

# AN OVERVIEW OF SPORTS VISION

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*Don Loran And Caroline MacEwen's Book, "Sports Vision" Is Still The Leading Text In This Country On The Subject.*

## **INTRODUCTION**

Play is an essential facet in the emotional and physical development of a child. At about four years it incorporates rules and becomes a game (Sheridan, 1989) and when individual and team participation occur it becomes a sport (Loran, 1995).

The majority of people who consult eye care practitioners are likely to be involved in sport (The General Household Survey, 1987, Beashel and Taylor, 1992, Mintel, 1993). Thus, Sports Vision or the optimising of safe and efficient vision in sport is an essential part of optometric care to the community.

## **History**

Eskimos were arguably the first to introduce sports spectacles to reduce glare from snow and water (Doland, 1917) although the Chinese may have used transparent coloured pebbles for magnification and light protection (Duke-Elder, 1970). The earliest use of sports spectacles was however attributed to the emperor Nero who reputedly viewed gladiators in combat through an emerald (MacGregor, 1992). In 1886 sports spectacles were offered by Sears, Roebuck & Co and later advertised in the Times of London in 1909. In the 1920's an Oklahoma optometrist, Alexander Skeffington, developed "Behavioural Optometry" which led to sports vision enhancement training on the premiss that visual skills are learned and could be improved (Gregg, 1987, Holland, 1993, Coffey and Reichow, 1995).

## **Contact Lenses, Refractive Surgery and Safety**

Contact lenses, and to a lesser extent refractive surgery effectively revolutionised sports participation by ametropic players (Contact Lens Society of Great Britain 1948, Rabkins 1994, Efron 1995, Loran 1995 and Rosen 1995) whilst sports headgear and sunglasses protected the eye from the hazards of light in outdoor pursuits (MacEwen, 1995, Obsfeld and Pope, 1995). Sport injury and assault are the major cause of serious eye injury despite the fact that sports vision eye injuries are completely avoidable by the use of protectors which meet the appropriate standards (GSA 1982, ASTM 1988, MacEwen 1989, ASIN7 1992, BSI 1993, North 1993, Easterbrook 1995, Jones 1995, and Obsfeld and Pope 1995).

## **Vision Screening**

Since 1979, optometrists have become extensively involved in vision screening of sports people and have been appointed as sports team optometrists (Gregg 1987, Sherman 1990, Ivins 1992, Edmunds 1993, Bausch & Lomb 1995 and Garner and Sherman 1995). Sports participants are more comfortable when glare is eliminated, better protected from eye injury by wearing suitable eye protectors and perform better when visual sensitivity is minimised and visual skills enhanced.

**SPORTS OPTOMETRY**

Sport participation in the UK, 1992

| <b>Sport</b>             | <b>Men<br/>(Millions)</b> | <b>Women<br/>(Millions)</b> | <b>Total<br/>(Millions)</b> |
|--------------------------|---------------------------|-----------------------------|-----------------------------|
| <b>Swimming</b>          | 4.4                       | 5.6                         | 10.0                        |
| <b>Rambling /hiking</b>  | 2.6                       | 1.8                         | 4.3                         |
| <b>Snooker</b>           | 3.5                       | 0.5                         | 3.9                         |
| <b>Kept fit /dance</b>   | N/A                       | 3.9                         | 3.9                         |
| <b>Jogging /training</b> | 2.7                       | 0.9                         | 3.6                         |
| <b>Badminton</b>         | 1.8                       | 1.6                         | 3.4                         |
| <b>Golf</b>              | 2.9                       | 0.5                         | 3.4                         |
| <b>Cycling</b>           | 1.9                       | 1.2                         | 3.1                         |
| <b>Darts</b>             | 2.2                       | 0.8                         | 3.1                         |
| <b>Weight training</b>   | 2.1                       | 0.7                         | 2.8                         |
| <b>Tennis</b>            | 1.5                       | 1.1                         | 2.7                         |
| <b>Football</b>          | 2.2                       | 0.1                         | 2.4                         |
| <b>Squash</b>            | 1.5                       | 0.6                         | 2.1                         |
| <b>Cricket</b>           | 1.2                       | 0.1                         | 1.4                         |
| <b>Table Tennis</b>      | 1.1                       | 0.6                         | 1.7                         |
| <b>Bowls</b>             | 0.9                       | 0.4                         | 1.4                         |
| <b>Skiing</b>            | 0.8                       | 0.5                         | 1.2                         |
| <b>Climbing</b>          | 0.5                       | 0.2                         | 0.7                         |
| <b>Athletics</b>         | 0.5                       | 0.2                         | 0.7                         |
| <b>Rugby Union</b>       | 0.6                       |                             | 0.7                         |
| <b>Wind surfing</b>      | 0.3                       |                             | 0.3                         |

Sport participation in the UK, 1992

Source: Mintel, 1993 (Angling and fishing not included).

