European Council of Optometry and Optics



EVIDENCE ASSESSMENT REPORT

THE STRATEGIC ROLE OF EYE CARE PROFESSIONALS IN OPTIMISING VISION IN SPORT

Current perspectives and future directions

26 October 2026

Prepared by Dr Jesus Vera Vilchez, Dr Matjaz Mihelcic, Prof Julie-Anne Little, Prof Brendan Barrett, Ignacio Costa Gonzalez, Pavel Sebek

CONTENTS

Executive summary **3**

1 Introduction **4**

2 Visual and ocular health assessment in athletes **4**

2.1 Spatial vision 5

2.2 Binocular vision and vergence function 5

2.3 Oculomotor function 5

2.4 Accommodation 5

2.5 Peripheral and adaptation-related vision 6

2.6 Fine spatial and contrast processing 6

2.7 Colour vision 6

2.8 Sport-specific visual and visuomotor tests 6

3 Prescription, adaptation, and customsation of sport-specific visual aids to optimise visual performance **7**

4 Vision-based, sensory-motor training **9**

4.1 Low-level visual processing training 10

4.2 Oculomotor and visuomotor training 10

4.3 Perceptual-cognitive training 10

4.4 Visual perturbation training (e.g., stroboscopic training) 11

4.5 Integrated and representative training approaches 12

4.6 Transfer of training and implications for practice 13

5 Conclusions **13**

References **14**

Authors and affiliations **19**

About ECOO **19**

EXECUTIVE SUMMARY

This document summarises the view of the ECOO Working Group on Sports Vision, informed by a detailed consideration of the available scientific literature. It is intended as an expert synthesis to inform the development of a shorter ECOO position statement on the strategic role of eye care professionals in optimising vision in sport, rather than as a clinical practice guideline. The strength and consistency of the available evidence vary across the different areas addressed in this document, and this is reflected in the interpretation and wording of the statements and recommendations presented.

1 INTRODUCTION

Sports vision is a complex interdisciplinary field concerned with the assessment of vision and eye health in athletes, the prescription and adaptation of optical appliances, and, when needed, the custom design of sport-specific visual aids. In addition, vision-centred sensory or sensory-motor training may be applied to enhance visual performance and athletic outcomes. In its narrower sense, sports vision refers specifically to the specialised assessment and training of visual skills relevant to sports performance.

Overall, the field bridges optometry and optics, dispensing of appliances, sensory - and athletic training. In this document, sports vision encompasses eye care for individuals participating in sport and exercise across the full spectrum of participation, from recreational activity to elite competition. This is a broad area but the field can logically be divided into three categories:

1. **Visual and ocular health assessment in athletes -** core optometric domain,
2. **Prescription, adaptation, and customisation of sport-specific visual aids** - core optical & optometric domain
3. **Vision-based, sensory-motor training** - often delivered in collaboration with professionals from sports science or neuro-performance disciplines.

2 VISUAL AND OCULAR HEALTH ASSESSMENT IN ATHLETES

Visual assessment should be considered a core domain of optometric care in the field of sports vision. Its importance is supported by the broader optometric literature and by sport-specific research suggesting that visual function may contribute to athletic performance and safe participation, although the strength of these associations varies across visual domains and sporting contexts.[1,2]

A comprehensive visual assessment in individuals participating in sport should begin with an optometric examination consistent with usual standards of care. Depending on clinical findings, symptoms, and the visual demands of the sport, this assessment may include evaluation of visual acuity, refractive status, binocular and accommodative function, ocular motility, contrast sensitivity, visual fields, peripheral visual awareness, colour vision, and ocular health.[3] These measures represent validated clinical constructs with established reliability and diagnostic value. There is some evidence to suggest that athletes may exhibit superior performance in selected visual and visuomotor domains compared with non-athletes, including faster reaction times, enhanced peripheral awareness, and improved oculomotor control.[4–6] However, these findings are largely observational, heterogeneous, and sport-specific, and do not establish whether these characteristics contribute to superior athletic performance or develop as a consequence of training and experience. They therefore do not support the notion of a universal “athlete visual profile”. Instead, visual demands are context-dependent, varying according to sport type (e.g., interceptive vs. strategic), playing position, and the informational constraints of the task, such as movement speed, opponent behaviour, and visual conditions.

Across all levels of sporting performance, a key limitation in the current literature is the lack of standardisation in test selection, in test format and reporting. Visual assessment should therefore be guided by task analysis, ensuring that selected tests are relevant to the specific visual demands of the sport.[7] Moreover, several commonly used sports vision tests lack direct evidence linking them to on-field performance, reinforcing the need for ecologically valid and standardised approaches.[1]

Within this framework, visual function in athletes may be assessed across the following domains:

2.1 Spatial vision

- Static visual acuity.
- Dynamic visual acuity.
  These measures establish baseline resolution capacity, with dynamic visual acuity being particularly relevant in sports involving motion, interception, or tracking.[8,9]

2.2 Binocular vision and vergence function

- Positive and negative fusional vergence
- Phorias
- Vergence facility
  Binocular stability is essential for visual comfort and efficiency. Importantly, binocular dysfunctions such as convergence insufficiency have been reported in elite athletes, supporting routine assessment in this population.[10] Where indicated by task analysis, binocular and vergence function may also be assessed at fixation distances and gaze positions representative of the specific sporting task, rather than exclusively under standard primary-gaze conditions.

