

# Vision Enhancement

From Average Joes to the Pros

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## Understanding the Role of Vision in Athletics

- **Sight:** The clarity of the image on the retina and an intact retina
- **Motor:** pursuit & saccadic eye movements, accommodation, vergence and fusion
- **Information Processing:** quick interpretation and visual perceptual processing

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## Areas of Sports Vision

- Prevention/management of eye injury
- Refractive compensation
  - Spectacles vs Contact Lenses (CRT?) vs Refractive Surgery
- Assessment/remediation of functional visual inefficiencies
- Assessment of sport-specific visual abilities
- Enhancement Vision Training
- Consultation

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THREE PARTS

- Visual Task Analysis
- Visual Skills To Evaluate
- Visual Skills that are "Improvable"

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Eye Trauma vs Sports Vision Doctors

- Usually are mutually exclusive
- Vast majority of teams/programs only have an eye trauma doctor
- Almost all need both

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CSF

- Contrast Sensitivity was found to be a more important indicator of flight performance in fighter pilots than visual acuity

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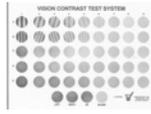
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### Visual Analysis

#### • Contrast Sensitivity Function

- Most use grating patterns
  - Vistech
  - Vectorvision
  - Multiple computer generated designs



[www.vistech.com](http://www.vistech.com)



[www.vectorvision.com](http://www.vectorvision.com)

- Want to assess binocularly with correction that is habitually worn during sport
  - If wearing CLs, should check monocular<sup>1</sup>

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### Literature Support

- The general results suggest elevated CSF across all spatial frequencies for athletes.
- It has been demonstrated that contact lenses can degrade CSF if the lenses are not optimal.
  - Be very specific about who fits your athletes with contact lenses
- CSF should also be assessed with any performance tints used for competition.

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### Visual "Correction"

#### • Prescribing (cont)

- Contact Lenses (CLs)
  - In general, I will primarily fit...
    - Daily disposables
    - Tighter fitting lenses
    - Low to moderate water content lenses
    - Multiple trials until I get optimum clarity and comfort
    - Possibly over-minus for sport



[www.daviddarling.info](http://www.daviddarling.info)

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### Filters and Lighting Variations

- Incandescent lighting
- Fluorescent lighting
- Sodium lighting
- Daylight (clear vs. cloudy)
- Outdoor night lighting

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### Filters and Performance Factors



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### VISUAL SKILLS THROUGH FILTERS

- Visual Acuities
- Refractive Status
- Contrast Sensitivity
- Dynamic VA



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VISUAL SKILLS  
THROUGH FILTERS

- Phorias & Vergences (stance & facility)
- Fixation Disparity
- Speed & Accuracy of Depth Perception



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VISUAL SKILLS  
THROUGH FILTERS

- Visual-Motor Reaction Time
- Eye-Hand Coordination



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VISUAL SKILLS  
THROUGH FILTERS

- Vision Anticipation Skills
- Speed of Recognition



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### FILTER TYPES & SPORTS

- **Polarizing filters**
  - Suppresses reflected light (horizontal)
  - Best with reflected glare (water, road surfaces)
  - Transmit a maximum of 50% (usually ~40%)
  - Act as neutral filters for unwanted reflections
  - Sports applications
    - \* Fishing, water sports, driving/cycling (wet surfaces)
    - \* May remove important details in skiing, golf, etc.

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### FILTER TYPES & SPORTS

- **Yellow range filters**
  - Transmits only longer wavelengths
  - Ocular media scatters short wavelength light more - improves contrast by eliminating some of this "internal glare"
  - May enhance contrast differences (contours)
  - Sports applications
    - \* Shooting sports, Snow sports, Driving, Flying
    - \* Blue backgrounds (tennis, baseball, golf, etc.)

