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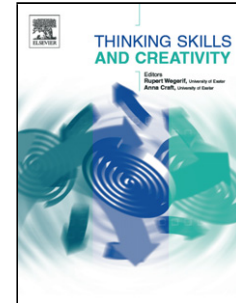
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Thinking in Action: Some Insights from Cognitive Sport Psychology

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### Abstract

Historically, cognitive researchers have largely ignored the domain of sport in their quest to understand how the mind works. This neglect is due, in part, to the limitations of the information processing paradigm that dominated cognitive psychology in its formative years. With the emergence of the embodiment approach to cognition, however, sport has become a dynamic natural laboratory in which to investigate the relationship between thinking and skilled action. Therefore, the purpose of this paper is to explore some insights into the relationship between thinking and action that have emerged from recent research on exceptional performance states (e.g., ‘flow’ and ‘choking’) in athletes. The paper begins by explaining why cognitive psychologists’ traditional indifference to sport has been replaced by a more enthusiastic attitude in recent years. The next section provides some insights into the relationship between thinking and skilled action that have emerged from research on ‘flow’ (or peak performance) and ‘choking’ (or impaired performance) experiences in athletes. The third section of the paper explores some practical issues that arise when athletes seek to exert conscious control over their thoughts in competitive situations. The final part of the paper considers the implications of research on thinking in action in sport for practical attempts to improve thinking skills in domains such as business organizations and schools.

**Keywords:** cognitive psychology

## 1. Introduction

At first glance, thinking and action seem to lie at opposite ends of the behavioural spectrum. After all, whereas people's thoughts are private, their actions are publicly observable – at least in principle. Despite its superficial plausibility, however, this apparent disjunction between thinking and action has proved to be problematic in cognitive psychology. It also has wider consequences both for conceptions of thinking and for educational approaches to teaching thinking. In order to understand these issues, however, a brief historical prelude is required.

During the 1970s, cognitive psychology was dominated by the information processing approach to the mind (see review by Lachman, Lachman, & Butterfield, 1979). At the heart of this approach lay the computational metaphor – the proposition that the mind is an abstract, incorporeal, general-purpose, computational system or thinking machine (Casey & Moran, 1989). This metaphor had at least three important implications for the study of mental processes such as thinking. Firstly, it suggested that thinking is a form of computation in which conscious knowledge is manipulated symbolically according to formal rules or programs. As a corollary, the formal study of thinking – or the mission of cognitive psychology - was deemed to be analogous to “trying to understand how a computer has been programmed” (Neisser, 1967, p. 6). Secondly, the computational metaphor assumed that the mind's cognitive and motor systems were functionally independent. In other words, research on cognitive processes such as thinking “could proceed independently from the study of sensorimotor processes and mechanisms” (Laakso, 2011, p. 410). Thirdly, the computational metaphor conveyed the impression that motor action was somehow less important than thought because it was

merely the “uninteresting end-result of cognitive processing ... the *aftermath* of cognition” (see critique by Freeman, Dale, & Farmer, 2011, p. 1; italics added).

Fortunately, the limitations of information processing psychology’s disembodied approach to cognition were exposed by a combination of theoretical developments and empirical discoveries (see Laakso, 2011, for a detailed critique of this issue). Theoretically, the emergence of the ‘embodiment’ approach in the early 2000s promulgated the idea that cognitive representations are “grounded in, and simulated through, sensorimotor activity” (Slepian, Weisbuch, Rule, & Ambady, 2011, p. 26; see also Laakso, 2011; Shapiro, 2010). In other words, many of the brain circuits that are responsible for abstract thinking are inextricably linked to those that process sensory experience. Empirically, research on the ‘functional equivalence’ hypothesis (Jeannerod, 1994) showed that cognitive simulation processes (such as mental imagery) share certain representations, neural structures, and theoretical mechanisms with like-modality perception and with motor preparation and execution (Moran, Guillot, MacIntyre, & Collet, in press). For example, neuroimaging studies show that mentally simulated and executed actions rely on similar neural representations and activate many common brain areas such as the posterior parietal, premotor, and supplementary motor cortex (de Lange, Roelofs, & Toni, 2008; Munzert, Lorey, & Zentgraf, 2009). Based on such evidence, it seems clear that the neural substrates and psychological mechanisms of cognition and movement overlap significantly. Therefore, thinking cannot be arbitrarily decoupled from bodily action. Echoing this idea, Eysenck and Keane (2010) defined thinking as the ‘internal processes involved in making sense of the environment, and *deciding what action might be appropriate*’ (p. 1; italics added).

