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Metacognitive processes in the self-regulation of performance in elite endurance runners

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ABSTRACT

Objective: This study sought to investigate the dynamics of attentional focus and cognitive control during endurance activity from a metacognitive perspective. The study also intended to examine the situational factors which may influence cognitive strategy use by elite endurance runners.
Design: Semi-structured qualitative interviews were utilised.
Method: Ten elite-level endurance runners were interviewed to explore retrospectively their attentional focus and cognitive strategy use during endurance running.
Results: The findings revealed that metacognitive strategies such as planning, monitoring, reviewing and evaluating, and metacognitive experiences were fundamental to cognitive control and cognitive strategy use in elite endurance runners. The findings also added to the array of active self-regulatory strategies previously reported in the literature.
Conclusions: These results suggest that metacognitive processes are central to effective cognitive control in elite endurance athletes during running. The findings allowed for the development of an integrative metacognitive framework, which incorporates dimensions of attentional focus. This model may better represent the processes which underpin cognitive control and determine cognitive strategy use in elite athletes during endurance running.

Introduction

The study of attentional focus in endurance activity has operated on a largely atheoretical basis since its inception almost four decades ago. While subsequent research has progressed our understanding of how cognitions – both deliberate and spontaneous – impact endurance performance (see Brick, MacIntyre, & Campbell, 2014 for a detailed review), the need for a comprehensive conceptual framework still exists. Recent proposals include a social-cognitive perspective (Tenenbaum, 2001), Leventhal and Everhart (1979) parallel processing model of pain (Brewer & Buman, 2006), and a mindfulness approach (Salmon, Hanneman, & Harwood, 2010).

The above approaches allude to potential mechanisms to explain how specific cognitions may allow endurance performers better tolerate exertional discomfort. For example, Tenenbaum's (2001) social-cognitive perspective considers the multidimensional nature of effort tolerance and perceived exertion. Similarly, Brewer and Buman (2006) application of the parallel processing model provides an insight on how attentional foci may alter pain perception. Some issues remain unaddressed, however. Brewer and Buman (2006), for example, expressed a need to clarify how individuals develop schemata, or cognitive structures developed from previous pain experiences, to accurately evaluate exertional signals during exercise. Concomitantly, we further highlight the need for a framework to illustrate how endurance performers control cognitive activity to optimise performance.

More recently, researchers have sought to better understand mental processes in athletic performance from the perspective of cognitive sport psychology (Moran, 2009, 2012). Theoretical approaches, such as *grounded cognition* recognise the interaction between perception, action, the body, and the environment during goal achievement (e.g., Barsalou, 2008). When these interactions pose a significant challenge, such as during effortful endurance running, a high level of cognitive control, or the ability to 'regulate, coordinate, and sequence thoughts and actions in accordance with internally maintained behavioural goals' (Braver, 2012; p. 106) should be important. In such situations, a focus of attention which best facilitates performance may be considered an imperative to competitive success.

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To emphasise the significance of cognitive control, much research evidence supports the contention that attentional focus impacts endurance performance (e.g., Brick et al., 2014; Schücker, Knopf, Strauss, & Hagemann, 2014). Amongst elite performers, task-relevant, self-regulatory cognitive strategies have been shown to facilitate performance improvement, while distractive thoughts may result in non-optimal pacing (e.g., Clingman & Hilliard, 1990; Rushall & Shewchuk, 1989). What is less clear is *when*, or *why* endurance athletes engage specific attentional strategies. It has been suggested that elite performers employ cognitive strategies depending on circumstance and need (e.g., Moran, 1996). However, little is understood about the determinants of cognitive strategy use amongst elite endurance athletes.

One framework which may help to address these conceptual issues is the metacognitive approach. Metacognition has been defined as an individual's insight into, and control over their own mental processes (Flavell, 1979), and is a key sub-process of, and essential to effective self-regulation (Tarricone, 2011). Efklides (2006) describes metacognition as a model of cognition, acting at a meta-level, and related to cognition through monitoring and control functions. Thus, *meta*-cognition implies two (or more) processes, one concerning cognitions of external objects (i.e. object-level cognition), and a second, the meta-level, concerning cognitions of object-level cognitions (Nelson, 1996).

