Shhh… We're talking about the Quiet Eye!

A Perceptual Approach to the Transfer of Skill: Quiet Eye as an Insight into Perception-Action Coupling in Elite Football Goalkeepers – Methodological and Feasibility Considerations

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"Unfortunately, empirical work on learning within the direct perception school appears limited to demonstrating that learning occurs…and theory is little more than a collection of slogans and metaphors" (p. 273)
Michaels and Beek (1995)

Rationale and Aims

Amidst the continued theorising and objective epistemological approach to perceptual research (Michaels and Beek, 1995), there remains little clarity regarding what information athletes use to direct decision making in performance settings and how skill is transferred from training to performance.
The role of perception-action coupling within decision-making in team sports has been discussed at great length (Vaeyens et al, 2007; Pinder et al, 2011), with some consensus being reached that skilled performers do not necessarily have superior visual ability, but that their ability to locate and interpret key specifying information determines expertise in a particular skilled actions (Vickers, 2006). The methodological accord has often been to recreate core, single action motor-control tasks in the hope of elucidating data to suggest a change in behaviour in any given number of constraint manipulations (Vickers, 1996; Williams, Singer and Frehlich, 2002; Vine and Wilson, 2011). However, research remains in isolation of the complexities of the real world (Vaeyens, 2007; Williams and Grant, 1999).
The Quiet Eye (QE) has become increasingly popular (Vickers, 2016), it details the final fixation towards a specific location or object within 3* of visual angle or less for a minimum of 100m/s (Vickers, 2016). It is reasonable to suggest that QE describes the variable in which to examine the relationship between perception and action (Panchuk and Vickers, 2006). A SensoMotoric Instrument – Eye Tracking Glasses (SMI-ETG) binocular system will be employed within an elite level goalkeeping context. QE data will be collected in three different practice trial environments and compared to QE measures taken in a representative performance simulation. The practice trial environment design will be informed by principles of ecological dynamics as presented in the Environment Design Framework (Newcombe et al, in preparation).

1. To understand the gaze behaviours of elite goalkeepers in-situ to determine an optimum approach to training that represents similar gaze patterns and fixations to competitive performance through the use of SMI Eye Tracking Glasses.
2. Use the Quiet Eye as an objective measure to understand how transfer occurs between training and performance from the means of perceptual attunement.

The Infinite Variable and Beyond

There is a requirement to view the QE beyond an isolated and interventionist approach, for which the QE could become used as a key perceptual tool to measure the transfer of skill from training to competitive performance (Reinhoff et al., 2015; Davids & Araujo, 2016). Approaching the design of research practices for the study of perception must be categorised under a key experimental research principle. Originally introduced by Egon Brunswik (1956), representative design advocates for the dynamics of any experimental task must host some reciprocity with that of the natural task constraints present.

Adopting a *probabilistic functionalism* perspective will provide the necessary scope of analysis towards QE behaviour under principles of Ecological Dynamics (Brunswik, 1956; Pinder, 2011). Due to the nature of information in complex environments being variable and emergent, practice and training conditions must illustrate a field of affordances that creates opportunities for relative game like actions to occur (Bruinberg and Rietveld, 2014).

This study attempts to view the QE under conditions rich in variability, and in which truly replicate the natural performance conditions of the studied task. Through this, it allows the versatility of the QE to be stretched further towards the design of sporting training environments that can replicate the visual energy arrays available in performance conditions (Vickers, 2006).

Coupled gaze and motor action footage for the VIA analysis tool from Quieteyesolutions

Tunnel Vision

Williams, Janelle and Davids (2004) discussed how there may be benefit in understanding visual search by way of the interacting constraints that shape emergent behaviour. Key observations were raised by Davids and Araujo (2016), in an interesting commentary presented by the authors, they questioned the QE scope, voicing concerns that the QE has become the simple answer in understanding decision making.
A vast amount of the QE literature has utilised QE as a tool for perceptual training in sport. For example, QE training interventions have been used in an attempt to train the visual search strategies of non-experts within similar tasks used by their expert counterparts. Harle and Vickers (2001) study demonstrated the potential of QE based training interventions for which significant improvements were noticed during free throw simulations and into games, this is further supported by Schmidt and Lee (1999) whom used a 6-week intervention with volleyball players, for which improvements in gaze durations were noted. Causer, Holmes and Williams (2011) again employed a training intervention to demonstrate the use of QE as a tool for perceptual training, yet there are numerous concerns cited across the literature. Questions are still raised over the legitimacy of QE training interventions, as Causer (2016) suggested in his commentary to Vickers (2016) that there are limited trials and short retention periods across a number of training interventions. It is clear from the literature that the design of training methodologies employed has been given little thought. Resulting in isolated intervention based training methodologies. It is worth noting that often the trials are isolated incidents of performance, with the tasks often being non-representative of the constraints that would occur in the natural task setting (Reinhoff et al.. 2015).
Whilst there is great depth in QE research, performance environments are littered with interacting constraints which shape emergent behaviour, yet the role of interacting constraints has been limited in the design of research tasks for study of the QE. Reinhoff et al (2015) search found just 51 studies dedicated towards understanding the impact of constraints on QE, however, a vast proportion of this branch of research has highlighted the resultant gaze behaviour from the interacting constraints compared across trials and individual, rather than the process to which gaze is attuned because of the environments that shape their actions.