Against this background of shifting paradigmatic sands, and inspired by James' (1890) dictum that 'my thinking is first and last and always for the sake of my doing' (p. 333), the present paper will argue that action is the *hub* rather than the aftermath of cognition. And so, we can learn a great deal about how the mind works by studying 'thinking in action'. Of all the domains in which this theme could be explored, there is one that seems particularly suitable because of its emphasis on how thought becomes translated into skilled action – namely, sport. To illustrate the role of thinking in elite sport, consider an insight from Xavi Hernandez, the famous Spanish soccer player who won both World Cup (2010) and Champions' League (2011) medals. He revealed recently that when he joined Barcelona football club, "the first thing they teach is: Think, think, think" (cited in Lowe, 2011, pp. 6-7). But Xavi's exhortation to think raises at least four intriguing questions for cognitive psychology. First, what exactly should athletes think *about* in striving to achieve optimal performance in competitive sport? Second, can thinking too much about what one is doing – or trying to exert conscious control over actions that are normally performed automatically - cause one's skills to unravel? If so, why does this type of 'paralysis by analysis' occur? Thirdly, what practical issues arise when athletes attempt to control their thoughts more effectively? Finally, what are the implications of research on thinking and action in sport for the attempt to improve people's thinking processes in other domains such as education and business?

In addressing these questions concerning the relationship between thinking and skilled action, I shall draw on research findings from the burgeoning field of 'cognitive sport psychology' or the scientific study of mental processes in athletes (Moran, 2009).

The paper is organized as follows. To begin with, I shall explain why cognitive psychologists' traditional indifference to sport has been replaced by a more enthusiastic attitude in recent years. After that, I shall consider some insights into the relationship between thinking and action that have emerged from research on 'flow' (or peak performance) and 'choking' (or impaired performance) experiences in athletes. Of particular interest here is what happens when skilled athletes attempt to exert conscious control over their thoughts in competitive settings. Next, I shall consider some practical issues that can arise when athletes try to control their thoughts more effectively. Finally, I shall sketch some implications of research on the relationship between thinking and skilled action in sport for practical ways to improve thinking processes in other domains – from the classroom to the boardroom.

## **2. Cognitive psychology and sport: How indifference changed to enthusiasm**

Although some early twentieth-century researchers (e.g., Judd, 1908; Swift, 1910; Lashley, 1915) used athletic skills to explore mental processes, cognitive psychologists have largely ignored the domain of sport in their quest to understand how the mind works (Moran, 2009). For example, the subject indices of popular textbooks in this field (e.g., Eysenck & Keane, 2010; Goldstein, 2011; Sternberg & Sternberg, 2012) contain few, if any, references to terms such as 'sport', 'athlete' or 'motor cognition' - the study of how the mind plans and produces skilled actions and movements. This oversight is surprising because competitive sport offers cognitive researchers a fertile natural laboratory in which to investigate how a combination of practice and pattern-recognition knowledge can help skilled performers to circumvent the limits of human information processing.

For example, how do top athletes in fast-ball sports such as cricket or tennis manage to hit balls directed at them at almost 200 kilometres per hour – a speed which precludes the possibility of accurate visual tracking? In other words, how can they respond accurately to stimuli of which they are not consciously aware? By addressing the neuroscience of expertise in sport, researchers have discovered that, contrary to received coaching wisdom, cricket and tennis players do *not* actually “watch the ball” as it approaches them (Moran, 2012). Instead, based on extensive practice (see Williams & Ford, 2008), they use early signals (“advance cues”) from their opponents’ body position and/or limb movements to anticipate the type of delivery, trajectory and likely destination of speeding balls directed at them (e.g., see Müller et al., 2009). The conclusion from such research is that expertise in sport is largely *knowledge-based* (and hence, to some extent, trainable) rather than ‘hard-wired’ in athletes’ brains and nervous systems.