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**FILTER TYPES & SPORTS**

- **Specialty filters - Mirror Coatings**
  - Limits glare and increases absorption
  - Reduces Infra-Red - reducing heat build-up
- Sports applications
  - \* Snow Sports
  - \* Water Sports
  - \* Cycling/Running

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**Performance Contact Lenses**

- Factors to consider:
  - Gaze positions (ex: upgaze for cyclists)
  - Speed of eye movements (re-orientation)
  - Length of competition
  - Environment (humidity, temperature, altitude, debris, wind, UV exposure)
  - Replacement possibilities
  - Tint possibilities

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**NIKE MAXSIGHT Sport-Tinted Contact Lenses**



*Tomorrow's New Tool for Peak Visual Performance ...  
MaxSight - Ultimate Performance Eyewear*

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**MAXSIGHT - Light Architecture**

**Light Architecture**

- Reduced Chromatic Aberration
  - Enhanced Target Recognition
- Contrast Enhancement: Luminance & Chromatic
  - Enhanced Target Visibility
- Perceived Brightening Effect
  - Improved Shadow/Glare Recognition
- Visual Comfort
  - Reduced Fatigue/Stress
- UV & Blue Light Filtration

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**Refractive Surgery**

Military Research

New standards of Care



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How do we know we can improve vision and performance?

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### What Is Neuroplasticity?

- **Neuroplasticity** is defined as a change in neural pathways and synapses due to changes in experience, environment, neural processes, or changes resulting from bodily injury.
- It occurs both on the cellular level due to learning and on the cortical map level in response to injury.
- Its role is widely recognized in development, learning, memory, and rehabilitation.
- The visual cortex retains the capacity for perception-dependent neuroplasticity following **perceptual learning** of both the physical structure (anatomy) and the functional organization (physiology) throughout life.



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### Is Perceptual Learning Effective?

#### Vision

**Prof. Huxlin U. Of Rochester, Ophthalmology**  
 a treatment for visual scotomas following stroke  
**Dr. Durrie, Kansas U. Medical Center, Ophthalmology**  
 a treatment for low myopia



#### Hearing

**Prof. Beverly A. Wright, Communication Sciences and Disorders, Northwestern U.**  
 a treatment for auditory dysfunctions



#### Somatosensory

**Prof. Moseley, Physiology, Anatomy & Genetics, U. of Oxford**  
 a treatment for chronic pain and tactile dysfunctions



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Perceptual learning has been extensively researched and published:



Found effective in amblyopia, low myopia and presbyopia

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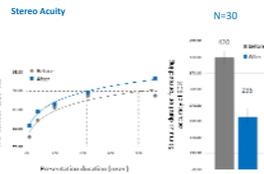
### 3: Israeli Air Force Pilots

Generalization. On average, there was an improvement of:

- 24% in the Processing Speed
- 44% in Stereo Acuity

Besides acuity and contrast sensitivity, improvements, training gains were generalized to higher functions:

- Rapid matching of object properties, such as **shape and color**
- a gain on 185 msec for a 90% accuracy in **Stereo Acuity**



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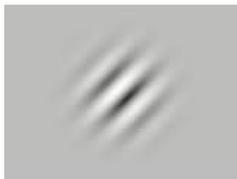
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### Vision enhancement training in professional baseball players using Gabor images



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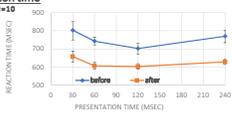
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Improvement in reaction time



- Large effect of improving reaction time (effecting by about 200 msec)
- Large effect (improving) overall effect (the greatest reduction in reaction time)
- P value < 0.0001

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Stroboscopic Technology



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Nutrition?



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**University of Georgia Researchers Show Link between Dietary Zeaxanthin Consumption and Improved Reaction Time**

- The study found that after 4 months of supplementation with an Eyepromise brand eye health supplement (zeavision), the group of young, healthy participants experienced statistically significant improvements including a 10% improvement in reaction time (at least 20 mg zeaxanthin)

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**Sports Eye Injury Demographics**

- Incidence (Prevent Blindness America)

	1993	2002	2012	2015
# 1	Basketball (20.8%)	Basketball (20.4%)	Basketball (18.6%)	Basketball (20.3%)
# 2	Baseball (14.9%)	Water Sports (14.2%)	Water & Pool Activities (16.6%)	Water & Pool Activities (17.7%)
# 3	Water Sports (8.4%)	Baseball / Softball (11.5%)	Guns – Air, Gas, Spring, BB (11.7%)	Guns – Air, Gas, Spring, BB (7.7%)
# 4	Racquet & Court Sports (7.8%)	Guns – Air, Gas, Spring, BB (11.3%)	Baseball / Softball (10.4%)	Baseball / Softball (6.8%)

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**Vision and Concussions**

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Conclusion

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