Title: Toward an explanation of continuous improvement in expert athletes: The role of consciousness in deliberate practice

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Abstract

In a body of research spanning three decades, Janet Starkes and her colleagues have produced a wealth of empirical evidence on the importance of deliberate practice in the development of elite performers. Within this corpus of work, a number of studies have alluded to the important role that self-focused attention plays in helping skilled athletes to refine inefficient movements during deliberate practice. Unfortunately, these studies have largely under-represented the role that somatic awareness plays in facilitating further improvement amongst sports performers who have already achieved elite status. In seeking to address this issue of continuous improvement in elite athletes, the current paper marshals evidence to suggest that reflective somatic awareness plays an important role in the practice activities of elite performers. In particular, we argue that such awareness enables elite athletes to consciously and deliberately improve their movement proficiency. More generally, we propose that Shusterman's (2008) theory of "somaesthetic awareness" offers expertise researchers a potentially fruitful theoretical framework for future research on skill advancement at the elite level of sport.

Toward an explanation of continuous improvement in expert athletes: The role of consciousness in deliberate practice

For over three decades, Janet Starkes and her colleagues have investigated the psychological foundations of expertise in motor performance. Whereas her early research (e.g., Starkes & Allard, 1983) elucidated perceptual-cognitive differences between expert and novice athletes, subsequent studies (e.g., Starkes, 2000) drew on the theory of "deliberate practice" (i.e., sustained engagement in training activities that are "very high on relevance for performance, high on effort, and comparatively low on inherent enjoyment"; Ericsson, Krampe, & Tesch-Römer, 1993, p. 373) to explore how athletes' practice activities paved the road to expertise. In this commentary, we take up the challenge of trying to understand a relatively neglected aspect of this otherwise well-charted road to expertise – namely, the issue of "continuous improvement" in individual sport athletes. This latter term refers to the phenomenon whereby certain elite sports performers appear to be capable of continuously improving their skills through deliberate practice, even *after* they have become experts. For us, continuous improvement among expert athletes is an important topic because it raises an intriguing puzzle. Put simply, what theoretical mechanisms explain the fact that for some expert athletes, performance improvements do not "level off" with increased practice but actually continue, thereby confounding the asymptotic effects predicted by the power law of practice (Newell & Rosenbloom, 1981)?

A finding consistent across much of the deliberate practice literature (e.g., Deakin & Cobley, 2003; Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Young & Medic, 2008; Young & Salmela, 2002) is that highly-skilled performers engage in practice

activities which require their "full attention and concentration" (Ericsson, 2006, p. 700) to gradually improve their performance by correcting specific weaknesses. For example, Deakin and Cobley (2003) found that elite-level figure skaters devoted conscious attention to the improvement of inefficient jumps and spins during practice. Similarly, Starkes et al. (1996) discovered that wrestlers concentrated on consciously refining their technique during 'mat work' with a partner. Interestingly, in evaluating the role that consciousness plays in facilitating athletic expertise, some disagreement appears to exist among psychology researchers. Specifically, whereas some investigators (e.g., Masters & Maxwell, 2008) have cautioned against the use of self-focused attention to alter habitual movement patterns, others (e.g., Gray, 2004) have suggested that conscious bodily awareness is *necessary* to improve problematic or 'attenuated' habits. In line with the latter perspective, and with findings from deliberate practice research, Beilock, Carr, MacMahon, and Starkes (2002) postulated that skill-focused attention may help performers during practice to consciously dismantle aspects of their technique that have been identified as inefficient on the basis of self-regulation of their actions. Researchers argue that having altered the inefficient movement in the practice context, athletes can relinquish conscious attention and allow the newly learned technique to be performed automatically or with minimal conscious control (see Gray, 2004; Jackson & Beilock, 2008) during competitive performance. Unfortunately, neither research in motor learning (e.g., Beilock et al.'s work) nor that in deliberate practice has adequately explained how performers appear capable of moving from a *reflective* mode of bodily awareness (i.e., one that occurs when correcting skills during practice) to a largely automated state (i.e., as typically occurs during competitive performance) and *vice versa.*

In addressing this issue, we propose that the concept of ‘somaesthetic awareness’ (see Shusterman, 2008; 2012), or heightened body consciousness, may help us to understand how expert performers avoid “prematurely arrested development” (Ericsson, 2013, p. 893) by alternating between reflective (in the practice context) and unreflective (in the performance context) modes of bodily awareness. To achieve this aim, we draw on empirical evidence and a theoretical argument concerning possible mechanisms underlying continuous improvement in expert performers. The theoretical argument comes mainly from Shusterman's (1999, 2008, 2011) philosophical proposal that 'somaesthetic' training (which involves paying heightened attention to and mastery of our somatic functioning) is crucial for skill-learning and continuous improvement. The empirical evidence comes mainly from studies of conscious 'fine-tuning' processes in expert performers (e.g., see Collins, Morris, & Trower, 1999; Hanin, Korsus, Jouste, & Baxter, 2002).