Despite its neglect by traditional cognitive psychology, sport has played a seminal role in the genesis of contemporary understanding of the mental representation of action. Specifically, it influenced the idea of motor *schemata* that was postulated by the British psychologist Sir Frederic Bartlett in his book *Remembering* (Bartlett, 1932). Imbued with a lifelong passion for the game of cricket, Bartlett marvelled at the ingenuity with which batsmen shaped their strokes in anticipation of bowlers’ intentions. Thus watching cricket led indirectly to Bartlett’s theory of schemata: “Suppose I am making a stroke in a quick game, such as tennis or cricket. How I make the stroke depends on the relating of certain new experiences, most of them visual, to other immediately preceding visual experiences and to my posture, or balance of postures, at the moment ... When I make the stroke I do not, as a matter of fact, produce something absolutely new, and I never merely repeat

something old. The stroke is literally manufactured out of the living visual and postural 'schemata' of the moment and their interrelations" (Bartlett, 1932, pp. 201-202).

Unfortunately, Bartlett's passion for athletic activity was not shared by his successors in cognitive psychology. This oversight is regrettable because it may convey the misleading impression that sport is a frivolous pursuit that is unworthy of serious academic scrutiny. Happily, this neglect of sport has changed considerably as a consequence of two changes in theoretical emphasis: one in cognitive psychology and another in cognitive neuroscience. First, the fact that the information processing approach could not explain adequately the interaction between thinking, perception and action led to the rise of "grounded cognition" (Barsalou, 2008) and the embodiment paradigm (Laakso, 2011). Meanwhile, a second – if more subtle - change in emphasis occurred in research in cognitive neuroscience. Specifically, since the early 2000s, investigators have augmented studies of cognitive deficits in *clinical* populations (e.g., patients with brain damage) with research on the neural 'signature' of highly skilled performers such as athletes (Aglioti, Cesari, Romani, & Urgesi, 2008) and dancers (e.g., Bläsing et al., 2012) drawn from *elite* populations. This shift from a 'deficit-based' approach to a 'strength-based' approach to the study of cognitive processes has led to an upsurge of research on the neural substrates of motor expertise (e.g., Nakata, Yoshie, & Kudo, 2010; Wei & Luo, 2010).

In summary, many psychologists and neuroscientists have (re)discovered that competitive sport provides a unique window on the mechanisms underlying people's ability to execute cognitive and motor skills in dynamic situations and under severe time constraints. In this regard, there has been an upsurge of research on topics such as

decision-making (Dosseville, Labourde, & Raab, 2011), working memory (Furley & Memmert, 2010), pattern perception (Gorman, Abernethy, & Farrow, 2011), expertise (Müller et al., 2009), motor control (Toner & Moran, 2011) and motor imagery (Moran et al., in press) processes in sport.

### **3. Thinking and skilled action: Exploring ‘flow’ and ‘choking’ in sport**

Cognitive sport psychologists who study the relationship between thinking and skilled action have explored in detail two phenomena occupying opposite ends of the athletic performance continuum. To explain, whereas some investigators have tried to find out what athletes typically think about when experiencing ‘flow’ or peak performance (see review by Jackson, 2011), other researchers have addressed the thinking processes associated with ‘choking’ in sport - or the sudden impairment of normally expert performance as a consequence of anxiety (Hill, Hanton, Matthews, & Fleming, 2010). So, what insights have emerged into the thinking processes that accompany these contrasting states of mind?

‘Flow’ may be defined as a highly coveted yet elusive state of mind that it characterised by at least four key features. First, it involves a present-centred “state of concentration so focused that it amounts to absolute absorption in an activity” (Jackson, Thomas, Marsh, & Smethurst, 2001, p. 130). In this attentional state, there is no difference between what the performer is thinking about and what s/he is doing. To illustrate, consider the claim by Michael Johnson, the sprinter who won nine world championships, that he had “learned to cut out all the unnecessary thoughts ... on the track. I simply concentrate. I concentrate on the tangible – on the track, on the race, on