"The QE is defined as the final fixation towards a specific location or object within 3* of visual angle or less for a minimum of 100m/s" (p. 4)
Vickers (2016)

Proposed Methodology

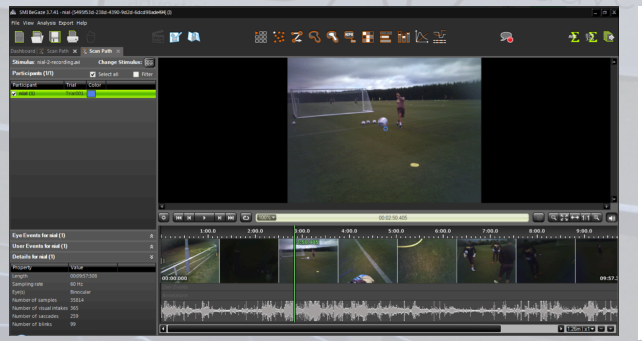
4 Elite Goalkeepers will use SMI-ETG (Eye-Tracking Glasses) in 4 training environments to locate the QE under an emerging number of constraints that create opportunities for action (Newell, 1976; Gibson, 1977). The tasks will be structured via a control measure (representative match simulation 11v11), which will be analysed against 3 different points on the Environment Design Continuum (Newcombe et al, in preparation)

Training environments will be designed following principles of environment design as designed in Newcombe et al (in review) (Fig 1)
Trial 1 – 'Practice Opposed'
Trial 2 – 'Practice Variable'
Trial 3 – 'Small-Sided Game'
Trial 4 – Representative Competitive Performance 11 v 11

Each Goalkeeper will perform 10 interceptive actions per training environment over a 6 week period with video footage from the SMI-ETG and an external camera to capture the skilled action will be collected. The video will be clipped and manually coded (Via Sportscode Gamebreaker+, BeGaze from tracksys and VIA analysis tool from Quieteyesolutions.com) to establish the start and end of each skilled action.

QE duration: Trial (1,2, 3 or 4) x location x saved actions – factorial ANOVA
QE location: Descriptive statistical analysis
Level of fidelity: Mean QE duration (Trial 1,2 or 3) x Mean QE duration Trial 4 x QE location – factorial ANOVA (Piras and Vickers, 2011).

Variance judged via an effect size measure. The trial with the smallest effect size will be determined as the one with the highest level of fidelity to that of competitive performance.



The BeGaze Analysis software tool

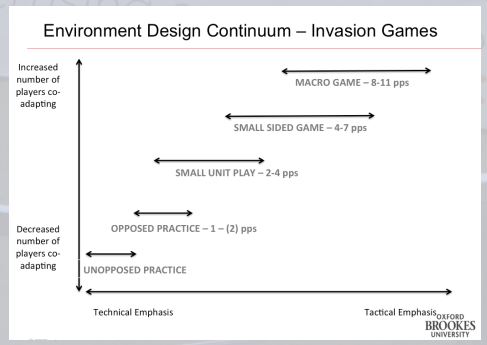


Fig 1. The Environment Design Continuum (Newcombe et al, in preparation)

Considerations and Critical Questions

- It is worth considering that individual players may possess variability in eye movements and not follow optimum patterns for which has usually been the case in perceptual based research (Davids and Araujo, 2016). However, when looking at averaged gaze behaviour across environments, rather than assuming optimum patterns across individuals, we believe that inter-intra individual variance does not play an impacting role.
- If a trial environment from the continuum is too close to the simulated game (in regards to high variability) then similar patterns will emerge naturally due to the task dynamics. Whilst gaze behaviours may remain near identical in nature of the QE, it may not be optimum for athletes to attune to the relevant invariants, thus not demonstrating learning, but a response to the perceptual dynamics of that given task (Friston, 2010; Bruinberg and Rietveld, 2014).
- The provisions of elite sport are notoriously difficult to manage and organise due to the huge temporal and financial constraints imposed on elite sport programmes. Research reflections thus far have demonstrated the difficulties of linking schedules, dealing with changes in staff, injuries, as well loss of form and cultural superstitions.

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