2.3 Oculomotor function

- Pursuits
- Saccades
- Fixation stability
  These functions underpin gaze control, tracking, and visual sampling of the environment, which are critical for performance in dynamic sports contexts.[11] However, despite their conceptual relevance, evidence linking isolated oculomotor measures to sport performance remains limited, with current literature highlighting a lack of ecological validity and inconsistent associations with on-field outcomes.[1,12]

2.4 Accommodation

- Amplitude of accommodation
- Accommodative facility
  Accommodation may be particularly relevant in sports requiring frequent changes in fixation distance. However, the sport-specific evidence supporting its routine assessment remains limited, and its evaluation should therefore be guided by clinical findings and task-specific visual demands.

2.5 Peripheral and adaptation-related vision

- Visual fields
- Peripheral awareness
- Light and dark adaptation, including glare recovery

Visual fields provide a clinical assessment of the extent and integrity of peripheral vision, whereas peripheral visual awareness reflects the ability to detect and respond to relevant information outside central fixation. Peripheral visual awareness may be particularly relevant in sports with substantial peripheral monitoring demands. Light and dark adaptation, including glare recovery, may be relevant in sports involving substantial changes in luminance or glare exposure. However, the available sport-specific evidence remains limited, and assessment should therefore be guided by the visual demands of the sport.[13]

2.6 Fine spatial and contrast processing

- Stereoscopic vision
- Contrast sensitivity
- Vernier acuity
  These measures support depth perception, object detection under degraded conditions, and fine spatial judgments.

2.7 Colour vision

- Colour discrimination
  Colour vision may be relevant in sports requiring rapid identification of coloured cues (e.g., teammates, signals, or environmental features).[14] Given the limited and sport-specific evidence, its assessment should be guided by the visual demands of the sport, informed by task analysis and clinical judgement.

2.8 Sport-specific visual and visuomotor tests

- Visual attention / span of attention
- Visual reaction time
- Eye-hand coordination
- Eye-foot coordination, where relevant
- Visual anticipation

These measures aim to capture sport-relevant aspects of visuomotor processing and may be particularly informative when they reflect the perceptual and motor demands of the specific sport. However, they typically combine visual, cognitive, and motor components, and their relationship with actual sport performance remains variable and task-dependent.[15] Their interpretation should therefore be guided by task analysis, and performance on isolated laboratory or device-based tests should not be assumed to predict competitive performance.

Fundamental aspects of spatial vision remain critical for athletic performance, as they define the limits of visual resolution under both optimal and degraded environmental conditions. Experimental evidence demonstrates that reductions in visual acuity or contrast sensitivity, as well as interocular differences, can impair sport performance, particularly in tasks requiring precise timing, interception, or rapid visuomotor responses.[16–18] However, this relationship is not consistent across all contexts, as some studies have shown that performance in certain interceptive tasks may be relatively robust to moderate levels of optical degradation, suggesting a degree of task-dependent resilience and the possible use of alternative perceptual or predictive strategies.[19]

While this report chiefly considers those with normal (or corrected-to-normal) vision, it is important to acknowledge that sport should be accessible to individuals across the full spectrum of visual ability. Participation in sport can provide important physical, psychological, and social benefits for individuals with visual impairment and may contribute to social inclusion and quality of life.[20] Appropriately trained eye care professionals can also play an important role in supporting participation in adapted and Para sport. Through specialist assessment of visual function and involvement in evidence-based classification, they can contribute to determining eligibility and sport class, helping to promote fair and meaningful competition for athletes with visual impairment.[21,22] Appropriate visual assessment and guidance may therefore support participation across both recreational and elite sporting environments.

Beyond identifying clinically significant visual deficits, sport-specific assessment may also help to characterise individual visual strengths and limitations in relation to the demands of the sport. However, such findings should be interpreted cautiously, as performance on individual visual or visuomotor measures should not be assumed to predict sporting performance or to represent a target for performance enhancement. Taken together, the available evidence supports an approach to visual assessment in sport that is guided by clinical findings and task-specific demands:

1. a comprehensive clinical examination consistent with usual standards of care.
2. additional sport-specific testing may be considered when justified by clinical findings or clearly identified task-specific visual demands, recognising the limited evidence linking many such tests to on-field performance.
3. interpretation of results within a multidisciplinary framework.

3 PRESCRIPTION, ADAPTATION, AND CUSTOMSATION OF SPORT-SPECIFIC VISUAL AIDS TO OPTIMISE VISUAL PERFORMANCE

As in all patient groups, the provision of optical appliances to correct refractive error, manage binocular anomalies, and ensure adequate visual protection represents a central component of optometric care in athletes. Appropriate correction of refractive error is an important component of optimising visual function in sport. Although some sporting tasks may tolerate mild visual blur, experimental evidence indicates that partial reductions in visual acuity or contrast sensitivity can impair performance, particularly in tasks requiring high spatial precision, rapid decision-making, or accurate visuomotor

coordination.[16–18] Therefore, uncorrected or undercorrected refractive error should be considered a modifiable limitation in athletes, even in the absence of subjective complaints.