Metacognitive process include *metacognitive strategies* (or metacognitive skills) such as planning and monitoring, and *metacognitive experiences* (Efklides, 2006; Tarricone, 2011). Based on monitoring processes, metacognitive experiences allow for concurrent, or 'on-line' monitoring during task performance. They include *metacognitive feelings*, which inform the individual about task performance in the form of a feeling, such as feelings of difficulty, and tend to be implicit in nature (Efklides, 2006). Alternatively, *metacognitive judgements and estimates*, such as judgement of solution correctness, are made *by* the individual, and may be the result of both implicit, non-analytic processes, and explicit, analytic processes (Efklides, 2006). Collectively, awareness of metacognitive experiences, in conjunction with performance, forms a representation of the task, or the context (Efklides, 2014). In turn, these metacognitive representations provide input for conscious, deliberate regulation and control of cognition via cognitive, or metacognitive strategies (Efklides, 2014). Applied to the current study of endurance running, metacognitive representations may indicate the perceived difficulty of a running task, for example, and provide the impetus for the initiation of an appropriate cognitive strategy to control attentional focus.

A metacognitive framework has the potential to enhance our understanding of self-regulation and cognitive control during endurance activity. Precedent for this contention can be found in physical activity (e.g., Setanni, Magistro, & Rabaglietti, 2012), and pain management (e.g., Yoshida et al., 2012) settings, for example. Metacognition has also been considered a distinguishing feature of expert performance in the sporting domain (MacIntyre, Igou, Campbell, Moran, & Matthews, 2014). However, few researchers have specifically employed a metacognitive perspective to investigate attentional dynamics in endurance activity. Only Nietfeld (2003) highlighted the significance of metacognitive monitoring and strategy use during endurance running. Consequently, the role of metacognitive processes in controlling cognition during endurance performance has yet to be fully explored.

The primary aims of the present qualitative investigation were firstly to apply a metacognitive approach to better understand the influences on, and dynamics of attentional focus and cognitive control during endurance activity. The emphasis was on elite endurance runners, to determine cognitive strategy use during both competition and endurance training. Employing this *strength-based approach*, high-ability participants were deliberately recruited on the basis of their expertise and experience in endurance activity, and potential for highly developed cognitive abilities (e.g., MacIntyre, Igou, Moran, Campbell, & Matthews, 2014; MacIntyre, Moran, Collet, & Guillot, 2013). Combined with a theory-driven analysis of cognitive activity, (i.e. metacognition), the convergence of these approaches (MacIntyre et al., 2013) may advance our understanding of attentional focus and cognitive control during endurance running. The second key aim of the study was to more clearly illustrate the situational factors which may influence the attentional focus and cognitive strategy use by elite endurance runners.

Method

Participants

Elite endurance runners were purposefully sampled for the present study. Following institutional ethical approval, a recruitment email was sent to prospective athletes via the national endurance coach. Potential participants were also contacted via email. Inclusion criteria were that runners had competed internationally at senior-level running competition during their career and still ran competitively in events ranging from 3000 m to ultra-distance (e.g. 24-hour, 100 km). The sampling procedure provided a total of 10 athletes who met these criteria and were willing to participate. Considering the idiographic aims of the study (e.g., Côté, Salmela, Baria, & Russell, 1993), the sample size was considered appropriate to allow individual cases to be represented in the data, and for a sufficiently intensive analysis of each case to be conducted (Robinson, 2013). Employing a classification system proposed by Swann, Moran, and Piggott (2015), two of the athletes were classified as *successful elite*, and eight were classified as *competitive elite*. See Table 1 for participant demographics.

Data collection

Pre-interview information

Approximately one week prior to interview, each participant was emailed a pre-interview information sheet (see Appendix 1). The purpose was to familiarise participants with the area of research, the procedures involved, and to clarify the purpose of the study (Wagstaff, Fletcher, & Hanton, 2012).

Qualitative interview guide

Given the limited knowledge available on metacognitive activity during endurance running, a qualitative approach to data collection was considered best suited to this study. A semi-structured

Table 1
Demographic variables of study sample ($n = 10$).

Demographic Variables	
Age	Mean: 35.6 ± 6.6 years
Gender	6 females, 4 males
Primary running event	Ultra-Distance ($n = 2$) 10 km – Marathon ($n = 6$) 3 km–10 km ($n = 2$)
Athlete's highest standard of performance	Olympic Games ($n = 2$) World championship level ($n = 4$) European championship level ($n = 3$) Commonwealth Games ($n = 1$)
Success at the athlete's highest level	Infrequent success at international level ($n = 3$) National titles, selected to represent nation ($n = 4$) Competitive at national level, selected to represent nation ($n = 3$)