Shusterman's (2008, 2011) theory of bodily awareness is rooted in an 'embodiment' approach to the mind - the idea that cognitive representations are grounded in, and stimulated by, sensorimotor processes (see more detailed discussion in Glenberg, Witt, & Metcalfe, 2013; Laakso, 2011). According to Wilson and Golonka (2013), the theory of embodied cognition is “the most exciting idea in cognitive science right now” (p. 1) because it challenges us to consider the possibility that bodily processes rather than brain states help us to achieve many of our everyday cognitive goals. In emphasizing that human consciousness is grounded in bodily movements and awareness Shusterman (2011) postulated that “heightened somatic consciousness can improve proficiency” (p. 321). What intrigues us about this embodiment proposal is that it runs counter to received

wisdom in sport psychology (e.g., see Masters & Maxwell, 2008; Wulf, 2013), which urges expert performers to direct attention *away* from habitual bodily movements. However, Shusterman (2008), in his critique of Western philosophy's neglect of bodily knowledge, argues that inefficient habits must be deliberately subjected to conscious critical reflection so that they can be worked on in a precise manner in the interest of self-improvement.

This latter idea is challenging for sport psychology because substantial evidence indicates that implicit learning (i.e., where knowledge of bodily movement is inaccessible to consciousness) can aid skill acquisition (see Masters, 2000; Masters & Maxwell, 2004) and that any attempt to consciously monitor or control movement during *on-line* performance is likely to result in the disruption of skilled performance (e.g., Beilock et al. 2002; Jackson, Ashford, & Norsworthy, 2006). Accordingly, researchers and sport psychologists typically exhort performers to direct their attention *away* from bodily movements in the practice context and to rely on spontaneity in guiding habitual movement patterns during competitive performance (see Weiss & Reber, 2012). We question this advice, however, and argue instead that although directing attention away from the body may be acceptable when people are performing habitual movements in a smooth and efficient manner, it is counterproductive in situations where performers' movements have become problematic or inefficient. We further propose that these latter difficulties are virtually inevitable at some point in every athlete's career - because we all tend to "lapse into bad habits of performance or face new conditions of the self (through injury, fatigue, growth, aging, and so on) and new environments in which we need to correct, relearn, and adjust our habits of spontaneous performance" (Shusterman, 2008, p.

138). Echoing these latter words, we propose that paying attention consciously to inefficient bodily habits is the first step in deliberate practice.

In support of our argument that somatic awareness has been undervalued to date, considerable anecdotal evidence exists to suggest that expert performers often try to improve their movement proficiency by *deliberately* and consciously refining their technique during practice. For example, in July 2012, Rory McIlroy, the world's number one ranked golfer at the time, appeared to be experiencing a performance slump having failed to make the halfway 'cut' in a number of recent high profile tournaments (e.g., US Open). During this period, McIlroy's coach Michael Bannon suggested that his poor form could be attributed to a specific flaw in his swing – namely, the possibility that he was getting underneath the plane on the downswing and that the club was travelling far too much on the inside and hence inducing a miss to the right of the target (Carter, 2012). To address this flaw, McIlroy underwent what Bannon described as a 'fine tuning process' which hinged on the player learning to *consciously discriminate* between the inefficient downswing position of his club and the desirable or more efficient one. Four weeks after struggling to make the cut in the British Open, McIlroy achieved a spectacular 8 stroke victory in the USPGA Championship. Clearly, McIlroy's quest for technical improvement prompted him to make *deliberate* conscious refinements to his golf swing in the practice context. Such refinements are not isolated idiosyncrasies, but instead, appear to be a common feature of many elite sports performers' training regimes (Collins et al. 1999). Furthermore, empirical evidence shows that coaches regularly construct practice activities that allow elite performers to *consciously* refine inefficient technical movements (e.g., Hanin et al. 2002; Hanin, Malvela, & Hanina, 2004). In these

circumstances, spontaneity of skill execution is replaced by deliberate and conscious attempts by athletes to alter and improve their movement during practice.