**Fig 1** - shows the breakdown of visual skills by sport and the relative importance of these skills to each sport – included at end of document.

| SPORTS VISUAL TASK ANALYSIS  |               |                       |                     |                        |                  |                                 |                              |                      |                      |               |  |
|--|---------------|-----------------------|---------------------|------------------------|------------------|---------------------------------|------------------------------|----------------------|----------------------|---------------|--|
| Theoretical profile of the visual skills involved in a broad spectrum of sports (Gardner and Sheridan, 1995) |               |                       |                     |                        |                  |                                 |                              |                      |                      |               |  |
|  | Visual Acuity | Dynamic visual Acuity | Ocular-motor skills | Eye-hand Co-ordination | Depth perception | Accommodation Vergence facility | Central-peripheral awareness | Visual reaction time | Visual adjustability | Visualisation |  |
| Archery  | 4             | 1                     | 3                   | 5                      | 2                | 3                               | 5                            | 1                    | 5                    | 2             |  |
| Baseball hit and cricket   | 4             | 5                     | 5                   | 5                      | 5                | 5                               | 5                            | 5                    | 5                    | 5             |  |
| Baseball pitch   | 3             | 2                     | 3                   | 4                      | 3                | 3                               | 5                            | 1                    | 3                    | 5             |  |
| Basketball   | 3             | 3                     | 4                   | 5                      | 5                | 3                               | 5                            | 5                    | 5                    | 5             |  |
| Bowling/bowls  | 2             | 1                     | 3                   | 5                      | 3                | 2                               | 4                            | 1                    | 3                    | 4             |  |
| Boxing   | 2             | 2                     | 5                   | 5                      | 3                | 3                               | 5                            | 5                    | 5                    | 4             |  |
| Cricket wicket keeper  | 4             | 5                     | 5                   | 5                      | 5                | 5                               | 5                            | 5                    | 5                    | 3             |  |
| Cricket bowler   | 3             | 2                     | 3                   | 4                      | 3                | 5                               | 5                            | 1                    | 3                    | 5             |  |
| Cricket fielding   | 4             | 5                     | 4                   | 4                      | 4                | 4                               | 3                            | 3                    | 3                    | 2             |  |
| Cycling (road racing)  | 5             | 5                     | 5                   | 4                      | 5                | 2                               | 5                            | 5                    | 4                    | 5             |  |
| Darts  | 4             | 1                     | 3                   | 5                      | 3                | 3                               | 5                            | 1                    | 1                    | 3             |  |
| Diving (spring board and platform)   | 2             | 3                     | 2                   | 3                      | 3                | 1                               | 5                            | 2                    | 3                    | 5             |  |
| Football   | 4             | 5                     | 5                   | 5                      | 5                | 3                               | 5                            | 5                    | 5                    | 5             |  |
| Golf   | 3             | 1                     | 4                   | 5                      | 5                | 3                               | 5                            | 1                    | 3                    | 5             |  |
| Gymnastics   | 1             | 3                     | 3                   | 5                      | 5                | 3                               | 5                            | 5                    | 5                    | 5             |  |
| Handball   | 4             | 5                     | 5                   | 5                      | 5                | 3                               | 5                            | 5                    | 5                    | 3             |  |
| High jump  | 3             | 3                     | 4                   | 3                      | 5                | 3                               | 5                            | 4                    | 3                    | 5             |  |
| Hockey (goalie)  | 4             | 5                     | 5                   | 5                      | 5                | 5                               | 5                            | 5                    | 5                    | 3             |  |
| Hurdles  | 4             | 4                     | 4                   | 4                      | 4                | 3                               | 4                            | 3                    | 3                    | 5             |  |
| Kayaking   | 4             | 4                     | 4                   | 5                      | 5                | 3                               | 5                            | 5                    | 4                    | 5             |  |
| Mountain eering  | 5(b)          | 3                     | 2                   | 5                      | 5                | 3                               | 5                            | 5                    | 3                    | 5             |  |
| Pool/ Snooker billiards  | 2             | 1                     | 4                   | 5                      | 5                | 2                               | 3                            | 1                    | 4                    | 5             |  |
| Race car driving   | 5             | 5                     | 5                   | 4                      | 5                | 2                               | 5                            | 5                    | 5                    | 5             |  |
| Racquetball /Squash  | 4             | 5                     | 5                   | 4                      | 5                | 4                               | 5                            | 5                    | 5                    | 5             |  |
| Running  | 1             | 1                     | 2                   | 1                      | 1                | 1                               | 4                            | 3                    | 1                    | 4             |  |
| Shooters (clay pigeon, skeet, trap, hunting, long gun)   | 5             | 5                     | 4                   | 5                      | 5                | 5                               | 5                            | 5                    | 4                    | 5             |  |
| Shooters (range, fixed distance)   | 4             | 2                     | 3                   | 5                      | 2                | 3                               | 5                            | 1                    | 1                    | 2             |  |
| Skiing   | 5             | 5                     | 5                   | 5                      | 5                | 3                               | 5                            | 5                    | 5                    | 5             |  |
| Soccer (d)   | 3             | 4                     | 5                   | 5(c)                   | 5                | 3                               | 5                            | 5                    | 5                    | 5             |  |
| Soccer goal keeping  | 4             | 5                     | 5                   | 5                      | 5                | 5                               | 5                            | 5                    | 5                    | 3             |  |
| Swimming   | 1             | 1                     | 1                   | 1                      | 1                | 1                               | 4                            | 3                    | 1                    | 4             |  |
| Tennis/table-tennis  | 4             | 5                     | 5                   | 5                      | 5                | 5                               | 5                            | 5                    | 5                    | 5             |  |
| Track—high jump  | 1             | 3                     | 3                   | 4                      | 4                | 3                               | 3                            | 4                    | 4                    | 4             |  |
| Track- pole vault  | 1             | 3                     | 3                   | 5                      | 5                | 3                               | 4                            | 4                    | 4                    | 5             |  |
| Volleyball   | 4             | 5                     | 5                   | 5                      | 5                | 3                               | 5                            | 5                    | 5                    | 5             |  |
| Weight lifting   | 1             | 1                     | 1                   | 2                      | 1                | 1                               | 1                            | 1                    | 1                    | 5             |  |
| Wrestling  | 2             | 1                     | 1                   | 3                      | 2                | 1                               | 3                            | 5                    | 5                    | 4             |  |

