



ELIPSYS

ELITE PERFORMANCE SYSTEMS

**JUNE
2023**

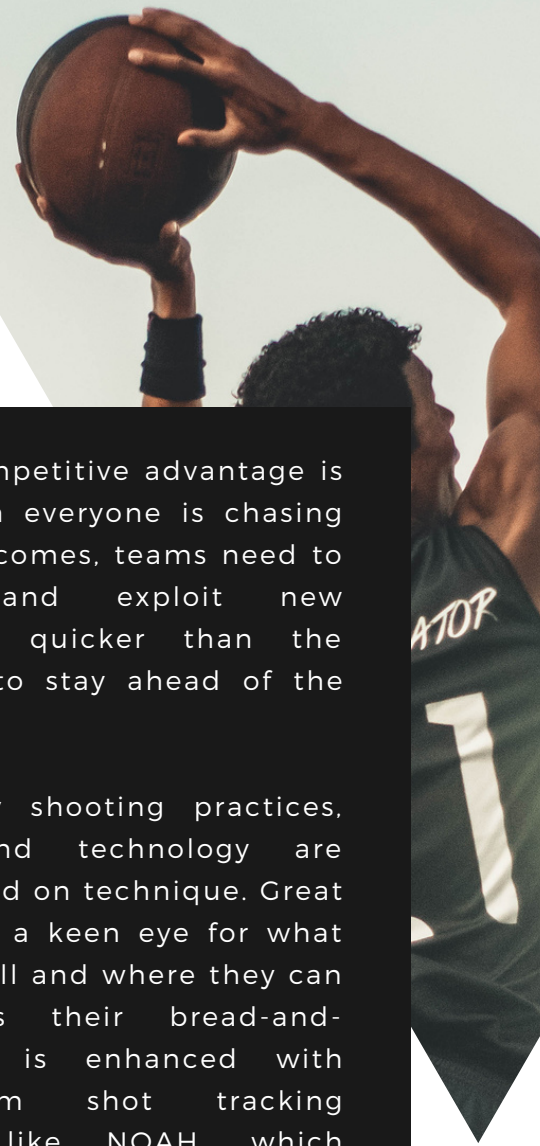
AIM SMALL MISS SMALL

EYE TRACKING & QUIET
EYE® IN BASKETBALL

By Dr Derek Panchuk, Founder

© Elipsys, 2023

THE RISE OF THE SHOOTER



Shooting is at a premium in modern basketball thanks to a transformation in playing style over the last 8 years.

With the rise of analytics and its influence on tactics, 3-point shooting is more prevalent than ever. Player and shot tracking technology has enabled greater access to performance data. And specialist coaches are providing more individualized approaches to player development.

This means players who get the most out of their playing time are more valuable, coaches who can accelerate development towards a player's potential are priceless, and technology that transforms performance is worth its weight in gold.

These changes are shifting the conversation on what being a good shooter means. Every player is expected to have the capability to shoot the ball from anywhere on the court.

But what's the ceiling? How do you make already good shooters better?

Finding a competitive advantage is critical. When everyone is chasing the same outcomes, teams need to look for and exploit new opportunities quicker than the competition to stay ahead of the pack.

Contemporary shooting practices, coaching, and technology are heavily focused on technique. Great coaches have a keen eye for what players do well and where they can improve. It's their bread-and-butter. This is enhanced with insight from shot tracking technology, like NOAH, which provides a more precise view of shooting and allows players to refine their technique like never before. The rise of biomechanical analyses will allow coaches to dissect shooting technique in new ways.

There's no question, the technical side of shooting in the NBA is elite. It's not perfect and there is room to grow, but the margins are getting smaller.

Teams need to look beyond technique for bigger returns on their investment. But where?

MORE THAN TECHNIQUE: COMPLETING THE PERFORMANCE PUZZLE

Effective shooting is more than just action.

Shooting is a complex, multifactorial skill and, if we think about shooting like a puzzle, technique is just one piece of many. Physical capabilities, strength, flexibility, and psychological factors are other pieces. The challenge for players, and the key to effective shooting, is putting these pieces together at the right time.

