

APPENDIX - General testing approaches applicable to elite sport

Table 1. General testing approaches applicable to elite sport**Visual Acuity**

A commonly used test that involves reading progressively smaller letters on a chart usually placed 20 feet away.

Visual Processing Speed and Hand-Eye Coordination

Ability to see and react quickly to objects such as hitting a baseball, catching a pass, returning a tennis serve, or stopping a puck. This tests assesses how quickly one can process and react to visual information.

Contrast Sensitivity

A test to quickly identify and track objects against various backgrounds, which is an important visual skill for athletes who play in challenging conditions and varying lighting levels. An example of this is baseball or softball players trying to track the ball as it leaves the hand of a pitcher or off the bat of a hitter during a night game under lights.

Eye Tracking

An athlete must be able to quickly and accurately locate landmarks and follow objects (i.e., a football goalkeeper). There are a number of Eye Tracking tests that assess how well one's eyes follow moving objects.

Ocular Alignment

Tests to determine how well eyes work together and respond to visual stimuli.

Eye Dominance

Knowing which eye is your dominant eye can help one perform better in a variety of activities such as target shooting, archery, and golf. This information is critical for proper alignment relative to one's dominant eye for drives, fairway shots, and putting.

Depth Perception

Depth perception refers to one's ability to focus on an object and determine approximately how far away it is. Testing may reveal poor depth perception for an athlete consistently over- or underestimating the distance to a target. For example, athletes, such as football and tennis players, need to be able to quickly and accurately judge the distance between themselves and the ball, their opponents, teammates, and out-of-bounds lines.

Table 2. Thirteen components of vision that seem to be important in shooting

1. **Visual acuity:** Both static (discerning detail of a stationary target) and dynamic visual acuity (discerning detail of a moving target) are important to, for example, a marksman. Good dynamic acuity will enhance a shooter's visual reaction time and eye-tracking abilities.
2. **Peripheral vision:** Skilful shooters have reported a visual ability to maintain an awareness of a central target while simultaneously maintaining a vast amount of peripheral visual awareness. A fully functioning visual system is capable of responding to objects located within a total visual field (which for each eye is approximately 40 degrees up, 60 degrees toward the nose, 70 degrees down, and 90 degrees towards the temple measured from a central point of fixation). It is critical that shooters are aware of what is beyond and around the target to ensure safety, and peripheral vision awareness is crucial to achieving this task.
3. **Depth perception:** An essential skill for the shooter who needs to judge relative distances between targets.
4. **Eye motility:** Eye tracking abilities are crucial to maintain accurate detail and awareness of any moving target. This skill is highly critical if a marksman needs to shoot a moving target.
5. **Eye-hand-body-mind coordination:** A necessary set of visual coordinated abilities that are used in developing precise trigger control while maintaining precise aim on the target.
6. **Visualisation:** The ability to use your "mind's eye" to create a mental visual picture when the direct view of a target may not be possible. This highly developed visual skill is useful to anticipate where a target or adversary is most likely to be located during episodes of lack of direct vision.
7. **Speed of recognition time:** Extremely important when a target may be only visible for a brief moment in time. The ability to accurately recognize as much of a target in as little as 0.01 seconds can be critical in deciding to shoot, or not shoot, a target.
8. **Eye focusing flexibility:** This ability plays an extremely important part of a shooter's ability to quickly adjust focus upon targets that are located in different distances in space. The speed and flexibility of quickly changing eye focus from one point in space to another point in space have a direct influence on maintaining clear, single binocular vision while in shooting competition or in combat.
9. **Colour perception:** This may prove to be a useful skill when confronted with the need to engage targets of specific colouring.
10. **Fixation ability:** Necessary to establish 'sight picture' awareness and consistency.
11. **Visual memory:** Used to embed the learning elements of training to help skills reach the point of automaticity. Training to the point of automaticity implies that the speed of processing and performing a set of skills is fast, there is a relative lack of effort to perform a skill, and the skill is autonomous such that it may be initiated and run completely on its own without an active voluntary conscious thought process. The automatic realisation of shooting skills is useful in avoiding visual perceptual overload resulting in confusion in target recognition.
12. **Central-peripheral awareness:** The ability to have awareness of the central details of a target and simultaneously be aware of the visual space surrounding the target (the peripheral space around the target). This skill helps a shooter avoid getting locked into "tunnel vision" for extended periods of time.
13. **Quiet Eye:** It is a gaze behaviour that seems to differentiate both expert-novice performance and successful and unsuccessful performance in experts; however, the quiet eye may only represent one aspect of the perceptual-cognitive expertise differences that exist between athletes and non-athletes.

Table 3. Some commonly used training modalities use by elite athletes

Eye-tracking technology is a non-invasive objective test that measures and analyses an athlete's eye movement brain processing and reaction time.

Sensory Station is a sensory evaluation and training platform that assesses 10 visual and sensorimotor skills in less than 25 minutes allowing therapists and athletes to quickly identify opportunities to improve sensory performance. It includes automated data collection analysis and immediate reporting. Used in various sports including volleyball boxing and tennis.

NeuroTracker - Another platform designed to improve reflexes reaction time and focus is the NeuroTracker. A typical exercise starts with seven stationary brightly coloured balls on a dark background. Four of the balls turn red for a second before returning to their original colour. Then all seven begin moving rapidly bouncing around on the screen. The athlete's task is to maintain focus on the balls that briefly turned red.

Gamified neuro-fitness is a platform designed to improve eye-hand coordination and reaction time among other metrics. The system comes with a 6 foot by 2 foot LED touch screen that can be mounted on a wall or with a tripod stand. In one of its "games" called "Minefield" athletes stand in front of the screen and for 30 seconds they attempt to spot and respond to flashing lights of varying colours. Though the LED screen is large it is also lightweight meaning it can travel with athletes and teams wherever competition takes them.