A visual task analysis should form an important component of sports-specific eye care. This should consider the level of participation, viewing distances, target size and speed, visual field requirements, lighting and environmental conditions, protective requirements, head and body position, compatibility with other protective equipment, and, where relevant, factors such as ocular dominance, near-vision requirements, and lens geometry. Any applicable regulations or guidance from sporting bodies should also be considered. The findings of this analysis should inform both additional visual assessment and the selection of optical or protective solutions.

The selection of optical correction should be tailored to the specific demands of the sport. Contact lenses may offer practical and optical advantages in some sporting contexts, including a wider field of view, reduced spectacle-related optical distortions and fogging, and greater stability during movement.[23,24] However, evidence that these advantages translate into improved sports performance remains limited. In contrast, spectacles may be more appropriate in certain contexts, particularly when combined with protective features or when contact lens wear is contraindicated. Regardless of the modality, the primary objective remains the optimisation of visual clarity under real sporting conditions.

Beyond refractive correction, optometric management may include the treatment of binocular and accommodative anomalies when clinically indicated. As previously noted, such dysfunctions are not uncommon even in elite athletes,[10] and their management should be considered part of standard clinical care rather than performance enhancement.[3] While evidence supports improvements in visual function following appropriate intervention, the extent to which these changes translate directly into improved sport performance remains less clearly established.[12,25]

The use of optical appliances to enhance visual performance beyond normal correction (e.g., tinted lenses, filters, or specialised contact lenses) requires cautious interpretation. Although certain filters may reduce glare, improve comfort, or enhance contrast under specific environmental conditions, the evidence supporting consistent improvements in visual performance and in turn, competitive outcomes, is limited and often context-dependent.[26,27] Consequently, their prescription should be individualised and based on environmental demands rather than generalised claims of performance enhancement. Product-specific claims regarding sports eyewear should be supported by appropriate independent evidence and relevant performance or safety standards, rather than by manufacturer claims alone.

Ocular protection is an essential, and sometimes overlooked, aspect of visual care in sport. A substantial proportion of sports-related eye injuries are preventable with appropriate protective eyewear.[28] Importantly, not all eyewear provides adequate protection. For example, standard spectacles, contact lenses, or non-sport-specific eyewear may fail under impact and, in some cases, increase the risk of injury. In contrast, sport-specific protective devices designed according to recognised safety standards have been shown to significantly reduce the incidence and severity of ocular trauma.[29,30] The selection and dispensing of protective eyewear should take account of the safety standards and regulations applicable to the specific sport and jurisdiction, including relevant ISO (International Organisation for Standardisation), EN (European Standard), BS (British Standard), or equivalent national standards where applicable. Many sports-specific protective devices also offer the means to incorporate refractive

correction, thereby facilitating safe participation for individuals who require optical correction.[31] Where a risk of ocular injury exists, safety and compliance with applicable protective standards should take precedence over performance-enhancement considerations.

Taken together, the available evidence supports an approach to optical correction in athletes that prioritises accurate refractive correction, consideration of lighting conditions in sport and advice on use of filters to aid visual comfort, appropriate management of visual dysfunction, and the use of sport-specific protective solutions when indicated. Interventions aimed at enhancing visual performance beyond normal visual function should be considered with caution and grounded in the best available evidence.

4 VISION-BASED, SENSORY-MOTOR TRAINING

Visuo-cognitive training, or also named “sports vision training”, refers to a broad range of interventions designed to enhance the processing, integration, and use of visual information in perceptual-motor tasks. Unlike optical correction or the management of visual dysfunction, these approaches are typically applied to enhance performance in healthy athletes.[12]

The evidence base for performance-enhancement interventions is heterogeneous and remains less established than that supporting core optometric care, refractive correction, and ocular protection. Sports vision training should therefore be clearly distinguished from evidence-based clinical care, and its effectiveness should be evaluated primarily according to whether improvements transfer to meaningful real-world sporting performance.

The central objective of sports vision training is the enhancement of sports performance. For true enhancement of sporting performance to occur, vision training would need to ‘transfer’ across to the sport. Accordingly, the concept of transfer is central to evaluating the effectiveness of sports vision training. Transfer can be classified as:

- Near transfer: improvements in tasks similar to the training activity
- Intermediate transfer: improvements in related tasks
- Far transfer: improvements in actual sport performance

While improvements in laboratory-based or training-specific tasks (near transfer) are commonly reported, the extent to which these gains translate into meaningful changes in sport performance remains the key criterion for evaluating effectiveness.[1,3,12] The literature consistently shows that near transfer is common, whereas far transfer is less frequent and highly dependent on task specificity, ecological validity, and training design.[32]

Recent systematic reviews and meta-analyses suggest that certain visual and perceptual training interventions may improve visuomotor skills and, in some cases, sport-related outcomes.[25,33,34] However, the literature remains heterogeneous in terms of intervention types, populations, and outcome measures, thus significantly limiting the strength of general conclusions.

4.1 Low-level visual processing training

Low-level visual training targets basic visual functions such as contrast sensitivity, motion perception, and visual discrimination. These approaches are typically grounded in perceptual learning paradigms, where repeated exposure to specific stimuli leads to improvements in neural efficiency within early visual pathways. Experimental studies demonstrate that perceptual learning can produce significant improvements in contrast sensitivity and spatial discrimination under controlled conditions.[35] However, evidence for transfer beyond the trained stimuli is limited. Improvements are generally restricted to similar visual tasks, with limited generalisation to complex, dynamic sport environments.[36]

From a performance perspective, these interventions primarily demonstrate near transfer, with weak and inconsistent evidence for far transfer to sport-specific outcomes.[36] Consequently, while they may contribute to improving basic visual processing, their isolated use is unlikely to result in meaningful improvements in athletic performance.

