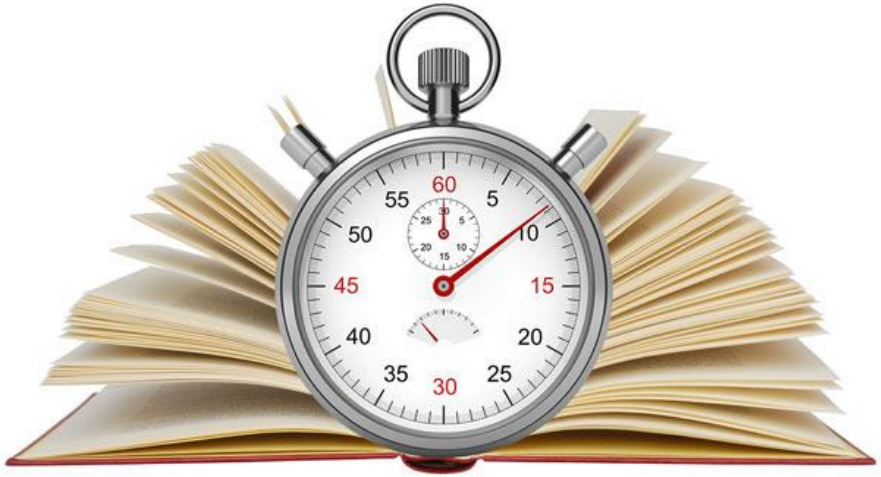
Optical prisms are one of the most commonly employed treatment modalities to correct binocular (vergence) dysfunctions involving eye misalignments, including heterophorias, fixation disparities and tropias. There is an inter-clinician variability in prism prescribing guidelines which is driven by factors such as clinicians' opinion or knowledge on prism corrections and binocular vision. There is anecdotal clinical evidence on the efficacy of prism treatment on patients with various binocular dysfunctions. Some clinicians also argue that prism corrections are not good given an individual's ability to adapt to prism corrections. This lack of consensus is coupled with a lack of evidence-based clinical standards on how to effectively use prisms to correct binocular dysfunctions[1]. There are three main reasons why a prism correction tends to be unstable: (i) individual differences in a person's innate ability to adapt to a prism; (ii) presence of a latent eye misalignment that may not have been detected during the initial eye examination; and (iii) our inability to measure an accurate and repeatable clinical parameter that assesses the vergence mechanism and consistently represents the symptomatology experienced by the patient.

The vergence system is unique, in terms of its cross-coupled relationship with the accommodative mechanism and its ability to adapt naturally. Broadly speaking, an alignment response to a stimulus in the real world comprises of outputs from two components of the vergence mechanism: a fast (reflex) and a slow (adaptive) responding controller.

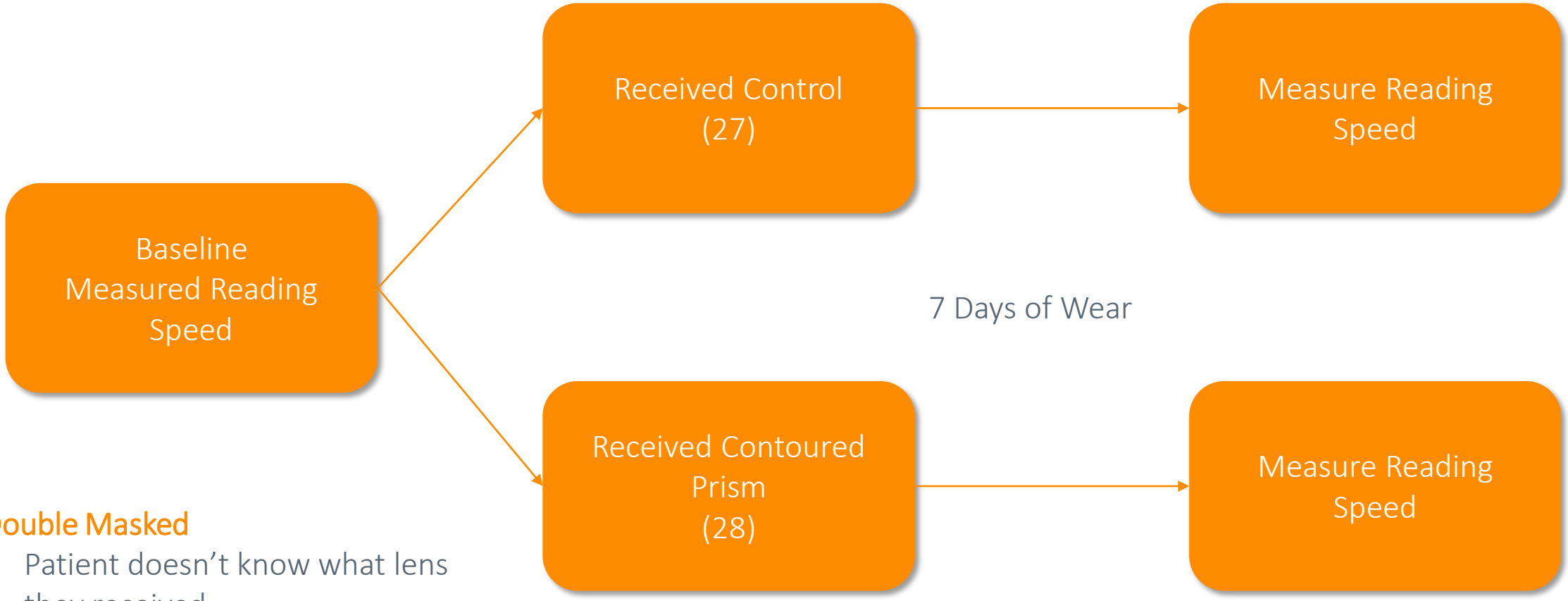
Binocularity & Productivity

Study Parameters

- Parallel arm study
- N=55 (Combined)
- Evaluate reading speed at baseline and after seven days of lens wear



