



Vision and sports: An overview



Authors:

Joas R. Ramaja¹ 
Rekha Hansraj² 

Affiliations:

¹Department of Optometry,
Faculty of Health Sciences,
University of Limpopo,
Polokwane, South Africa

²Discipline of Optometry,
Faculty of Health Sciences,
University of KwaZulu-Natal,
Durban, South Africa

Corresponding author:

Joas Ramaja,
joas.ramaja@ul.ac.za

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Background: Visual skills and their components are thought to be responsible for much of the manner whereby athletes obtain information about the sporting environment. The field of sports vision deals with the vision care services that are provided to athletes. If visual skills of athletes are not assumed as natural attributes, they should be assessed and be subjected to training according to need. Studies have shown that the visual abilities of the athletes can be divided into software and hardware visual skills, and it is the software visual skills that separate expert athletes from non-experts.

Aim: The study aims to collate (1) studies that show the importance of visual skills in sports performance, (2) studies that show that visual skills are trainable and (3) studies that show the effect of training on the visual skills and performance in sports.

Method: An extensive search of literature was performed on studies that supported the importance of vision in sports performance. Also included were studies that supported the transfer of improved visual skills to improved performance on the field of play.

Results: There is literature that supports the significance of visual skills in sport. There is also literature that attempts to show evidence that improved visual skills can improve performance on the field of play.

Conclusion: Sports vision practitioners need to develop standardised testing and training protocols for visual skills. Standard protocols will harmonise the development of visual skills norms.

Contribution: Literature has shown the importance of vision in sports performance. Literature has also shown that improved visual skills can improve performance on the field of play. The current paper is an attempt at calling for the development of standardised protocols and norms for sports vision training.

Keywords: sports vision; visual skills; athletes; sports performance; visual skills enhancement; visual skills norms.

Introduction

The Sports Information and Science Agency (SISA) outlines five key performance indicators that need to be addressed to enhance performance levels, to accelerate sports development and to support athletes and coaches, irrespective of their level of competition.¹ These performance indicators include physical evaluation, sports medicine screening, sport psychology assessment, sports nutrition assessment and sports vision.¹ Of these five indicators, sports vision ranks quite high when one considers vision to be the signal that provides the athlete with information regarding where and when to perform, with the eyes leading the body.² Visual skills and their components are responsible for around 80% of the manner in which athletes obtain information about the sporting environment.³ Furthermore, about 70% of all sensory receptors in the body are in the eyes.⁴ Not surprisingly, therefore, athletes and coaches are in continuous search for new and better ways to enhance sports performance, with vision often forming the basis for this search.⁵

The term 'sports vision' is used to describe vision care services provided to athletes.² As early as the second century, Claudius Galen, the most famous Greek physician during the Roman period (129–200 AD), as well as a brilliant anatomist and pioneer of experimental physiology,⁶ believed that ball sports, body and visual status were interconnected.⁷ However, the origin of modern sports vision is traced to Abel⁸ and Fullerton⁹ who studied the visual abilities of the famous baseball player 'Babe Ruth'. Ruth (George Herman Jr) (1895–1948) was an American professional baseball player whose career in Major League Baseball spanned 22 seasons, from 1914 through 1935. Ruth is regarded as one of the greatest sports heroes in American culture and is considered by many to be the greatest baseball player of all time.²

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There is a general belief that an athlete who is not visually fit is not physically fit,^{10,11} and in sports nothing affects performance negatively more than the inability to see clearly.¹² Considering the sporting code of football, by seeing and being aware of, amongst other things, the sports field, placement of players and the position of the ball, players are able to identify and pick out task-specific information whilst ignoring other irrelevant stimuli that could interfere with task execution, which is expected to increase the accuracy of the required response.¹³ Whilst inexperienced players fixate on the ball and the player passing the ball, experienced players, in addition, focus on peripheral aspects of play, such as the movement of other players not in close contact with the ball, as well as players who are moving into open areas of the field in which they might eventually receive a strategic pass.¹⁴ Williams¹³ found that expert athletes use more effective visual search strategies than non-experts.

The different visual abilities of athletes can be classified into hardware and software skills. Hardware components of the visual system are the non-task-specific abilities such as visual acuity, stereopsis, accommodation, fusion flexibility, colour vision and contrast sensitivity.¹⁵ Visual software components, on the other hand, incorporate the cognitive abilities and include visualisation, visual reaction time, central-peripheral awareness, eye-hand and eye-body coordination.^{16,17} The hardware visual system may set the potential limit to visual performance in sport, but once the hardware deficiencies have been addressed, it is the software skills of visual perception that separate experts from non-experts.^{18,19} In studies involving rugby players, Ludeke and Ferreira²⁰ found that professional players outperform non-professional players in software visual skills, but found no difference between professional and non-professional players in hardware visual skills.²¹

Visual skills and sports performance

In sports performance a clear distinction should be made between the structural components of the visual system and the visual perceptual elements. The importance of a particular hardware skill varies for the different codes of sport.²⁰ An athlete with superior visual acuity will use the focal system more often, whilst the athlete with a poorer visual acuity will depend on the peripheral system. Good static visual acuity may guide other visual abilities, although in itself it may be of lesser importance because of the dynamic nature of the sporting environment.¹ Contrast sensitivity and colour vision do not play such an important role in certain codes of sports such as rugby, as reported in the study by Ludeke and Ferreira.²⁰ Also, Sorate²³ asserted that the position of the footballer in the field of play has no bearing on colour vision or visual acuity. Ludeke and Ferreira²⁰ argued that an abnormal contrast sensitivity score could be related to an uncorrected refractive error or possible diseases such as glaucoma, cataracts and diabetic retinopathy. The importance of accommodation in sport was also questioned in dynamic sports such as rugby and cricket.²⁰

In an assessment of players' software skills, club rugby players performed better than professional players on visual

concentration²¹ but the professional players performed better than the club players on eye-hand coordination and eye-body coordination. In a study involving rugby players from two different age groups, Venter and Ferreira²⁴ found that 17-year-olds outperformed 15-year-olds on software visual skills.