4.2 Oculomotor and visuomotor training

Oculomotor and visuomotor training focuses on improving eye movement control (e.g., saccades, pursuits) and the coordination between visual input and motor output. These functions are theoretically relevant to sports requiring tracking, gaze shifts, and rapid visuomotor responses. Athletes have been shown to have a different gaze behavior in comparison to non-athletes.[37–39] However, the causal relationship between isolated oculomotor training and improvements in sport performance remains unclear.

Within this domain, Quiet Eye (QE) phenomenon is a well-established research concept associated with motor performance.[40–42] QE training has also been investigated as an intervention, although evidence regarding its effectiveness and transfer to sport performance remains more limited.

4.3 Perceptual-cognitive training

Perceptual-cognitive training targets higher-order processes such as anticipation, decision-making, visual search, attentional allocation, and the processing of multiple dynamic stimuli. These skills are critical in many sports, particularly those involving complex and rapidly changing environments.

Several studies indicate that expert athletes outperform novices in perceptual-cognitive tasks, particularly in anticipation and decision-making.[11,43] Training studies using sport-specific paradigms, such as video-based temporal occlusion tasks, have shown improvements in anticipation accuracy and response selection.[32,44]

Within this domain, Multiple Object Tracking (MOT) training, including three-dimensional implementations, has received considerable research attention.[45] The evidence regarding transfer of MOT training to real-world sports performance remains mixed. While some studies suggest improvements in passing decision accuracy, reaction time, or game-related metrics following MOT training, others highlight limited or task-specific transfer.[46–48] As with other perceptual-cognitive

approaches, the degree of transfer appears to depend strongly on the ecological validity of the training and its alignment with sport-specific demands.

Importantly, perceptual-cognitive training appears to offer potential for far transfer when it is embedded within representative tasks that preserve the natural coupling between perception and action, as well as the informational and temporal constraints of the particular sport that is under investigation. Under such conditions, training engages the same perceptual processes, decision-making demands, and motor responses required during competition, thereby increasing the likelihood that improvements may generalise to real-world performance within that sport.[32,49] In contrast, isolated or de-contextualised implementations may lead primarily to improvements in the trained task itself.[12,25]

4.4 Visual perturbation training (e.g., stroboscopic training*)*

Sensory perturbation approaches, particularly stroboscopic training, have received increasing attention in recent years as a method to enhance visuomotor performance under conditions of reduced or intermittent visual input.[50] These interventions typically involve the use of stroboscopic eyewear or similar devices that periodically occlude vision, thereby increasing perceptual uncertainty and placing greater demands on predictive processing, attentional allocation, and visuomotor integration. From a mechanistic perspective, stroboscopic training is thought to promote more efficient use of visual information by encouraging the visual system to extract task-relevant cues within limited time windows, while simultaneously enhancing reliance on anticipatory control and sensorimotor memory. This aligns with theoretical frameworks in motor learning suggesting that performance under constrained or degraded sensory conditions may facilitate more robust skill acquisition and retention.

Experimental and controlled studies have consistently reported improvements in visuomotor coordination, reaction time, and selected sport-specific skills following stroboscopic interventions.[51–54] These effects have been observed across a range of sports, including ball sports and interceptive tasks, where rapid processing of dynamic visual information is critical.

Importantly, recent meta-analyses have begun to quantify the effects of stroboscopic training across studies. These analyses generally report moderate effect sizes for visuomotor and perceptual outcomes**,** with emerging evidence for improvements in sport-specific performance measures. In particular, some meta-analytic findings suggest that stroboscopic training may lead to meaningful gains in time- and accuracy-dependent performance outcomes supporting its potential relevance for applied sport contexts.[33,34,55–57] However, while some studies report positive effects on sport-specific tasks, the literature is characterised by substantial heterogeneity in training protocols, duration, participant characteristics, and outcome measures. Furthermore, many studies rely on laboratory-based or semi-ecological tasks rather than in-game performance metrics, limiting the strength of conclusions regarding competitive transfer.

Another important factor is the specificity of the training context. Evidence suggests that the likelihood of transfer increases when stroboscopic training is integrated into sport-specific tasks that preserve perception–action coupling, rather than being performed in isolation. This is consistent with broader principles of representative learning design and may explain some of the variability observed across studies.[36]

Taken together, the current evidence supports stroboscopic training as a promising sensory perturbation approach. However, while meta-analytic findings indicate emerging support for transfer to sport-related outcomes, consistent and generalisable improvements in competitive performance have not yet been firmly established**.** Future research should prioritise ecologically valid study designs, standardisation of training protocols, and the use of objective performance metrics in real sporting contexts. Optometric involvement in such training regimes would be expected to take place as part of a multi-disciplinary team, with sport-scientists and coaches, and in dedicated training facilities rather than in clinical settings.