How can Shusterman's (2008, 2011) theory of 'somaesthetic awareness' help us better understand the mechanisms which mediate continuous improvement in expert athletes? One way is by encouraging researchers to question their assumptions about the detrimental effects of bodily-focused attention. To explain, Shusterman (2011) set out to explore "the differences between those occasions when heightened somatic consciousness is helpful and when it is detrimental" (Shusterman, 2011, p. 319). Proclaiming that learning is never complete, Shusterman (2011) argues that somatic attention is necessary for expertise because without critical self-reflection, we often lapse into bad habits of performance (as evidenced in the above case of Rory McIlroy). Furthermore, we cannot trust these 'attenuated' habits to correct themselves through unconscious trial and error or by directing attention away from bodily movement (i.e., adopting an external focus of attention). Unfortunately, adopting either of the latter approaches will merely "reinforce these bad habits and the damage they cause" (Shusterman, 2008, p. 169).

Shusterman's model proposes that the reconstruction of habitual movement is a two-stage process. First, the performer must be somaesthetically aware of the efficiency of his or her current movement mechanics. Here, Shusterman is not suggesting that performers should monitor on-line performance in a way that would prove detrimental to skill execution (e.g., by focusing on part-process goals) but rather, that they should pay attention to the "proprioceptive feel of what we are doing" (2009, p. 138). This focus of attention merely requires the performer to be *aware* of their movement and whether it is causing discomfort or some other outcome that is unusual or undesirable. Accordingly, it

seems reminiscent of the goal of mindfulness training – to develop non-judgmental awareness of oneself (Kabat-Zinn, 2005). In seeking to develop an athlete's somaesthetic awareness during training, a coach may use strategically placed mirrors to help the athlete become aware of how they appear when adopting various postures (e.g., their spine angle when addressing a golf shot) or when achieving certain movement positions (e.g., top of the golfer's backswing). By noting the proprioceptive sensations in different postures (e.g., a stooped or hunched posture versus a more upright posture at address), it seems plausible that the golfer could begin to associate different visual "forms" with different proprioceptive feelings. Having engaged in a program of such *associative training*, athletes could learn to infer from their proprioceptive feelings what their movement or posture looks like in actual competitive performance. Research has shown how visuo-motor mirror neurons are discharged when an individual performs a motor movement and when the individual sees such actions performed by others (or by themselves; see Rizzolati & Craighero, 2004) – thereby helping to explain how an athlete might integrate visual and motor-proprioceptive perception. Interestingly, recent research by Teper, Segal, and Inzlicht (2013) suggest that mindfulness training is linked to enhanced executive control and improved attentional processing.

According to Shusterman (2012), athletes may use somaesthetic awareness during deliberate practice or in competition to identify failures in performance or when coaches are telling them that they are "doing something awkward, peculiar, or detrimental" (p. 212). Furthermore, elite athletes are subject to demanding performance schedules which often mean that they are away from home for weeks or months at a time and thus may have little opportunity to consult their coaches. Developing somaesthetic awareness of

the efficacy of their movement may represent the key psychological mechanism which allows athletes to move beyond pure reliance on coaches' feedback and helps them to analyze or critique their own skills, practice, shortcomings etc (Starkes, 2008).

Second, performers often work with coaches to alter, refine, and improve these 'attenuated' habits. In doing so, the attenuated habit must be brought into conscious reflection (during deliberate practice) so it can be "grasped and worked on more precisely" (Shusterman, 2009, p. 135). In this regard, a number of researchers (e.g., Collins et al. 1999; Hanin et al. 2002) have shown how conscious bodily awareness allows the performer to discover the difference between old, undesirable techniques and new, more efficient movement patterns. According to Shusterman (2008), we must *inhibit* the problematic habit and replace it with a superior mode of response. The coach may achieve this by manipulating the athlete's body and helping him or her gain a new and reliable sensory appreciation of the desired movement. This process could inhibit the tendency of "end-gaining" and, instead, ensure that the athlete learns to focus on the means (e.g., correct shoulder turn in the golfer's backswing) involved in reaching an end (e.g., generating club-head speed at impact). Collins et al.'s (1999) intervention sought to inhibit undesirable technique by utilising 'contrast' drills which initially increased an elite javelin thrower's physical and mental awareness of correct versus incorrect movement positioning. It is important to initiate the change process by driving a 'wedge' between the current and desired movement pattern to "generate a distinction and realize the required changes" (Carson & Collins, 2011, p. 152). The ultimate goal of this process is to ensure that the new movement can be internalized or automatized to the extent that its on-line execution during competitive performance no longer requires conscious control.

