Quiet Eye Facilitates Processing Complex Information in Elite Table Tennis Players

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“You see but you don’t observe.”

Reaching elite performance in sport goes beyond merely seeing. One important mechanism that helps athletes to observe relevant clues and helps them to couple their motor behavior to their visual perception system, in order to perform efficiently, is Quiet Eye (QE).
What is Quiet Eye (QE)?

Final ocular fixation before the athlete initiate a specific movement (e.g., a forhand stroke) (Vickers, 1996)

**Characteristics of QE:** a specific location in the visuomotor workspace (1-3 °) & a duration of minimum 100-300 ms

Measured with Eye Tracking Systems (e.g., Tobii)
Theoretical Background

Preplanning & Complexity
Online control
Attentional Control Theory
Information Processing
Neural correlates
Inhibition Hypothesis
Ecological perspective
Error Recovery

Eysenck et al., 2007; Klostermann & Hossner 2018; Oudejans et al., 2002, 2005; Vickers, 1996, 2012; Walters-Symons et al., 2017; Wilson et al., 2015; Xu et al., 2021)
What we know so far?

- Longer duration of QE is associated with greater athletic expertise (Vickers & Williams, 2007)
- Athletes display longer QE duration before successful compared to missed shots (Panchuk & Vickers, 2006)
- Training of QE lead to more effective performance enhancement compared to other types of trainings (Vine et al., 2014)
- Replicated in meta-analytic studies (Lebeau et al., 2016)
What we do not know?

- Whether QE remains a robust phenomenon in interceptive tasks
- Whether QE remains a robust phenomenon in a dynamic game situation
- Whether QE works as a compensatory mechanism
- Whether QE remains a robust phenomenon for elite athletes
HYPOTHESES

H1
In hit shots, as opposed to missed shots, athletes extend their QE durations more in the difficult compared to the easy task.

H2
Athletes extend their QE duration more after a missed shot, compared to after a hit shot.
Method

Participants: 12 male table tennis players ($M_{age} = 14.75, SD = 1.65$)

Inclusion criteria: (1) Table tennis experience above five years ($M_{experience} = 6.83$ years, $SD = 0.88$, range 6-8 years) and (2) at least one selection in the national team

Task: A regular table tennis exercise, named multiball, in two conditions (low difficulty and high difficulty)

Eye Tracking System: Tobii Pro Glasses 2

Measurements: Quiet Eye and Table Tennis Performance

Inferential statistics: 2 (performance: hit, missed) x 2 (difficulty: low, high) within subjects ANOVA; 2 (first ball: hit, missed) x 2 (second ball: hit, missed) x 2 (difficulty: low, high) within subjects ANOVA
The task in the low difficulty condition

The task in the high difficulty condition
## Results

### Descriptive results: QE & Performance

<table>
<thead>
<tr>
<th>Condition</th>
<th>Low difficulty</th>
<th>High difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>QEhit</strong></td>
<td>411.79 ($SD = 175.82$)</td>
<td>395.82 ($SD = 93.47$)</td>
</tr>
<tr>
<td><strong>QEmissed</strong></td>
<td>408.09 ($SD = 175.36$)</td>
<td>341.62 ($SD = 99.22$)</td>
</tr>
<tr>
<td><strong>Percentage of hit balls</strong></td>
<td>78.52 % ($SD = 0.05$)</td>
<td>23.14 % ($SD = 0.05$)</td>
</tr>
</tbody>
</table>

*Note. QEhit = The mean duration of Quiet Eye before successfully hit balls; QEmissed = The mean duration of Quiet Eye before missed balls.*
## Results

### Descriptive results: Locations of the fixations

<table>
<thead>
<tr>
<th>Location</th>
<th>Condition</th>
<th>Low difficulty</th>
<th>High difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>The coach’s’ racket</td>
<td>85.91 (SD = 12.25)</td>
<td>78.16 (SD = 19.79)</td>
<td></td>
</tr>
<tr>
<td>Opponents’ half of the table</td>
<td>3.66 (SD = 6.19)</td>
<td>4.83 (SD = 5.20)</td>
<td></td>
</tr>
<tr>
<td>The athletes’ half of the table</td>
<td>0.25 (SD = 0.62)</td>
<td>0.25 (SD = 0.45)</td>
<td></td>
</tr>
<tr>
<td>Coach’s face</td>
<td>0.08 (SD = 0.28)</td>
<td>0.08 (SD = 0.28)</td>
<td></td>
</tr>
<tr>
<td>Other areas</td>
<td>1.58 (SD = 2.10)</td>
<td>0.91 (SD = 1.50)</td>
<td></td>
</tr>
<tr>
<td>The cards</td>
<td>N.A.</td>
<td>8.25 (SD = 14.09)</td>
<td></td>
</tr>
</tbody>
</table>

No further analysis was conducted on the location of QE because several athletes displayed zero fixation in some of the coded locations.
Results

Inferential statistics: QE as a mechanism for dealing with complexity

We found a significant effect for performance $F(1,11) = 5.75, p = .0035, \eta^2_p = 0.33$

Which indicates that athletes made longer QE before executing a successful shot, which means that QE contributes to performance in an interceptive timing task, in a dynamic situation.

We found a significant effect for the interaction between performance and difficulty of the task $F(1,11) = 12.10, p = 0.005, \eta^2_p = 0.52$

This interaction supports our hypothesis, that extended QE durations reflect that athletes deal effectively with increased task complexity.
Results

Inferential statistics: QE as a recovery mechanism

We obtained a marginally significant effect for the first ball $F(1,11) = 4.44, p = .059, \eta^2_p = .38$

In other words, athletes increased more their QE duration after a missed shot than after a successful one. This effect supports the hypothesis, that after a missed shot athletes prolonged their QE duration in order to improve performances.

* When we conducted the same analyses separately for each level of difficulty, in the condition where athletes made more mistakes ANOVA yield a significant effect for the first ball in the HD task $[F(1,11) = 6.21, p = .03, \eta^2_p = .36]$, but not in the LD task $[F(1,11) = 0.77, p = .39, \eta^2_p = .006]$
Implications

Practical
Effective performance enhancement training

Practical
Specific Adaptation for Imposed Demands Principle

Theoretical
One of the functions of QE is to help athletes to recover
Limitations and future directions

- Small sample size
- Dynamic Targets
- Binary performance approach
- Investigations in competitive setting
References (Selection)


Thank you!

Do you have any questions?

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