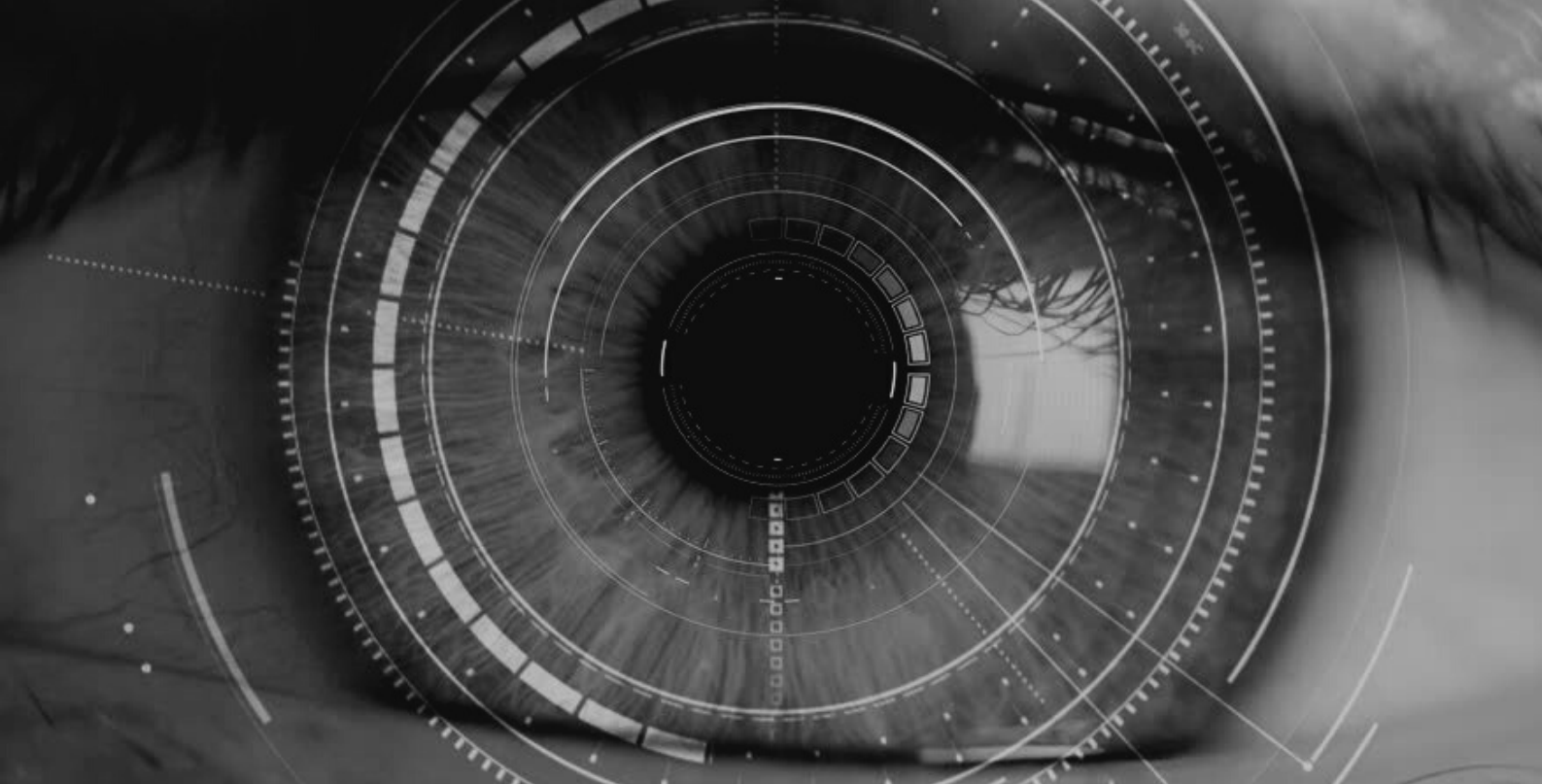
But one of the most obvious pieces is often the most overlooked.