4.5 Integrated and representative training approaches

Integrated training approaches embed visual demands within realistic, sport-specific contexts, aligning with the concept of representative learning design. These interventions aim to preserve the natural coupling between perception, cognition, and action, which is considered essential for the acquisition and transfer of skill in dynamic environments.[58,59] From a theoretical standpoint, ecological dynamics frameworks emphasise that perceptual and motor processes are functionally interdependent, and that training should reflect the informational constraints present in competition.[49] Accordingly, ecological dynamics frameworks propose that training environments replicating the spatiotemporal structure and decision-making demands of the sport may facilitate more meaningful learning.

In practical terms, integrated approaches include sport-specific drills with embedded visual constraints, small-sided games, reactive decision-making tasks, and immersive simulations. Within this context, the use of reactive light systems or stroboscopic eyewear may be used as constraint-based tools within representative training environments, as they allow controlled manipulation of temporal and visual demands while preserving perception–action coupling. Importantly, unlike the isolated and often decontextualised use described above, these tools are applied while athletes are actively performing sport-specific actions, embedding the visual constraint within the movement itself rather than separating it from action. In theory, embedding visual constraints within representative training environments may increase the likelihood of transfer to sport performance. However, further evidence is required to determine the extent to which such transfer occurs in practice.

Evidence from perceptual-cognitive research indicates that training based on representative tasks improves anticipation and decision-making in sport-specific contexts, with greater transfer compared to de-contextualised or generic training methods.[32,60,61] A key advantage of these approaches is their potential to facilitate far transfer to sport performance, as they target the same perceptual and motor processes required during competition.

Emerging evidence supports the potential effectiveness of integrated approaches in enhancing decision-making and visuomotor performance.[25,62,63] A recent meta-analysis provides further support for integrated sports vision training approaches. A systematic review and meta-analysis of multicomponent sports vision training batteries reported significant improvements in both time- and accuracy-dependent outcomes assessed during sport-specific tasks.[64] These findings suggest that integrated interventions combining visual, perceptual-cognitive and motor demands may facilitate transfer to sport-relevant performance. However, substantial between-study heterogeneity was observed, particularly for time-dependent outcomes, and improvements in sport-specific tasks should not necessarily be interpreted as equivalent to enhanced competitive performance. Taken together, integrated and representative training approaches provide a conceptually attractive framework and are supported by emerging meta-

analytic evidence. However, further high-quality and ecologically valid studies are required to establish their impact on competitive performance.

4.6 Transfer of training and implications for practice

Current literature consistently shows that near transfer is common, whereas far transfer is less frequent and highly dependent on task specificity, ecological validity, and training design.[62,63]

A key implication is that interventions lacking sport specificity or performed in artificial environments are unlikely to produce meaningful improvements in competitive performance. Conversely, training that closely replicates the perceptual and motor demands of the sport is more likely to result in transferable gains (i.e., far transfer).

Taken together, the available evidence supports a cautious but evolving role for sports vision training. While certain approaches show promising results (e.g., stroboscopic training or integrated approaches), the overall evidence base remains limited by methodological heterogeneity.

Crucially, the primary objective of these interventions should be the enhancement of sports performance (far transfer). Improvements restricted to laboratory-based or training-specific tasks should not be interpreted as evidence of effectiveness in competitive contexts.

Therefore, sensory training should be considered an adjunct to evidence-based optometric care, and its application should be guided by:

- Scientific evidence
- Task specificity
- Ecological validity
- Clearly defined performance outcomes

Interventions that do not meet these criteria, particularly those making generalised or unsupported claims, should be interpreted with caution.

5 CONCLUSIONS

Eye care professionals have a significant role to play in helping individuals access sport and exercise at all levels from recreational to elite levels. This report provides information across three areas, (i) stemming from the core eyecare domain of visual and ocular health assessment of athletes, (ii) how to effectively manage and prescribe visual aids and (iii) synthesising the current scientific evidence regarding the potential applications, effectiveness, and limitations of sports vision training. Last but not least, sports vision represents a valuable area of research, as its methodologies, analytical approaches, and solutions may offer important insights and serve as reference examples for the development of effective practices in vision assessment and correction in everyday settings.

REFERENCES

1. Laby DM, Appelbaum LG. Vision and On-field Performance: A Critical Review of Visual Assessment and Training Studies with Athletes. Optometry and Vision Science. 2021;98(7):723–31. doi:10.1097/OPX.0000000000001729 PubMed PMID: 34328451.

2. Erickson GB. Visual Performance Assessments for Sport. Optometry and Vision Science. 2021;98(7):672–80. doi:10.1097/OPX.0000000000001731 PubMed PMID: 34328449.

3. Erickson GB. Sports vision: vision care for the enhancement of sports performance. Elsevier Health Sciences; 2020.

4. Burris K, Liu S, Appelbaum L. Visual-motor expertise in athletes: Insights from semiparametric modelling of 2317 athletes tested on the Nike SPARQ Sensory Station. J Sports Sci. 2020 Feb 1;38(3):320–9. doi:10.1080/02640414.2019.1698090 PubMed PMID: 31782684.

5. Yee A, Thompson B, Irving E, Dalton K. Athletes demonstrate superior dynamic visual acuity. Optometry and Vision Science. 2021;98(7):777–82.

6. Vera J, Jiménez R, Cárdenas D, Redondo B, García JA. Visual function, performance, and processing of basketball players vs. sedentary individuals. J Sport Health Sci. 2020;9(6):587–94. doi:10.1016/j.jshs.2017.05.001 PubMed PMID: 33308808.