the blocks, on the things I have to do. The crowd fades away and the other athletes disappear and now it's just me and this one lane" (cited in Miller, 1997, p. 64). A similar fusion of thought and action was evident after Roger Bannister had run the first sub-4 minute mile in May 1954 in Oxford: "there was no pain, only a great unity of movement and aim" (Bannister, 2004, p. 12). Second, flow is usually characterised by the absence of thinking and/or by low levels of self-reported conscious control of action (e.g., Ravizza, 1984). For example, when the triple-major champion golfer Pádraig Harrington won the 2007 Open Championship in Carnoustie after a play-off against Sergio Garcia, he described his thoughts as he prepared for his final putt: "no conscious effort whatsoever went into that putt. There were no thoughts about 'this is for the Open' ... I stroked it in" (cited in Jones, 2007, p. 12). Similarly, when asked how he prepares for races, Michael Phelps, the swimmer who has won more Olympic gold medals than any other athlete in history, revealed that "I'm not thinking ... I block everything else out" (cited in Whitworth, 2008, p. 25). Third, flow experiences are invariably reported by athletes as feeling effortless. This transcendental experience is epitomised in the following quotation from Pelé (a three-times World Cup winner with Brazil and one of the best soccer players of all time): "it was a type of euphoria, I felt I could run all day without tiring, that I could dribble through any of their team or all of them, that I could almost pass through them physically. I felt I could not be hurt. It was a very strange feeling and one I had not felt before" (cited in Jones, 1995, p. 10). Finally, flow is usually accompanied by enhanced skilled performance. For example, golfing champion Darren Clarke's experience of flow at the K-Club (Ireland) on 31 July 1999 (when he claimed that he was "in my own little world, focusing on every shot"; cited in Otway, 1999, p. 13) coincided

with a record-equalling round of 59. In summary, flow is “an almost automatic, effortless, yet highly focused state of consciousness” (Csikszentmihalyi, 1996, p. 110) that has attracted considerable research in domains such as sport (Jackson, 2011; Jackson & Kimiecik, 2008) and music (Sinnamon, Moran, & O’Connell, 2012).

Given the characteristics of flow described above, could an attentional training strategy be used to facilitate the experience of this phenomenon in skilled performers? In attempting to answer this question, some researchers have investigated the possibility of mindfulness training with athletes. Mindfulness is an attentional focusing strategy that originated in the Buddhist meditative tradition (Erisman & Roemer, 2010). According to one of its leading proponents Kabat-Zinn (2005), it involves “an openhearted, moment-to-moment, non-judgmental awareness” (p. 24) of oneself and of the world. Evidence is accumulating to suggest that mindfulness-based interventions are effective in reducing stress (Chiesa & Serretti, 2009), in improving certain cognitive abilities such as attention (Chiesa, Calati, & Serretti, 2011) and in eliciting changes in the brain regions associated with learning and memory processes (Hölzel et al., 2011). Based on such evidence, it seems plausible that training in mindfulness could increase the likelihood of flow experiences in athletes. Interestingly, mindfulness training differs from more active cognitive control techniques such as thought stopping (whereby a verbal cue such as “stop” is stated aloud every time an undesired thought is encountered) because it urges *acceptance* rather than attempted elimination of intrusive, unwanted thoughts and feelings. In short, mindfulness training purports to help sports performers to concentrate on the here-and-now.

Recently, Aherne, Moran, and Lonsdale (2011) investigated the effects of a six-week, CD-based mindfulness training programme on elite athletes' flow experiences in training. Participants (who were international athletes from a university's "high performance centre") were assigned either to a control group or an experimental group. Athletes in the experimental group received a 6-week program of mindfulness training exercises (e.g., somatic awareness activities involving breath control and yoga). Both groups of athletes completed a psychometric measure of flow. Results showed that the athletes who underwent the mindfulness training reported increases in their global flow experiences. Given the exploratory nature of this experiment, however, additional research employing larger samples and more stringent controls is required before firm conclusions can be drawn regarding the efficacy of this cognitive strategy of mindfulness training for enhancing flow.

By contrast with the experience of flow, 'choking' in sport is a phenomenon in which an athlete's normally expert level of performance deteriorates suddenly and significantly under conditions of perceived pressure (Kremer, Moran, Walker, & Craig, 2012; Moran, 2012). It is ubiquitous among competitive athletes. As Tom Watson (the former world number 1 golfer) remarked, "we all choke. You just try to choke last!" (cited in MacRury, 1997, p. 99). Not surprisingly, this phenomenon has attracted considerable attention from psychologists - ranging from coverage in popular science (e.g., Beilock, 2010) to reviews of the relevant research literature (e.g., Hill et al., 2010).