**“IT DOESN'T MATTER HOW AN ATHLETE EXPLODES FROM
END TO END IF THEY CAN'T RECOGNIZE THE UNDERLYING
PATTERNS IN FRONT OF THEM IN A SMALL WINDOW OF
TIME.”**

Players need to see the right things at the right time. They need to make decisions about whether to shoot or not using information available for an instant; to use a laser-like focus to find and hit a target through a wall of traffic. Reviews of the scientific literature in basketball shooting consistently highlight that good vision is essential for good shooting. But it's also a piece of the puzzle coaches and players can't see.

YET.





EYE TRACKING: THE MISSING PIECE

Until now, coaches and teams had to guess about what players see and how they focus. There's always been an assumption that vision is important, but how do you coach something you can't see? Eye tracking takes away the guesswork by providing a glimpse into the mind of the player

Eye tracking uses technology to let us see what players see. Modern eye trackers are essentially a pair of glasses with tiny cameras embedded into the frame that record the position of the eye. This is combined with a camera mounted in the glasses between the eyes that records the world from the player's perspective. The eye tracker uses the data from the eyes to place a small cursor on the first-person video which represents where the player is looking.

The eye tracking glasses can be worn in almost any performance environment and allow athletes to perform skills in a natural way. Recording data is easy; just slip on the glasses, complete a short calibration procedure, and away you go! We've used them in sports from ballet to downhill skiing and there aren't really many sports you can't do eye tracking in these days.

By using eye tracking to provide new pieces of the performance puzzle, we can raise the ceiling on where performance could go by giving access to new insight. Rather than just refining skill around the edges, eye tracking opens a whole new world of possibilities for assessing and identifying talent and building shooting skill.

A close-up profile of a person wearing a Tobii eye-tracking device on their glasses. They are holding a red basketball with both hands. The background is dark, and the lighting highlights the person's face and the texture of the basketball.

A WINDOW ON PERFORMANCE

Eye tracking has been studied in sports since the late 1970s and psychologists studied eye movements well before then. The interest in eye tracking stems from the link between eye movements and attention – we can't move our eyes without moving our attention. This means that measuring eye movements in sport provides a good indication of what is important for athletes while they are performing.

With this link in mind, sport researchers have been interested in where athletes look and how long they look at different areas in the performance environment. If athletes spend more time looking at particular locations, then we can assume that area is important for supporting performance. By measuring when and how long athletes look at those features, we can begin to understand how they link to performance. To put it simply, understanding eye movements gives insight into the perception-action relationship that underpins skilled performance, but without eye tracking you're only seeing 50% of the equation.

The sequence of eye movements that athletes use while they're performing also provides insight into how they learn skills. Research shows that as player's skill level improves, their eye movements change as well. An extensive body of research across many sports has demonstrated that the eye movements of elite performers are different from their lesser-skilled counterparts. In aiming sports like golf, for example, skilled golfers look at fewer locations for longer durations. And in tactical sports, like hockey, players scan a wide range of locations early and then zoom in on specific areas as they get closer to making a decision and performing an action.

Essentially, the gaze behaviour of elite athletes is more efficient and optimized for the specific sport skill they are required to perform. These visual skills are learned through experience and training. This combination helps elite performers develop visual skills that help them look at the right things at the right time and these subtle differences in behaviour can mean the difference between success and failure.

QUIET EYE®

3 consistent results from Quiet Eye research:

1. Elite performers across sports tend to have a QE that occurs earlier and is longer in duration than their lesser-skilled and novice counterparts.
2. QE varies across tasks but is optimized for the specific task being performed (e.g., it is 2-3 seconds in golf and 300 milliseconds in a jump shot).
3. When elite performers are successful, their QE tends to start earlier and have a longer duration than when they are unsuccessful.

While many types of eye movements can be assessed during sport performance, fixation are of particular interest. Fixations are periods of time where the eyes are still, and information is perceived. In sport, one fixation that has received a significant amount of attention is the Quiet Eye (QE).

QE was discovered by Prof Joan Vickers in 1996 and is formally defined as the final fixation or tracking gaze located on an object or location in the performance environment within 3-degrees of visual angle (about twice the width of your thumb at arm's length) for 100 milliseconds. Put simply, it's the last good look an athlete has at a critical location before the point-of-no-return during execution of a sport skill. For example, it's the final fixation on the ball before the fore swing on a golf putt or before swinging a baseball bat.