7. Lochhead L, Feng J, Laby DM, Appelbaum LG. Visual performance and sports: A scoping review. J Sport Exerc Psychol. 2024;46(4):205–17.

8. Vera J, Redondo B, Molina R, Jiménez R, Dalton K. Relationship between dynamic visual acuity and multiple object tracking performance. Perception. 2022;51(8):539–48.

9. Hirano M, Hutchings N, Simpson T, Dalton K. Validity and repeatability of a novel dynamic visual acuity system. Optometry and Vision Science. 2017;94(5):616–25.

10. Jorge J, Diaz-Rey A, Lira M. Prevalence of binocular vision dysfunctions in professional football players. Clin Exp Optom. 2022;105(8):853–9.

11. Mann DY, Williams AM, Ward P, Janelle CM. Perceptual-cognitive expertise in sport: A meta-analysis. J Sport Exerc Psychol. 2007;29(4):457–78. doi:10.1123/jsep.29.4.457 PubMed PMID: 17968048.

12. Appelbaum LG, Erickson G. Sports vision training: A review of the state-of-the-art in digital training techniques. Int Rev Sport Exerc Psychol. 2018;11(1):160–89. doi:10.1080/1750984X.2016.1266376

13. Tu J, Lin Y, Chin S. The influence of ball velocity and court illumination on reaction time for tennis volley. J Sports Sci Med. 2010;9(1):56–61.

14. Harris RW, Cole BL. Abnormal colour vision is a handicap to playing cricket but not an insurmountable one. Clin Exp Optom. 2007;90(6):451–6.

15. Hodges NJ, Wyder-Hodge PA, Hetherington S, Baker J, Besler Z, Spering M. Topical Review: Perceptual-cognitive Skills, Methods, and Skill-based Comparisons in Interceptive Sports. Optometry and Vision Science. Lippincott Williams and Wilkins; 2021. p. 681–95. doi:10.1097/OPX.0000000000001727 PubMed PMID: 34328450.

16. Vera J, Molina R, Cárdenas D, Redondo B, Jiménez R. Basketball free-throws performance depends on the integrity of binocular vision. Eur J Sport Sci. 2020;20(3):407–14. doi:10.1080/17461391.2019.1632385

17. Leivers HK, Allen PM, Timmis MA, Zenk F, Uppal J, Runswick OR. The effects of simulated monocular and binocular vision impairment on football penalty kick performance. Eur J Sport Sci. 2024;24(7):918–29.

18. Zwierko T, Redondo B, Jedziniak W, Molina R, Jiménez R, Vera J. Gaze behaviour during multiple object tracking is dependent on binocular vision integrity. Ophthalmic and Physiological Optics. 2024;44(1):23–31.

19. Mann D, Abernethy B, Farrow D. The resilience of natural interceptive actions to refractive blur. Hum Mov Sci. 2010;29(3):386–400.

20. Alcaraz-Rodríguez V, Medina-Rebollo D, Muñoz-Llerena A, Fernández-Gavira J. Influence of physical activity and sport on the inclusion of people with visual impairment: A systematic review. Int J Environ Res Public Health. 2022;19(1):443.

21. Mann D, Ravensbergen H. International Paralympic Committee (IPC) and International Blind Sports Federation (IBSA) Joint Position Stand on the Sport-Specific Classification of Athletes with Vision Impairment. Sports Medicine. 2018;48(9):2011–23. doi:10.1007/s40279-018-0949-6 PubMed PMID: 29987675.

22. Chun R, Creese M, Massof RW. Topical Review: Understanding Vision Impairment and Sports Performance through a Look at Paralympic Classification. Optometry and Vision Science. 2021 Jul 1;98(7):759–63. doi:10.1097/OPX.0000000000001723 PubMed PMID: 34328454.

23. Zeri F, Livi S, Maffioletti S. Attitudes towards visual correction in sport: What coaches, physical education teachers and sports physicians think. Contact lens and anterior eye. 2011;34(2):71–6.

24. Zeri F, Pitzalis S, Di Vizio A, Ruffinatto T, Egizi F, Di Russo F, et al. Refractive error and vision correction in a general sports-playing population. Clin Exp Optom. 2018;101(2):225–36.

25. Lochhead L, Feng J, Laby DM, Appelbaum LG. Training vision in athletes to improve sports performance: a systematic review of the literature. Int Rev Sport Exerc Psychol. 2026;19(2):333–55. doi:10.1080/1750984X.2024.2437385

26. Erickson GB. Optimizing Visual Performance for Sport. Advances in Ophthalmology and Optometry. Elsevier Inc; 2018. p. 1–19. doi:10.1016/j.yaoo.2018.05.001

27. Erickson GB, Horn FC, Barney T, Pexton B, Baird RY. Visual performance with sport-tinted contact lenses in natural sunlight. Optometry and vision science. 2009;86(5):509–16.

28. Moe MC, Özmert E, Baudouin C, Binadra A, Crafoord S, Jo Y, et al. International Olympic Committee (IOC) consensus paper on sports-related ophthalmology issues in elite sports. BMJ Open Sport Exerc Med. 2023;9(3).

29. Hoskin AK, Mackey DA, Keay L, Agrawal R, Watson S. Eye Injuries across history and the evolution of eye protection. Acta Ophthalmol. 2019;97(6):637–43.