Theoretically, choking has at least two intriguing features. First, athletes who choke tend to report that the more deliberately they strive to excel, the worse their performance becomes. Therefore, choking seems to occur, paradoxically, because people

try *too* hard to perform well. Second, choking is characterised by an internal focus of attention in which athletes become self-conscious and think too much about the mechanics of their skills. As Beilock (2010) explained, just as thinking about where to place our feet as we rush downstairs may cause us to trip, focusing deliberately on actions that are normally regulated outside our conscious awareness can lead to choking.

### **3.1 Understanding flow and choking: The perils of conscious control**

Although the theoretical mechanisms underlying flow remain almost as elusive as the phenomenon itself, Dietrich (2004) postulated that this experience may be triggered when performers switch from a conscious to an unconscious mode of control over their actions. Specifically, he suggested that flow is likely to occur when “a highly practiced skill that it represented in the implicit system’s knowledge base is implemented without interference from the explicit system” (p. 746). Extrapolating from this proposal, it seems that, to paraphrase a Zen koan, in order to gain procedural control, one has to *give up* conscious control. From a neuroscientific perspective, the suppression of conscious control is associated with a ‘dampening’ of the performer’s prefrontal cortex - that part of the brain which regulates working memory and conscious awareness (see Baddeley, 2012; Logie, 2011). Typically, when conscious working memory gives way to unconscious procedural memory, highly-practised skills can run smoothly and effortlessly. Interestingly, this intricate interplay between conscious and unconscious forms of cognitive control is highlighted in Kahneman’s (2011) and other writers’ (Stanovich & West, 2000; Evans, 2008) models of thinking. Specifically, Kahneman distinguished between two modes of thinking – intuitive (“System 1”) and reflective

(“System 2”). System 1 thinking is postulated to be fast and automatic (i.e., it “cannot be turned off”; Kahneman, 2011, p. 25) and is believed to regulate unconscious activities such as recognizing faces, avoiding obstacles and playing practiced skills such as tennis. By contrast, System 2 thinking is held to be slow, effortful and deliberate and is believed to be required for reflective activities (e.g., filling in a tax form, parking in a narrow space or waiting for the starter’s gun in a race) that demand “a surge of conscious attention” (p. 24). Although Kahneman (2011) suggests that both modes of thinking are continuously active, “our thoughts and actions are routinely guided by System 1 and are generally on the mark” (p. 416). However, when the stakes are high or when a surprising event challenges us, System 2 usually takes over “to support more detailed and specific processing that may solve the problem of the moment” (p. 24). But because System 2 thinking is constrained by capacity limitations and tires easily, it is vulnerable to a range of cognitive biases that originate in the rapid and intuitive thinking of System 1. Nevertheless, Kahneman (2011) is at pains to point out that although System 1 thinking “is indeed the origin of much of what we do wrong, it is also the origin of most of what we do right – which is most of what we do” (p. 416).

Returning to the experience of flow, recent neuroscientific research may help to explain the apparent efficacy of idiosyncratic strategies used by athletes to prevent themselves from thinking too much in competitive situations. For example, consider how the snooker player Mark Williams managed to switch from System 2 to System 1 thinking by singing a song silently to himself in an effort to block out negative thoughts towards the end of his classic defeat of Ken Doherty in the 2003 world championship final. As he said afterwards: “At 16–16, I was singing songs in my head. I was singing

Tom Jones' Delilah. I just tried to take my mind off the arena, the crowd, everything" (cited in Everton, 2003, p. 31). Such covert singing may have helped Williams to counteract a tendency to mistakenly try to exert conscious control over actions that are better performed automatically (see also Beilock, 2010). In a similar vein, Rory McIlroy, the golfing champion, used conversations with his caddie to prevent himself from engaging in excessive conscious control of his strokes on his way to victory in the 2011 US Open championship. As he revealed afterwards, "having a conversation about something completely different is probably the best thing for me as it takes my mind off it and stops me getting too involved in what I'm doing" (cited in Irish Times, 2011, p. 20).

