



The future of Quiet Eye research – comment on Vickers

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ABSTRACT

The Quiet Eye (QE) phenomenon has a robust literature base. However, the specific mechanisms by which the QE enables athletes to be more accurate are still not fully understood. Furthermore, QE has been shown to negate the negative effects of anxiety, but similarly, the specific role it plays is unknown. A more systematic and strategic approach to future research is needed to delineate the different theories and develop a stronger, more concrete understanding. There is also the question of QE training, which appears to have a significant impact on performance in a relatively short time period. Limitations to current studies as well as suggestions for future projects are outlined. Technological advances are also discussed in relation to enabling researchers to better understand the neural underpinnings of the QE advantage.

Keywords:

eye-trackers – technology – Quiet Eye – anxiety – training – attentional control

Introduction

Expertise in sport, as well as other temporally and spatially demanding domains, requires a set of refined perceptual-cognitive skills in order for an athlete to be both efficient and effective (Causer & Williams, 2013). Specifically, the orientation of visual attention has been shown to differentiate between skill-levels and also task outcome in a number of aiming and interceptive tasks (Vickers, 2011). Seminal research by Joan Vickers (1996a, 1996b, 1996c) established a robust link between the duration of the final fixation on a target or object before execution of a critical action and success. Subsequently, there have been a plethora of studies examining this Quiet Eye (QE) phenomenon and trying to understanding its role in sporting expertise (Wilson, Causer, & Vickers, 2015). However, there are many questions that remain unanswered.

Why is Quiet Eye effective?

Despite the consistent and robust literature base now present on QE, researchers are still undecided as to what makes the QE critical for successful performance (Vine, Moore, & Wilson, 2014). In the earlier studies, researchers proposed QE played a functional role in motor programming, however, since then there has been evidence of its role in online control of action (Causer, Hayes, Hooper, & Bennett, 2016; Vine, Lee, Walters-Symons, & Wilson, 2015). Other proposed roles of QE include: external focus of attention, emotional regulation, distractor control, and quieting of the psychoneuromuscular system. In order to determine the QE advantage, a systematic program of work is required to differentiate the relative influence of each of these possible roles.

Furthermore, task demands have already been shown to influence the 'need' for QE, with more cognitively demanding tasks more likely to benefit from longer QE durations (Klostermann,

Kredel, & Hossner, 2013). Therefore, the transfer of QE characteristics to other, more dynamic scenarios involving decision-making and interaction with opponents or team mates is also required (Wilson et al., 2015), specifically looking at how QE metrics interact with other perceptual-cognitive skills, which enable athletes to utilize postural cues, recognize tactical patterns and make complex decisions based on complex environmental information (Causer & Williams, 2013).

Quiet Eye and anxiety

A popular area of research is examining how QE can negate the potentially negative effects of anxiety (Wilson, 2008). It appears that individuals who are able to maintain a longer QE under high-anxiety are more likely to sustain performance (Causer, Holmes, Smith, & Williams, 2011). However, it is not fully understood in which way this longer QE reduces the effects of anxiety on performance (Wilson et al., 2015). The popular opinion is that the longer final fixation enables the individual to minimize the influence of external distractors, which in turn enables athletes to focus on the primary task (Moore, Vine, Cooke, Ring, & Wilson, 2012). Findings are typically linked to Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007), which outlines the effect anxiety has on performance efficiency and effectiveness. It is thought that a longer QE is an example of an efficient gaze strategy, which maximizes attentional resources on the principal task. However, further research is needed to provide a more comprehensive understanding of the mechanisms by which QE enables certain athletes to overcome anxiety. Furthermore, it is also important to determine how different types of anxiety influence the performance on tasks of varying skill-levels, ages, and for individuals from other domains.

Quiet Eye training

As described in Vickers (2016), after the initial descriptive findings of QE had been reported, researchers proceeded to attempt to train these characteristics in order to replicate the expert advantage (Vine et al., 2014). However, despite the effectiveness of many of these training programs, there are some limitations that should be considered. For instance, in many of the respective studies, there are limited acquisition trials, short retention periods and multiple training interventions (instructions, gold-standard eye movement, feedback of self), which makes it difficult to ascertain which manipulations are most effective (Causer, Janelle, Vickers, & Williams, 2012). It is also difficult to compare between many of the training studies due to the different practice structures, feedback and instruction procedures and research designs (Broadbent, Causer, Williams, & Ford, in press). With a more comprehensive understanding of the mechanisms involved, and the underlying neural events that occur during the QE period, more effective training programs can be developed.

Effective QE characteristics are associated with high-level expertise, which has been developed over years of deliberate practice (Ericsson, Krampe, & Tesch-Römer, 1993). However, researchers are expecting athletes to circumvent these practice hours by giving them explicit instruction on how to orientate their visual attention. Therefore, a more precise study of how QE evolves over the lifespan of an athlete is needed to determine whether QE training, although effective in the short term, is a viable option for the long-term development of visual attention.

Neural underpinnings of Quiet Eye

There have been some attempts to determine the neural correlates of QE, which may give researchers a better understanding of the link between performance and QE (Gonzalez et al., 2015). A combination of neurophysiological techniques, such as fMRI and TMS, can be used to determine causal relationships between behavior and specific anatomical regions (Mann, Coombes, Mousseau, & Janelle, 2011). However, the specific task demands may influence the relative contributions of the attentional networks, which would make generalization of findings difficult. Despite this, researchers should look to enhance their understanding of the networks activated during QE and how the expert brain differs to less-skilled athletes. This would enable researchers to better understand how QE training can lead to brain plasticity specific to aiming.

Advances in Technology

In many of the early QE studies, a limiting factor in enabling more detailed conclusions to be drawn was the eye-trackers themselves (Panchuk, Vine, & Vickers, 2015). Typically with low sampling frequencies, poor mobility and low spatial resolution, researchers were forced to use self-paced, unrepresentative laboratory-based tasks, which limited the applied implications that could be made (Ericsson & Williams, 2007). Furthermore, this limited accuracy can lead to discrepancies between temporal aspects of QE (onset, dwell, offset), which may impact on instructions used for training programs (Gonzalez et al., 2015). However, with the significant advancement of eye-tracking technology over the last few years, it is now easier to develop more representative task, or collect data *in situ*, which enable coaches and athletes to access more reliable and meaningful data (Vickers, 2009). Furthermore, the high-sampling frequencies now available in mobile eye trackers can enable a more in-depth analysis of the specific eye movements occurring in the final aiming action. For example, high-resolution eye-trackers can enable researchers to examine saccades and microsaccades, as well as providing a more accurate definition of what constitutes a stable QE (Gonzalez et al., 2015).

Summary

In summary, the discovery of the QE period has had a significant impact on both motor control and learning theory as well as the applied arena for improving sports performance. Moving forward, researchers should seek to better understand the specific mechanisms by which the QE advantage is acquired and understand the long-term learning of QE characteristics. Furthermore, with the perpetual improvement in technologies, researchers should continue to refine their understanding and definition of what the QE advantage entails and how it can be expedited effectively over an athlete's lifespan.

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Data Availability Statement

All relevant data are within the paper.

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