(a) A pattern ESO deviations or V pattern EXO deviations can significantly affect performance in these sports.

(b) Contrast sensitivity may be crucial (to the point of being life-saving) in this sport.

(c) Eye-body (foot-head-chest) co-ordination.

(d) Including American Football, Australian rules football, Canadian rules football, Gaelic football, rugby league and rugby union.

**PRESCRIBING**

| SPORT  | FEATURES   | ACTION  |
|--|--|---|
| <b>RACQUET HOCKEY<br/>CRICKET HURLING</b>  | Risk of eye injury, Good visual performance, Glare   | Eye protectors, Tints   |
| <b>FOOTBALL<br/>Soccer, Rugby, Gaelic,<br/>Australian Rules, Sand<br/>Soccer</b> | Trauma<br>ball, finger, elbow,<br>good peripheral awareness, depth<br>perception, Foot hand eye co-<br>ordination  | Soft contact lenses   |
| <b>FISHING &amp; ANGLING</b>   | High acuity, Glare, Spray, Injury from<br>hooks  | Plastic lenses, Bifocals with low<br>segments, polarising lenses, Tints   |
| <b>PUGILISM</b>  | Unacceptable high risk of eye injury.<br>68% sight threatening (Giovinazzo et<br>all 987), 12.5% detachments 8% angle<br>recession (Abramson & McDonagh<br>1982) | Regular eye examinations,<br>including dilation with direct and<br>indirect ophthalmoscopy. Prompt<br>medical attention. Discourage high<br>risk groups.  |
| <b>CYCLING &amp; SKIING</b>  | Glare, Wind (drying), Cold, Dust and<br>debris   | Resilient plastic wrap-round<br>frames with impact resistant<br>lenses. UV blockers and high<br>optical centres for cycling.  |
| <b>GOLF</b>  | Head turn with visual axes stationary,<br>glare. Working distances vary from<br>40cm (card) to 1 metre (ball) and<br>infinity                                    | Large eyes sizes, Tints/<br>photochromics, Low segment, Add<br>bifocals or single displaced<br>segment (down to right for<br>presbyopic right-hander).  |
| <b>WATER SPORTS</b>  | Aquatic environment<br>Tonicity, Osmolarity, pH., Chlorine,<br>Glare & Spray   | C E approved goggles (plano or<br>prescription), Scleral contact<br>lenses, Soft contact lenses (under<br>suitable goggles), UV blockers,<br>Saline rinse, Silicone hydrogels for<br>long distance events |
| <b>SHOOTING</b>  | High acuity, Discharging lead & debris   | Plastic spectacle lenses, use<br>dominant eye for aiming.<br>Prescription, telescopic sight.<br>Tinted lenses to enhance contrast   |

**PROTECTION****OCULAR HAZARDS IN SPORTS**

- High velocity projectiles at head height (ball, shuttlecock)
- Ancillary (elbow, finger, fist, ball or racquet)
- Environmental (sun, water, etc)