30. Mazarelo JFD, Winter SL, Fong DTP. A systematic review on the effectiveness of eyewear in reducing the incidence and severity of eye injuries in racket sports. Phys Sportsmed. 2024;52(2):115–24.

31. Little JA, Eckert F, Douglas M, Barrett BT. Eyewear for Rugby Union: Wearer Characteristics and Experience with Rugby Goggles. Int J Sports Med. 2020 Jan 27;41(5):311–7. doi:10.1055/a-1068-9501 PubMed PMID: 31986547.

32. Broadbent DP, Causer J, Williams AM, Ford PR. Perceptual-cognitive skill training and its transfer to expert performance in the field: Future research directions. Eur J Sport Sci. 2015 May 19;15(4):322–31. doi:10.1080/17461391.2014.957727 PubMed PMID: 25252156.

33. Vera J, Cantó-Cerdán M, García-Ramos A, Redondo B. Acute and long-term effects of stroboscopic training on sport performance: A systematic review and meta-analysis. J Sports Sci. 2026;44(4):604–15. doi:10.1080/02640414.2025.2598176

34. Wang Y, Wang Q, Bao H, Dong X, Cai K, Chen A. A systematic review and three-level meta-analysis of the effects of stroboscopic training on sport-specific performance. J Sports Sci. 2026;44(4):460–76. doi:10.1080/02640414.2025.2592441

35. Sagi D. Perceptual learning in vision research. Vision Res. 2011;51(13):1552–66.

36. Hadlow SM, Panchuk D, Mann DL, Portus MR, Abernethy B. Modified perceptual training in sport: A new classification framework. J Sci Med Sport. 2018;21(9):950–8. doi:10.1016/j.jsams.2018.01.011 PubMed PMID: 29433921.

37. Styrkowiec P, Czyż SH, Hyönä J, Li J, Oksama L, Raś M. Gaze behavior and cognitive performance on tasks of multiple object tracking and multiple identity tracking by handball players and non-athletes. Percept Mot Skills. 2024;131(3):818–42.

38. Martell SG, Vickers JN. Gaze characteristics of elite and near-elite athletes in ice hockey defensive tactics. Hum Mov Sci. 2004;22(6):689–712.

39. Kredel R, Vater C, Klostermann A, Hossner EJ. Eye-tracking technology and the dynamics of natural gaze behavior in sports: A systematic review of 40 years of research. Front Psychol. 2017;8:1845.

40. Dalton K. The quiet eye in sports performance—Is the quiet eye the ultimate explanation or only the beginning? Optometry and Vision Science. 2021;98(7):732–7.

41. Vine SJ, Moore LJ, Wilson MR. Quiet eye training: The acquisition, refinement and resilient performance of targeting skills. Eur J Sport Sci. 2014;14(sup1):S235–42.

42. Lebeau JC, Liu S, Sáenz-Moncaleano C, Sanduvete-Chaves S, Chacón-Moscoso S, Becker BJ, et al. Quiet eye and performance in sport: A meta-analysis. J Sport Exerc Psychol. 2016;38(5):441–57.

43. Roca A, Ford PR, McRobert AP, Williams AM. Perceptual-cognitive skills and their interaction as a function of task constraints in soccer. J Sport Exerc Psychol. 2013;35(2):144–55.

44. Williams AM, Ward P, Smeeton NJ, Allen D. Developing anticipation skills in tennis using on-court instruction: Perception versus perception and action. J Appl Sport Psychol. 2004;16(4):350–60.

45. Romeas T, Guldner A, Faubert J. 3D-Multiple Object Tracking training task improves passing decision-making accuracy in soccer players. Psychol Sport Exerc. 2016;22:1–9. doi:10.1016/j.psychsport.2015.06.002

46. Ehmann P, Beavan A, Spielmann J, Mayer J, Ruf L, Altmann S, et al. Perceptual-cognitive performance of youth soccer players in a 360°-environment – An investigation of the relationship with soccer-specific performance and the effects of systematic training. Psychol Sport Exerc. 2022 Jul 1;61. doi:10.1016/j.psychsport.2022.102220

47. Harenberg S, McCarver Z, Worley J, Murr D, Vosloo J, Kakar RS, et al. The effectiveness of 3D multiple object tracking training on decision-making in soccer. Science and Medicine in Football. 2022;6(3):355–62. doi:10.1080/24733938.2021.1965201 PubMed PMID: 35862166.

48. Romeas T, Goujat M, Faubert J, Labbé D. No transfer of 3D-Multiple Object Tracking training on game performance in soccer: A follow-up study. Psychol Sport Exerc. 2025 Jan 1;76. doi:10.1016/j.psychsport.2024.102770

49. Davids K, Araújo D, Vilar L, Renshaw I, Pinder R. An ecological dynamics approach to skill acquisition: Implications for development of talent in sport. Talent Development and Excellence. 2013;5(1):21–34.

50. Wilkins L, Appelbaum LG. An early review of stroboscopic visual training: insights, challenges and accomplishments to guide future studies. Int Rev Sport Exerc Psychol. 2020;13(1):65–80. doi:10.1080/1750984X.2019.1582081

51. Hülsdünker T, Rentz C, Ruhnow D, Käsbauer H, Strüder HK, Mierau A. The effect of 4-week stroboscopic training on visual function and sport-specific visuomotor performance in top-level badminton players. Int J Sports Physiol Perform. 2019;14(3):343–50.