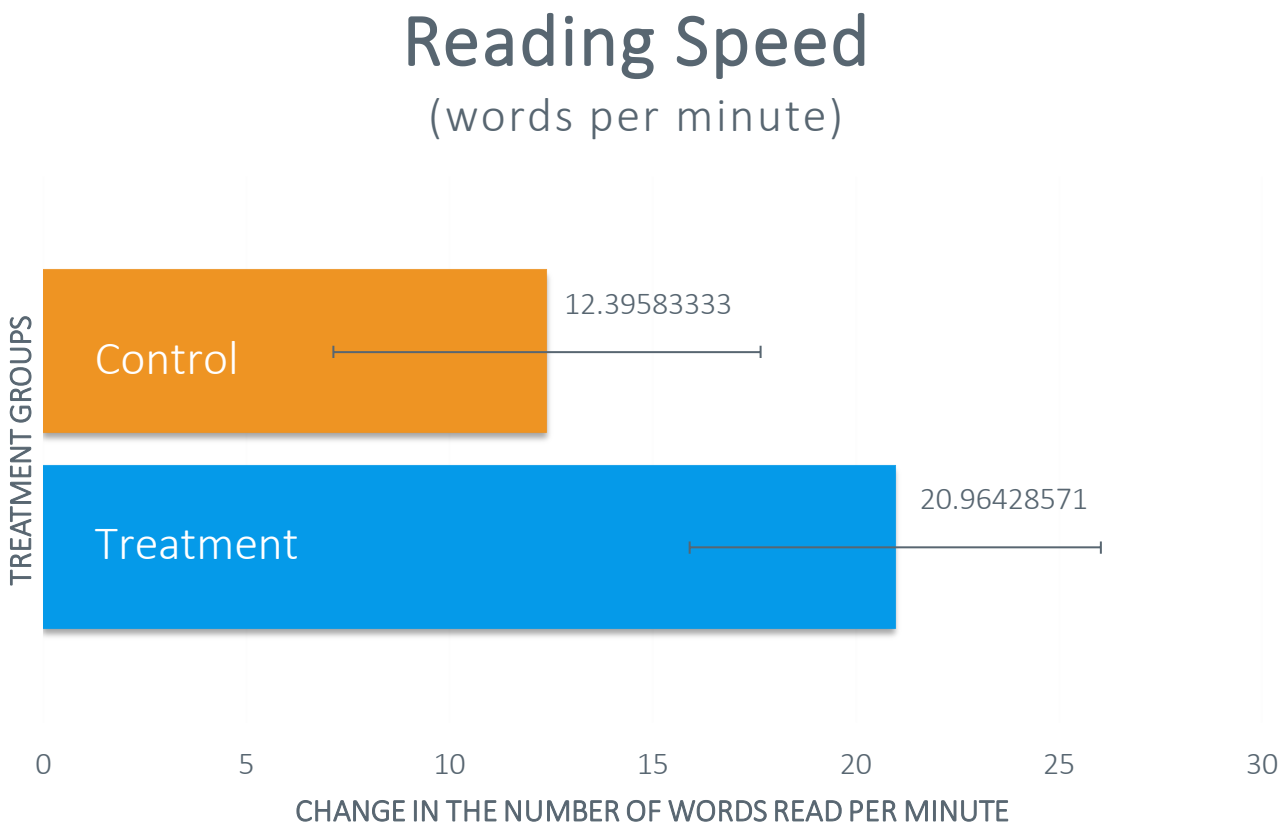
Study Design



Double Masked

- Patient doesn't know what lens they received
- Test administrator doesn't know what lens they received

Contoured Prism Improves Reading Speed



Control +12.39 words per minute,
Treatment +20.96 words per minute
(70% higher)

Statistically significant

- F = 4.45
- p = 0.03)

Case Study: Sara 63 yo female

Hx: Headaches for over a year, dry eye, currently in monovision Cl
Referred by neurologist

Rx:	OD: -2.25 -2.75 x 090	3 EP @ 6 M	1pd BD OS
	OS: -3.75 -2.75 x 090		
Add:	+2.25	10 xp	

NL value: 0.50 BI
CL for distance, Plano +2.25 add with NL

Progress check: 6 weeks
Hx: no HA, less problems with dry eye

In Summary

- BVDs are becoming more common & more disruptive for patients
- Proprioceptive conflict overstimulates the trigeminal nerve, leading to common symptoms such as headaches, neck pain and eye strain
- Contoured prism effective in relieving symptoms as a therapeutic offering
- Contoured prism improves reading speed 70% over standard lenses
- There are broad implications in productivity and learning


Questions?