The proportion of Eye Injuries Arising From Sports Participation (LORAN, 1992)

| <b>SPORT</b>     | <b>%</b> | <b>PARTICIPANTS<br/>(Millions)</b> |
|------------------|----------|------------------------------------|
| <b>Soccer</b>    | 45.4     | 2.4                                |
| <b>Squash</b>    | 16.2     | 2.1                                |
| <b>Badminton</b> | 12.6     | 3.4                                |
| <b>Rugby</b>     | 10.8     | 0.7                                |
| <b>Tennis</b>    | 7.8      | 2.7                                |
| <b>Cricket</b>   | 4.2      | 1.4                                |
| <b>Hockey</b>    | 3.0      | < 0.3                              |

Eye injuries in sport.

| <b>Black eye</b>                 | <b>Hyphaema</b>     | <b>Vitreous haemorrhage</b> |
|----------------------------------|---------------------|-----------------------------|
| <b>Orbital blow-outs</b>         | Rupture of the lids | Retinal detachment          |
| <b>Conjunctival haemorrhages</b> | Cataract            | Choroidal tears             |
| <b>Corneal abrasions</b>         | Sub-luxation        | Rupture of the globe        |

### THE USE OF EYE PROTECTORS

Sports where eye protection is particularly advisable are; water sports, snow sports, racquet sports, hockey, football and cricket.

### HIGH EYE-INJURY RISK AND MONOCULAR ATHLETES

Eye protection is essential and if difficult or impossible (eg. boxing and soccer) athletes should be cautioned against participation

### VISION SCREENING

Team sports optometrists may conduct vision screening in

- Consulting Room
- Sports Place
- Sports Clinic

**TESTS (Include)**

| Diagnostic   | Analytical   |
|--|--|
| <b>Static Visual Acuity</b><br><b>Ocular Dominance</b><br><b>Fixation Disparity</b><br><b>Speed of Stereopsis</b><br><b>Accommodation / Vergence</b><br><b>Facility Contract Sensitivity</b> | Auto-Refracton (or Retinoscopy)<br>Dynamic Visual Acuity<br>Eye/Hand Reaction and Response times<br>Eye/Foot Reaction and Response times |

**DATA FROM B&L OLYMPIC VISION SCREENING 1992 and 1994**

N = 1206

1:2 No Previous Eye Exam

1:4 Visual Difficulties

1:6 Contact Lenses

1:6 RGP:SCL

**VISION ENHANCEMENT**

| <u>Low Tech I Routine:</u>   | <u>High Tech I Specialist:</u>   |
|--|--|
| Visual Acuity,<br>Contrast Sensitivity,<br>Colour Testing,<br>Eye/Hand Dominance,<br>Mallet Test,<br>Brock String,<br>Vision & Balance,<br>Depth Perception.<br>Flipper Lenses | Dynamic Acuity,<br>Glare Recovery,<br>Wayne Saccadic Fixator,<br>Acuvision 1000 (eye hand and foot co-ordination)<br>Reaction time<br>Peripheral Awareness |

**ROUTINE**

Optometric principles are well established and in themselves provide the justification for an interest in sport.

(a) Optometric examinations, prescribing spectacles, contact lenses, polycarbonate & tinted lenses.

(b) Frequent examination including indirect ophthalmoscopy I visual fields of high risk sport participants, eg. boxers.

## DEBATE

There is a debate about whether sports vision training can improve peak athletic performance. There are arguments for and against this question.

### AGAINST IMPROVEMENT

- Traditionally anecdotal
- No scientific evidence (Cockerill, 1999)
- Test familiarity (Wood & Abernethy, 1997)
- Placebo therapy improves 1:3 (Hill, 1999)
- Elite athletes do not possess superior hardware\* (Williams, 1999)

\* Vision processing can be conveniently divided into two components:

1. Hardware, the eyes themselves and how they collect information (Optometry)
2. Software, which deals with how this information is perceived and used (Psychology)

### FOR IMPROVEMENT

- Soccer and visual skills correlate in young elite soccer players (Loran & Griffiths, 1999,  $p < 0.01$ ).
- All Under -14 players rejected by Nottingham Forest Football Club showed deficiencies in soccer related visual skills (Loran & Griffiths, 1999).
- Intuitively appealing.
- A significant improvement in performance occurred following visual training in: -Baseball (Worrel, 1996) -Volleyball (KJuka et al, 1996) Hockey (Calder, 1998)
- Elite athletes show superior perceptual skills (Williams & Grant, 1999) This skill can be trained especially in younger players (Williams & Grant, 1999)
- A debate at the first International Conference of the Sports Vision Association, 1999. The Audience consisted of Optometrists, Ophthalmologists, Dispensing Opticians, Sports Scientists, Sports Psychologists, Manufacturers and Coaches. The motion was that visual enhancement training improves visual performance.

**The Result : 85% for the motion.**

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