52. Zwierko M, Jedziniak W, Popowczak M, Rokita A. Effects of six-week stroboscopic training program on visuomotor reaction speed in goal-directed movements in young volleyball players: a study focusing on agility performance. BMC Sports Sci Med Rehabil. 2024;16(59). doi:10.1186/s13102-024-00848-y

53. Zwierko T, Tapia V, Vera J, Redondo B, Morenas-Aguilar MD, García-Ramos A. Enhancing reactive agility in soccer: The impact of stroboscopic eyewear during warm-up across fatigued and non-fatigued conditions. Eur J Sport Sci. 2024;24(12):1798–808. doi:10.1002/ejsc.12224

54. Wilkins L, Gray R. Effects of stroboscopic visual training on visual attention, motion perception, and catching performance. Percept Mot Skills. 2015;121(1):57–79. doi:10.2466/22.25.PMS.121c11x0 PubMed PMID: 26126135.

55. Luo Y, Cao Y, Pan X, Li S, Koh D, Shi Y. Effects of stroboscopic visual training on reaction time and movement accuracy in collegiate athletes: a systematic review and meta-analysis. Sci Rep. 2025;15(1):25151. doi:10.1038/s41598-025-10393-4 PubMed PMID: 40646137.

56. Guo J, Zhao L, Liu G, Li H, Wu J. Stroboscopic training effects on athletic performance and cognitive function across populations, purposes, and skill types: a systematic review and meta-analysis of randomized controlled trials. Front Sports Act Living. 2025;7:1705693.

57. Ren Y, Zhang J, Sun X, Qi F, Guo F. The effects of stroboscopic visual training on human cognitive function and motor performance: a systematic review. Front Physiol. 2025;16:1708783.

58. Pinder RA, Davids K, Renshaw I, Araújo D. Representative learning design and functionality of research and practice in sport. J Sport Exerc Psychol. 2011;33(1):146–55. doi:10.1123/jsep.33.1.146 PubMed PMID: 21451175.

59. Renshaw I, Davids K, O'Sullivan M, Maloney MA, Crowther R, McCosker C. An ecological dynamics approach to motor learning in practice: Reframing the learning and performing relationship in high performance sport. Asian Journal of Sport and Exercise Psychology. 2022 Jun 1;2(1):18–26. doi:10.1016/j.ajsep.2022.04.003

60. Oppici L, Panchuk D. Specific and general transfer of perceptual-motor skills and learning between sports: A systematic review. Psychology of Sport and Exercise. Elsevier Ltd; 2022. doi:10.1016/j.psychsport.2021.102118

61. Zhu R, Zheng M, Liu S, Guo J, Cao C. Effects of Perceptual-Cognitive Training on Anticipation and Decision-Making Skills in Team Sports: A Systematic Review and Meta-Analysis. Behavioral Sciences. Multidisciplinary Digital Publishing Institute (MDPI); 2024. doi:10.3390/bs14100919

62. Appelbaum LG, Lochhead L, Feng J, Erickson G, Liu S, Laby DM. Limited Evidence is Not No Evidence: A Rebuttal to Fransen, 2024. Sports Medicine. 2025 Jan 1;55(1):241–2. doi:10.1007/s40279-024-02141-x PubMed PMID: 39718745.

63. Fransen J. There is No Supporting Evidence for a Far Transfer of General Perceptual or Cognitive Training to Sports Performance. Sports Medicine. 2024 Nov 1;54(11):2717–24. doi:10.1007/s40279-024-02060-x PubMed PMID: 38907178.

64. Vera J, Redondo B, García-Ramos A, Cantó-Cerdán M. Effects of Integrated Sports Vision Training Batteries on Time- and Accuracy-Dependent Outcomes in Sport-Specific Tasks: A Systematic

Review and Meta-Analysis. Ophthalmic and Physiological Optics. 2026;46(5):1006–13. doi:10.1007/s44402-026-00147-8

AUTHORS AND AFFILIATIONS

AUTHORS Dr Jesus Vera Vilchez[1], Dr Matjaz Mihelcic[2], Prof Julie-Anne Little[3], Prof Brendan Barrett[4], Ignacio Costa Gonzalez[5], Pavel Sebek[6]

AFFILIATIONS [1] Universidad de Granada, Spain; [2] Društvo očesnih optikov Slovenije (DOOS), Slovenia; [3] Ulster University, UK; [4] University of Bradford, UK; [5] Consejo General de Colegios de Ópticos-Optometristas (C.G.C.O.O.), Spain; [6] Společenstvo českých optiků a optometristů z.s. (SCOO), Czech Republic

APPROVED ECOO Professional Services Committee and ECOO Executive Committee

CONTACT ECOO Secretariat · secretariat@ecoo.info

ABOUT ECOO

ABOUT ECOO

The European Council of Optometry and Optics (ECOO) is the European organisation which represents the interests of optometrists and opticians from 25 countries. It aims to promote eye health to the public across borders and to harmonise clinical and educational standards of optometric and optical practice throughout Europe.

www.ecoo.info · secretariat@ecoo.info · LinkedIn: European Council of Optometry and Optics