QE is important because it helps establish a link between perception and action. By focusing their attention on the right location in the performance environment, players can perceive important visual information that supports the emergence of successful coordination patterns. Essentially, good information, leads to good action. Research measuring brain activity and QE supports this by showing strong associations between areas of the brain that link the detection of important visual information, response execution, and QE duration.



Mobile eye tracking technology has allowed QE to be assessed in over 35 different sports and motor skills. Everything from shooting, goalkeeping, and tennis to surgery and ballet.

These findings were supported by a 2016 meta-analysis (this is a study that analyzes the existing research in a particular field and is considered one of the highest forms of scientific study) of 36 research studies that looked specifically at QE. The analysis found large expertise differences in the QE as well as moderate effects for successful vs unsuccessful performances.

Given the wide range of studies on QE, it's probably not surprising that it is one of the most notable and consistent scientific findings in research on visual perception in sport. In fact, in a 2007 meta-analysis of 42 different studies on perceptual and cognitive expertise, QE was one of only three variables that distinguished experts and non-experts!

SO, WHAT ABOUT BASKETBALL?



THE FREE THROW: ORIGINS OF QUIET EYE®

In basketball, visual performance has been identified as a critical contributor to shooting effectiveness. As a result, basketball is one of the most studied sports for QE researchers. In fact, the free throw is where the QE story begins. In 1996, Prof Joan Vickers used an eye tracking device built into a motorcycle helmet to measure the eye movements of varsity basketball players while they took free throws.

What she discovered was that, compared to lesser skilled shooters (FT% < 65%), players with a higher shooting accuracy (FT% > 75%) had a longer fixation on the hoop before the extension of the elbow during the shooting action. Skilled shooter's QE was 972 milliseconds when they made a FT compared to less than 400 milliseconds for less skilled shooters (see below).

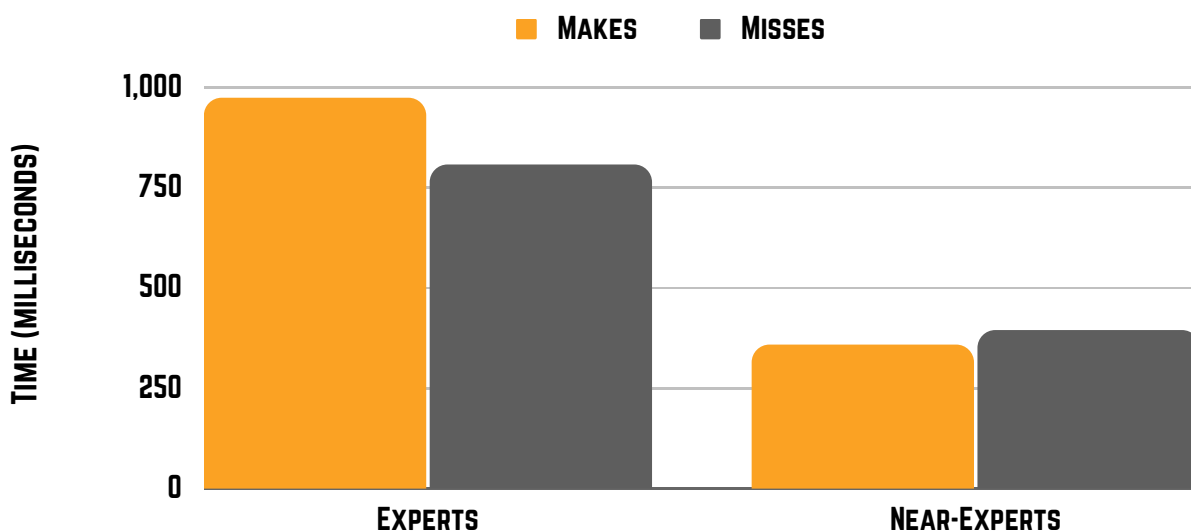
Prof Vickers suggested that the longer QE period was important for supporting the organization of different areas within the brain that coordinate movement and direct attention.