Once the inefficient movement patterns have been identified through somatic reflection and the more efficient pattern has subsequently been habituated through extensive practice, Shusterman (2012) argues that conscious attention may be relinquished and we may move into the more unreflective spontaneous mode where our attention can be focused on the external targets of our action (echoing Wulf's, 2013, emphasis on an external focus of attention), not on the somatic or conscious means of achieving them. However, although the newly acquired movement pattern should now be guided by spontaneity (or with minimal conscious control) during on-line competitive performance the performer must remain somaesthetically aware of their movement and continue to evaluate its overall efficacy. Such continuous critical reflection appears necessary as habitual behavior is continually threatened by factors such as injury, aging, growth, and so on (see Bissell, 2013; Shusterman, 2008). By remaining somaesthetically aware of their movement, athletes can identify when they have lapsed into bad habits of performance in a competitive context and choose to return to a 'cognitive' phase of learning where they can consciously correct or adjust these 'attenuated' habits of spontaneous performance in the practice context.

An important feature of Shusterman's model concerns the proposed existence of *interchanging phases* or *stages of learning*. To explain, Shusterman's theory of body consciousness is cyclical in the sense that the maintenance and enhancement of performance efficiency requires the skilled performer to alternate between different modes of bodily awareness. This represents a novel perspective as many influential theories of skill acquisition (which have had a profound influence on sport expertise research e.g., information processing theories) have argued that skill acquisition occurs in

a unidirectional manner (i.e., it moves from the cognitive to the associative to the procedural stage). Accordingly, some expertise researchers have emphasized the role procedural knowledge (i.e., automatic processing) plays in guiding skilled performance (for example, see Masters & Maxwell, 2008) and downplayed the utility of conscious bodily awareness. By contrast, other researchers (e.g., Ericsson, 2006) have argued that continuous improvement is reliant on the performer counteracting automaticity by remaining within the cognitive and associative stages. Unfortunately, these perspectives appear to have constructed an unhelpful dichotomization (between automatic/reflective and unconscious/unreflective awareness) that ignores the growing body of anecdotal and empirical evidence which suggests that continuous improvement requires skilled athletes to alternate between cognitive and procedural modes of processing.

We argue that Shusterman's (2008) theory may provide a useful bridge between these dichotomies by helping to explain how expert performers "continuously cycle back and forth between these stages depending on the current level at which they are performing" (Gray, 2004, p. 52). According to Shusterman's perspective, the skilled athlete who is moving proficiently should remain within the 'automatic phase' (contrary to Ericsson's advice). However, when the athlete acquires an attenuated habit they should return to the cognitive or associative phase (contrary to many contemporary perspectives; e.g., Weiss & Reber, 2012) and seek to consciously refine their movement during deliberate practice. Following a systematic method of constructive conscious control (see Carson & Collins, 2011, FIVE-A model of technical change) during deliberate practice may be crucial in 'pressure-proofing' the new movement pattern.

In seeking to explore this issue, future research could use diary studies and interviews to explore how skilled athletes use somaesthetic awareness to alternate between different modes of bodily awareness over the course of a competitive season. In doing so, researchers could ask athletes to note *why* they have chosen to focus on improving a specific aspect of movement during practice (i.e., did they or their coach identify the problem), the process by which they have gone about automatising the new movement (i.e., the specific drills they have used), the level of concentration required to make the adjustment, the extent to which they enjoyed the process, and, finally, whether the technical refinement resulted in improved performance in the competitive environment. Ultimately, this type of investigation would help skill acquisition researchers and coaches grasp a more comprehensive understanding of the role bodily awareness plays in facilitating continuous improvement at the elite level of sport.

In the present paper, we have drawn on theoretical argument and empirical evidence to argue that some expert athletes seek to improve their technical skills by using somaesthetic awareness to alternate between reflective and unreflective modes of conscious bodily attention. Although the deliberate practice literature has yet to fully consider this latter issue, Shusterman's (2008) theory of somaesthetic awareness suggests that bodily-directed attentional processes are crucial in this regard. To conclude, we hope that our comments in this paper will encourage expertise researchers inspired by Janet Starkes' studies to investigate the role of conscious attentional processes in mediating continuous improvement in athletes.

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