Arising from McIlroy's comments, what is the role of attempted conscious control in the experience of choking under pressure? The theory of "reinvestment" (Masters, 1992; Masters, in press; Masters & Maxwell, 2008) or the "conscious processing hypothesis" (Hardy, Mullen, & Jones, 1996) was postulated to account for the effects of consciousness on performance. This theory suggests that "unplanned use of task-relevant knowledge to control movement online is responsible for disrupted motor performance or deautomaticity" (Masters, in press). Reinvestment is defined as the attempted use of "conscious, explicit, rule based knowledge, by working memory, to control the mechanics of one's movements during motor output" (p. 208).

According to reinvestment theory, when athletes become anxious, they attempt to ensure task success by reverting to a mode of conscious control that is associated mainly with an *early* stage of motor learning (i.e., one that relies on explicit rules and that typically results in slow and effortful movements). For example, an anxious tennis player

who is serving at match point may become so preoccupied with trying to remember explicit coaching instructions (e.g., “throw the ball up high and slowly let your serving arm drop behind your shoulder”) that s/he freezes – thereby experiencing deautomaticity or what is known colloquially as ‘paralysis by analysis’. According to Masters and Maxwell (2004), this temporary regression involves a “reinvestment” of cognitive processes in perceptual-motor control. To summarise, the conscious processing hypothesis postulates that performance breakdown occurs when performers “reinvest” their verbal knowledge of task requirements in an effort to consciously control their movements.

In an effort to measure individual differences in susceptibility to reinvestment, Masters, Polman, and Hammond (2003) developed the “Reinvestment Scale” to assess people’s tendency to attempt to gain conscious control over an automatic skill in pressure situations. This 20-item scale purports to measure the extent of people’s self-consciousness in everyday situations. Typical items include “I’m aware of the way my mind works when I work through a problem” and “I’m concerned about my style of doing things”. Evidence to support the predictive validity of this scale was reported by Jackson, Ashford and Norsworthy (2006) who found that high “reinvesters” displayed greater susceptibility to skill failure under pressure than did low “reinvesters” counterparts. Recently, Toner and Moran (2011) investigated the effects of two different types of conscious processing (making technical adjustments to a stroke and simply paying attention to the execution of the stroke) on putting performance by expert golfers. Results showed that although technical adjustments did not affect these experts’ putting

proficiency (as measured by number of putts holed), they impaired kinematic aspects (e.g., swing consistency) of the putting stroke.

Having explored the role of thinking (or more precisely, conscious control) in flow and choking experiences, let us now consider some practical issues arising from athletes' attempt to control their thoughts.

#### **4. Thought control in athletes: From theory to practice**

A useful body of research literature on helping people to think more effectively may be found in studies of cognitive therapy. According to Clark and Beck (2010), cognitive therapy is a structured, collaborative and problem-oriented form of psychotherapy that helps people to modify their maladaptive thoughts, attitudes, beliefs and information processing biases (e.g., "if I fail to win an important match, then I'm a failure as a person").

At least three key principles underlie this form of therapy (Dozois & Beck, 2011). First, people's cognition is assumed to affect both their emotions and their behaviour. Second, people are assumed to be capable of learning to monitor and modify much of their cognitive activity. There is some debate among cognitive therapists, however, about the degree to which people can modify "automatic" thoughts (i.e., those that are not accessible to conscious deliberation) directly. Third, cognitive therapists assume that by changing one's beliefs, one can achieve desired change in one's behaviour and experience. An important implication of these ideas is that people can learn to regard their thoughts as *hypotheses* rather than as facts. By testing the validity of these hypotheses empirically, people can "shift their cognitive appraisals from ones that are

unhealthy and maladaptive to ones that are more evidence-based and adaptive” (Dozois & Beck, 2011, p. 30).

Before any such healthy cognitive change is possible, however, people need to become more aware of their thinking habits and self-talk (what people say silently to themselves; Zinsser, Bunker, & Williams, 2010). In an effort to investigate athletes’ awareness of their self-talk, Hardy, Roberts, and Hardy (2009) evaluated the efficacy of two cognitive-behavioural intervention strategies - a thought awareness logbook and an exercise requiring athletes to transfer paper-clips from one pocket to another whenever they used a negative self-statement. Results showed that although both treatment groups showed increased awareness of the *content* of their negative self-talk, the logbook group showed greater awareness than the control group of the *use* of negative self-talk. Accordingly, Hardy et al. (2009) recommended that logbook maintenance may be a useful tool for increasing awareness of negative self-talk among athletes in applied settings.

