What could an ecological dynamics rationale offer Quiet Eye research? Comment on Vickers

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TA COMMENTARY

Article History:
Received 22nd May 2016
Accepted 5th June 2016
Published 13th October 2016

Handling Editor:
Ernst-Joachim Hossner
University of Bern, Switzerland

Editor-in-Chief:
Martin Kopp
University of Innsbruck, Austria

ABSTRACT

In this commentary, we respond to suggestions in previous Quiet Eye (QE) research that future work is needed to understand how theories of ecological psychology and nonlinear dynamics might frame empirical and practical work. We raise questions on the assumptions behind an information processing explanation for programming of parameters such as duration, onsets and offsets of QE, and we concur with previous calls for more research considering how visual search behaviours, such as QE, emerge under interacting personal, task and environmental constraints. However, initial work needs to frame a more general ecological dynamics explanation for QE, capturing how a process-oriented approach is needed to address how perceived affordances and adaptive functional variability might shape emergent coordination tendencies, including QE, in individual performers.

Keywords:
Quiet Eye – ecological dynamics – task constraints – organismic constraints – affordances – intra-individual variability – inter-individual variability

Citation:
Davids, K., & Araújo, D. (2016). What could an ecological dynamics rationale offer Quiet Eye research? Comment on Vickers. *Current Issues in Sport Science, 1:104*. doi: 10.15203/CISS_2016.104
This is a commentary on a CISS target article authored by Joan N. Vickers. For retrieving the whole target article including index of contents, editorial, main article, all peer commentaries and author's response:
Hossner, E.-J. (Ed.) (2016). Quiet Eye research – Joan Vickers on target. *Current Issues in Sport Science, 1:100*. doi: 10.15203/CISS_2016.100

Introduction

Joan Vickers' (2016) target article describes how her highly influential research programme on Quiet Eye (QE) over the years was predicated on experiential knowledge, empirical data and theoretical ideas, to develop understanding of how skilled individuals control gaze and attention to perceive 'critical information' for performance. This approach is aligned with proposals of Greenwood, Davids and Renshaw (2014), that an elaborate cross-fertilisation of experience, theory and data can enrich practitioners' understanding of how to facilitate athletes' pick up of information to regulate functional actions. This type of integrative approach may lead researchers and practitioners towards different explanations, nuances, emphases, outcomes and applications, depending on the theoretical perspective utilised to frame studies and interpret data.

Vickers describes QE as a 'perception-action, neural-cognitive variable', and Rienhoff et al.'s (2015) systematic review showed that published research has been dominated by assumptions and terminology predicated on an information processing perspective. Good progress has been made seeking answers to questions on the 'optimal' duration of QE and its relationship with perception, cognition and decision-making. Most studies typically average measures across participants and intra-individual variability in performers is rarely discussed. Performance is studied with a correlational approach used to associate average values of QE durations and times of onset and offset in groups with different outcomes.

Vickers (2016; see also 2007), and Rienhoff et al. (2015) have pointed to the relevance of a constraints-based approach (Newell, 1986) to QE, suggesting how tasks, sport disciplines, individual characteristics and environmental features may shape QE parameters. Williams, Jannelle and Davids (2004) originally proposed this approach to understanding visual search patterns more generally, arguing that they need to be framed and studied as emergent behaviours continually shaped by interacting constraints. Rienhoff et al. (2015) located 581 published papers on QE, identifying 51 papers construed as investigating effects of constraints on QE. This body of work focused mainly on the categories of person, task and environmental constraints to describe effects on QE outcomes.

Rienhoff et al. (2015) commendably concluded that further work is needed to study the QE phenomenon from the perspectives of ecological psychology and nonlinear dynamical systems, theoretical approaches that we have integrated into an 'ecological dynamics' framework for studying emergent behaviours in sport and physical activity (Araújo, Davids & Hristovski, 2006).

Developing an ecological dynamics rationale for QE effects: some key issues

How might an ecological dynamics framework interpret findings from QE research and what accents, priorities and interpretations might it focus on in attempting to explain effects? This is a major question requiring a detailed position paper to elucidate how key concepts in ecological dynamics can be used to identify mechanisms and interpret findings. Although this task is beyond the scope of the current commentary, clearly concepts like affordances (invitations for actions), self-organisation under interacting constraints and adaptive variability are likely to be prominent in an ecological dynamics rationale. For example, such an elucidation could focus on understanding how QE behaviours emerge from interacting constraints of performer, task and environment, focusing on the role of adaptive variability in skilled individuals perceiving affordances in performance environments (Dicks, Davids & Button, 2008). Here, we outline key questions that an ecological dynamics framework can address in future work.