Visual skills enhancement and sports performance

Despite visual function being rarely taken into consideration when designing training programmes by coaches and athletes,²⁵ it is one of the most important sensory systems in sports performance. Studies^{26,27,28,20,30} have shown that the abilities of athletes improve after visual skills training. Kumar and Arumugam²⁸ found that in football players, dribbling, passing and shooting improved after visual skills training. Tomas, Perumal and Radhakrishnan³⁰ and Binu²⁷ asserted further that in addition to an improvement in dribbling, passing and shooting, the overall playing ability of football players improves after visual skills training. Similarly, in a study by Nithin and Vaithianathan²⁹ it was found that the batting statistics of baseball players improved after visual skills training. Schwab and Memmert³¹ found sports vision training programmes to be effective in training the different visual skills of the participating athletes with Shivaji and Jeyavelmurugan²⁶ concluding that athletes exposed to visual skills training fared better than their counterparts who only practiced with conventional training.

In their study, Paul et al.⁵ found that eye-hand coordination training improves the basic visual and motor skills of table tennis players; the improved performance was noticeable in the improved performance evaluation scores of the experimental group. The noticed improvements are in agreement with Du Toit et al.,³² who maintained that sports vision is an integral part of the holistic approach to improve performance on the field and should not be taken for granted.

Researchers have attempted to develop sports vision testing batteries over time.^{33,34} Buys¹⁷ and Buys and Ferreira⁴ compiled norms and protocols for sports vision assessment. There are studies that have supported the efficacy of sports vision enhancement programmes^{35,36,37,38} and on the other hand, those who were opposed to the programmes.^{39,40} The South African studies mostly involved rugby and cricket players^{4,17} and other sports such as archery.⁴¹ However, those studies claiming to prove a positive relationship between visual training and athletic performance are said to be lacking in proper scientific design, as is the case with studies that attempted to disprove such a relationship.²⁵

Visual skills norms

According to Ferreira²² the perfect visual skills testing battery does not exist, hence the implication that perfect norms also do not exist. Coffey and Reichow³³ developed a visual skill testing battery for the Pacific Sports Visual Performance Profile (PSVPP) and later Planer³⁴ developed the Sports Vision Testing Manual for the International Academy of Sports Vision and included a documentation of visual skills norms.

Buys,¹⁷ and later Buys and Ferreira,⁴ developed norms and protocols for sports vision evaluations. Like Coffey and Reichow,³³ and later Planer,³⁴ Buys¹⁷ and Buys and Ferreira⁴ divided the visual skills into different categories of competency, namely 'superior', 'above average', 'average', 'ineffective' and 'needs immediate attention'. As there were no standardised methods to define the norms, Buys¹⁷ and Buys and Ferreira⁴ developed two new methods to define the different categories.

The norms were defined using the percentage and mean and standard deviation methods. The percentage method had categories that comprised the top 10% best performing sports persons as having 'superior' visual skills, those scoring 70% – 90% as 'above average', 50% – 70% as 'average', 25% – 50% as 'ineffective' and those scoring 0% – 25% as 'needs immediate attention'. For the mean and standard deviation method the 'superior' category was any value higher than the 'above average' category, the 'above average' category will be the mean plus two standard deviations, the 'average' will be the mean plus one standard deviation, 'ineffective' will be the mean less one standard deviation and 'needs immediate attention' will be any value lower than 'ineffective'.^{4,17} In another study, Strydom and Ferreira⁴¹ used the percentage and mean and standard deviation methods to develop visual skills norms for archery.

Conclusion

Wood and Abernethy²⁵ and Abernethy and Wood³⁹ had contested that no improvement occurred in visual or motor performance as a result of visual skills training, beyond simply from test familiarity. Reichow and Stern⁴² maintained that sports vision practitioners should approach services to athletes in a performance-oriented manner, that is, improved visual performance resulting in enhanced athletic performance, which must be the ultimate goal of sports vision regimens. There are also studies that maintain that visual skills are trainable and that the training transfers to performance on the field of play.

Visual skills training and the transfer of the training to performance on the field of play has always elicited heated debates; what is needed to reinforce the role of vision in sports is the standardisation of the testing and training protocols around the globe amongst sports vision practitioners. The role of sports vision will be accepted only when well-designed, randomised, controlled blind trials show that sports vision training improves performance. Standard protocols will harmonise the development of norms for the different visual skills, which can then be used to provide evidence-based research on the role of vision in various sporting codes.

Currently, the face of sports has changed from mainly conservative amateur to a dynamic professional business that has created numerous opportunities. The interest of the media has also made sports a major marketing tool. On the other hand, sports have become increasingly competitive,

with sports vision identified as one of the key performance indicators when athletes strive to reach their full potential. If vision and visual skills are not assumed as natural attributes, coaches should consider the incorporation of sports vision training when preparing their athletes for competition. Validated training protocols supplemented with established norms are essential to optimising sports vision and hence sports performance.

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Both authors (J.R.R. and R.H.) declare co-authorship of the article.

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