Some applied sport psychology consultants have proposed that athletes should augment their awareness of negative self-talk with the use of a suppression technique such as “thought stopping” – the use of a verbal trigger (e.g., the word “stop”) or non-verbal cue (e.g., slapping one’s fingers) in an effort to interrupt or terminate an undesired thought (Zinsser et al., 2010). In other words, athletes who become aware of negative self-talk should actively try to suppress or stop this unhelpful internal dialogue. This approach may prove to be counterproductive, however. The difficulty here is that Wegner’s (1994, 2009) research on ironic processes suggests that when working memory is overloaded due to anxiety or fatigue, any attempts to suppress a thought may prove

paradoxical or counterproductive – serving only to *increase* the prominence of the thought in consciousness. In such circumstances, thought stopping may actually elicit a *rebound* experience whereby the suppressed thought becomes even more prominent in consciousness than was the case previously. This tendency for a suppressed thought to come to mind more readily than a thought that is the focus of intentional concentration is called “hyperaccessibility” (Wegner & Erber, 1992) and is especially likely to occur under conditions of heavy mental load. Wegner’s (1994) ironic processes model has attracted increasing attention from action researchers in recent years (e.g., see Erskine & Georgiou, 2011). In sport, anxious athletes often experience rebound effects as a result of using avoidant instructions (e.g., “Don’t double-fault!” or “don’t get caught offside”). Interestingly, Woodman and Davis (2008) investigated the effects of ironic processes on golf performance. They discovered that when players were under pressure (e.g., when competing for a financial prize) and when thinking about *not* doing something (e.g., don’t overshoot), they tended to commit ironic errors. Clearly, this finding raises doubts about the commonsense wisdom of exhorting anxious athletes *not* to worry about an important impending competitive event.

## **5. Conclusions and practical implications**

In this paper, I have presented two key arguments. First, based on neuroscientific evidence (e.g., arising from the functional equivalence hypothesis; Jeannerod, 1994), I suggested that, far from lying at opposite ends of the behavioural spectrum, thinking and action are inextricably linked. Second, I argued that research on certain exceptional performance states in sport (e.g., athletes’ experiences of ‘flow’ and ‘choking’) can

provide compelling insights into the mechanisms underlying thinking in action. For example, at a theoretical level, the mode of cognitive control adopted by the performer (i.e., either intuitive, System 1 thinking or reflective, System 2 thinking; Kahneman, 2011) appears to determine whether people execute skilled actions exceptionally well or exceptionally badly. And at a practical level, it seems clear that some of the idiosyncratic focusing strategies used by elite athletes in competitive situations (e.g., singing silently to oneself) reflect informal attempts to prevent themselves from thinking too much. So, what are the implications of these two arguments for practical ways to improve thinking processes in domains other than sport?

A clear implication of the preceding evidence and arguments is that different modes of thinking require different types of instructional strategies. For example, attempts to improve critical or reflective thinking (System 2; Kahneman, 2011) in any domain require explicit modelling and guided practice (Bensley, 2010). But how can we improve intuitive (System 1) thinking in the boardroom and the classroom? Although Kahneman (2011) acknowledged that such thinking is “not readily educable” (416), he claims that we can learn to “recognize the signs that you are in a cognitive minefield, slow down, and ask for reinforcements from System 2” (p. 417). Unfortunately, whereas business organizations can implement such advice quite easily (e.g., by using quality control checklists and by appointing “devil’s advocates” to challenge the rationale of strategic decisions), schools may struggle to do so. Nevertheless, evidence is emerging to suggest that inferential comprehension processes in the classroom can be improved by interventions using implicit learning strategies. For example, Yeh, McTigue, and Joshi (2012) reported a case-study in which the comprehension skills of a sixth-grade student

improved significantly as a result of systematic practice with word analogies, riddles and mystery stories. Clearly, additional research is required to establish the validity of such implicit learning interventions.

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### Research Highlights

- Explores insights into the relationship between thinking and skilled action in sport.
- Explains cognitive psychologists' more enthusiastic attitude to sport in recent years.
- Explores practical issues associated with athletes' conscious control over their thoughts.
- Considers implications of research on thinking in action in sport for other domains.

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