These results have been repeated in numerous studies since Prof Vickers early work and consistently show that, during the free throw, more skilled shooters have longer QE durations (in the range of 800-1000 milliseconds).

The mantra: aim small, miss small is certainly true. Elite players from the NCAA through the NBA have a longer QE and a tight clustering of gaze on the hoop.

More recent research shows that QE isn't only important for shooting accuracy, it can block out the harmful effects of performing under pressure. Basketball players with better QE performed significantly better in stressful situations suggesting that QE can act as a buffer against stress.

When the game is on the line, do you know if your best shooters have a strong QE?





BEYOND THE LINE: QUIET EYE® DURING THE JUMP SHOT

Free throws matter but, given the majority of shots are taken during open play in basketball, it's important to understand how QE translates to the rest of the game. With modern eye tracking technology, it's possible to assess measure eye movements and QE across the entire range of gameplay scenarios.

Quiet Eye helps players shoot better under pressure.

When taking 3-point shots, players have a shorter duration QE in the range of 300-700 milliseconds, compared to 800-1000 milliseconds during FTs. The wider range of QE durations in the 3-point shot is due to differences in pressure and shooting locations used across various studies. When shooters are put under pressure on 3-point shots, QE duration drops to around 300 milliseconds.

This also is consistent with other studies that have measured QE during small-sided games. In catch-and-shoot situations, the ability to move the eyes quickly from the ball during the pass to allow for QE to start earlier was essential. Our own research during game-like conditions, showed that the QE effect was more pronounced when players were put under pressure by an opponent. Compared to unopposed shots, players fixated the hoop earlier and longer when under pressure.

Across a number of studies, it seems that, regardless of the type of shot, better shooters have a longer QE that starts earlier compared to less skilled shooters. This raises an important question: do players who shoot better have better QE to begin with? Or, does the development of QE improve shooting accuracy?



TRAINING QUIET EYE®

200

MILLISECOND
INCREASE IN QE

22%

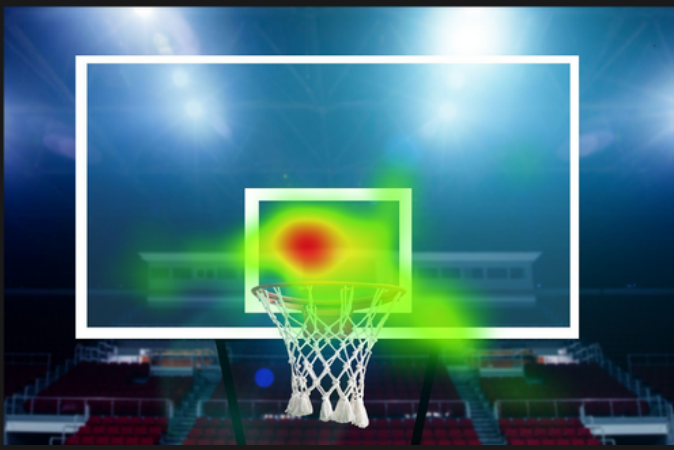
INCREASE IN
TEAM FT%

(results from Harle & Vickers, 2001)

The best part about eye tracking is that, just like muscles and technical skills, we can grow and develop the visual skills of players. Our own meta-analysis of research on perceptual training across a range of sports has shown that using training perceptual skills like vision, can improve skill accuracy by approximately 5% and response time by up to 115 milliseconds.

By assessing player performance using eye trackers, we can identify strengths and deficits, the specific situations that have the biggest impact on performance, and specific metrics that can be improved (e.g., target localization, ball tracking, etc.). It also opens the door for new methods of coaching and using innovative technology to develop skills.

By combining a perceptual focus with their current technical focus, coaches can add new tools to their coaching toolkit and become more wholistic teachers of the game. There are also opportunities to leverage technology like virtual reality and augmented reality to develop visual skills without adding more physical workload.



CAN YOU GUESS WHICH PLAYER IS AN 88% SHOOTER AND WHICH IS A 55% SHOOTER?



If you guessed that player on the bottom is the 88% FT shooter, you'd be correct!