Although QE characteristics may vary according to task constraints, how do interacting constraints shape this, and other, visual search behaviours? For example, how is useful information revealed as such for an individual performing a given task? How to decide what is the critical spatial location that QE needs to target in each task? Vickers (2016, p. 2) clarifies that the role of QE is to extract "critical information sooner, thus enabling transmission of higher quality commands to the motor system", providing "a way to access to the brain". But how can relevant spatial information be distinguished from non-relevant information, before the information extracted by QE is transmitted to the brain? This is an important question because the explanations about the usefulness of QE rely on the assumption that gaze is fixated on "relevant cues". Information from these cues will then "feed" neural networks, allowing these brain structures to organize (programme) a motor response. For example, how does a dorsal attention network distinguish what is distracting or what is anxiety-producing for each individual (Vickers, 2016, p. 7)? Indeed, the explanation presented by Vickers (2016, p. 8) is that "the neural networks underlying high levels of performance are 'fed' very precisely with external visual information, and it is this information that is central to organizing the complex neural systems underlying control of the limbs, body and emotions."

The problem, we believe, is that the starting point is missing in an information processing explanatory framework: How does the brain tell the eye where to look (and perform the QE)? How is the action that allows the body to search for relevant cues and perform a QE "programmed by the brain"? A possible answer to these questions implies a clear understanding of the role of constraints and information in explaining how intertwined processes of perception, cognition and action subserve goal-achievement in athletes (Araújo et al., 2006). And this explanation cannot be confined to how task constraints and information are represented in the brain, because this will always postpone the answer to the question concerning how these task constraints and information sources were selected in the first place.

An ecological dynamics framework that formally includes both the individual (with his/her body and brain) and the environment (including task constraints), would not place QE as the sole explanation for expert performance, as implied by Vickers (2016, p. 4) when she writes: "when the spatial information is insufficient or incomplete, then the action is only partially organized and performance suffers." There are many sources of information relevant for expert performance beyond patterns of energy detected by the visual system, such as those detected by haptic systems (Kim et al., 2013). The view that "visuo-motor control dominates the brain" (Vickers, 2016, p. 7) is too restricted for an ecological dynamics viewpoint, which advocates that there are more variables than gaze in explaining expert performance in complex adaptive systems (Davids, Araújo, Seifert, & Orth, 2015). Otherwise, designing practice task constraints would be a relatively straightforward task for coaches and practitioners: just emphasise an average value of QE in each specific sport.

This is one reason why it may be timely for QE research to focus on the role of interacting constraints. This application cannot be restricted to the categorisation of circumstances in which QE is used. Rather an interacting constraints model can be used to theoretically inform experiments and practice on behaviours *before QE emerges*. To explain that an expert performer is already "in the right place at the right time", an ecological dynamics perspective can address how QE needs to be understood beyond an 'organismically-biased' perspective (Davids & Araújo, 2010).

Considering athletes performing a task as complex adaptive systems mitigates against imputing so much importance to

one perceptual variable, which leads to researchers seeking 'optimal' values of QE durations, onsets and offsets. It is doubtless a characteristic of visual search behaviours, but ecological dynamicists seek to understand how intentions, perception and actions are intertwined in a given task with specific informational and physical constraints to support goal achievement in athletes. From an ecological dynamics perspective, current research on QE seems too 'outcome-oriented' (especially averaged across participants in groups). A preferred emphasis in future ecological dynamics work may be on an individualised, process-oriented approach, which would raise questions like: How does QE relate to emergent coordination tendencies of an individual athlete as he or she attempts to satisfy changing task constraints? How do skilled performers adapt and vary QE parameters during performance to support coordination of their actions with important environmental events, objects, surfaces and significant others? Rather than looking for optimal values, it would be important to look for 'critical threshold bandwidths' which could be distinguished according to task constraints and individuals, within and between expertise levels, while studying emergent actions in sport performance.

As a starting point, the concepts of affordances, self-organisation and emergent behaviours make it likely to expect that there may be functional variability in QE characteristics between individuals as they accept 'invitations for actions' under different task constraints.

Funding

The authors have no funding or support to report.

Competing Interests

The authors have declared that no competing interests exist.

Data Availability Statement

All relevant data are within the paper.

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