Heatmaps help us visualize where players look while they're performing and how long they spend looking at different areas in the playing environment. "Cooler" areas are marked in green and mean that a player looked there, but not for very long. Areas get "hotter" (yellow then red) when players spend more time looking in that spot.

We know that hot areas that are the places that players find more important for performing. As you can see in the pictures on the left, for both players, the area around the rim is very hot. Which is probably not that surprising given that's where the ball is headed.

What is interesting are the small differences in the amount of time spent looking around the rim. The top player has trouble focusing their eyes on the rim, while the player on the bottom has a laser-like focus. These small amount of focus can mean the difference between a make and miss!

Several scientific studies have trained the QE of players and seen improvements in QE duration, shooting performance, and development of more resilient skills that stand up in the face of pressure. The first QE training study in basketball used a combination of video feedback (players watched their performance and an expert model) and a 3-step QE routine that promoted optimal gaze control during the free throw. The found that players increased their QE by about 200 milliseconds after training, but, more importantly, increased their in-game FT% by 22%!

While a 22% might not be the norm, other studies have shown improvements in shooting performance using QE training. Vine and Wilson used QE-related instructions to promote a free throw routine that increased the duration of QE by 200 milliseconds as well in novice shooters and more than doubled their FT accuracy. QE trained shooters were also able to maintain their accuracy under pressure while an untrained group choked. Similar benefits of QE training have been found in the jump shot. QE-training leads to improved performance and more robust performance under pressure.

THE 7-STEP QUIET EYE[®] TRAINING PROCESS

Through extensive research across a number of sports, a 7-step approach has been developed for QE training.

1

Prototyping

Determining typical QE behaviour between elite and lesser-skilled athletes, as well as differences between successful and unsuccessful performances.

2

Assessment

Measuring QE behaviour using an eye tracking device during a comprehensive skill assessment

3

Instruction

Teach the player the importance of QE and the characteristics of QE in shooting.

4

QE Feedback

Video feedback comparing the player's performance and an optimal model (either the player's successful shots or another player with exceptional QE behaviour).



5

Decision Training

The player determines which aspects of performance to focus on based on the QE feedback

6

Intervention

Development of targeted drills to promote QE behaviour using principles of skill learning (e.g., blocked/random practice).

7

Test

Follow-up assessments using real-world conditions and monitoring of competitive performance.

A great way to think about QE training is as a high-tech assessment with low-tech interventions. Once a player's eye movements and QE have been assessed during performance using an eye tracker, training can be implemented quite easily using video review, development of QE-aligned shooting routines, and deliberate practice of QE strategies in shooting.

HIGH-TECH ASSESSMENT, LOW-TECH INTERVENTION

WHY EYE TRACKING?

Eye tracking and QE training isn't a silver bullet. But it can help organizations get a more complete view of the performance puzzle and see a side of the game they've never seen before. It opens the door for new ways of thinking about performance and player development and helps organizations navigate the challenges of modern-day basketball.

There are number of potential benefits for using eye tracking as part of the player development process including:



TALENT ID

Player scouting and testing is focused on physical and technical performance, but eye tracking can provide new insight into a player's potential. Eye tracking could be used to uncover hidden gems by giving teams a look into the minds of the players their scouting or avoiding potential busts who haven't got the visual tools to excel.



PLAYER PROFILING

Eye tracking assessments add to a wholistic view of player performance. Understanding baseline visual performance can be used to identify potential areas for improvement but can also be used as a benchmark when players are injured or have shooting slump. Differences in visual performance from baseline may indicate the root cause of dysfunctional shooting where there are no obvious technical issues.



TRAINING

Not every player is going to need to QE training but, for those who do, eye tracking assessments can be used to pinpoint deficiencies for training and guide the design of routines and drills to improve performance.



COACHING

Understanding eye tracking to promote a focus on vision and attention can help coaches discover new tools for their coaching toolkit. It unlocks new areas for coaching that can optimize workload by ensuring that the right priorities are being focused on. Plus, improved intelligence on where visual performance breaks down can be used to inform practice design.



**IS IT TIME TO
SEE WHAT
YOU'VE BEEN
MISSING?**

ELIPSYS

Contact us at info@elipsystech.com