

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

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Date of revised submission: 27/03/14

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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.

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

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

42 A finding consistent across much of the deliberate practice literature (e.g., Deakin
43 & Cobley, 2003; Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Young & Medic,
44 2008; Young & Salmela, 2002) is that highly-skilled performers engage in practice

45 activities which require their “full attention and concentration” (Ericsson, 2006, p. 700) to
46 gradually improve their performance by correcting specific weaknesses. For example,
47 Deakin and Cobley (2003) found that elite-level figure skaters devoted conscious
48 attention to the improvement of inefficient jumps and spins during practice. Similarly,
49 Starkes et al. (1996) discovered that wrestlers concentrated on consciously refining their
50 technique during ‘mat work’ with a partner. Interestingly, in evaluating the role that
51 consciousness plays in facilitating athletic expertise, some disagreement appears to exist
52 among psychology researchers. Specifically, whereas some investigators (e.g., Masters &
53 Maxwell, 2008) have cautioned against the use of self-focused attention to alter habitual
54 movement patterns, others (e.g., Gray, 2004) have suggested that conscious bodily
55 awareness is *necessary* to improve problematic or ‘attenuated’ habits. In line with the
56 latter perspective, and with findings from deliberate practice research, Beilock, Carr,
57 MacMahon, and Starkes (2002) postulated that skill-focused attention may help
58 performers during practice to consciously dismantle aspects of their technique that have
59 been identified as inefficient on the basis of self-regulation of their actions. Researchers
60 argue that having altered the inefficient movement in the practice context, athletes can
61 relinquish conscious attention and allow the newly learned technique to be performed
62 automatically or with minimal conscious control (see Gray, 2004; Jackson & Beilock,
63 2008) during competitive performance. Unfortunately, neither research in motor learning
64 (e.g., Beilock et al.'s work) nor that in deliberate practice has adequately explained how
65 performers appear capable of moving from a *reflective* mode of bodily awareness (i.e.,
66 one that occurs when correcting skills during practice) to a largely automated state (i.e.,
67 as typically occurs during competitive performance) and *vice versa*.

68 In addressing this issue, we propose that the concept of ‘somaesthetic awareness’
69 (see Shusterman, 2008; 2012), or heightened body consciousness, may help us to
70 understand how expert performers avoid “prematurely arrested development” (Ericsson,
71 2013, p. 893) by alternating between reflective (in the practice context) and unreflective
72 (in the performance context) modes of bodily awareness. To achieve this aim, we draw
73 on empirical evidence and a theoretical argument concerning possible mechanisms
74 underlying continuous improvement in expert performers. The theoretical argument
75 comes mainly from Shusterman's (1999, 2008, 2011) philosophical proposal that
76 'somaesthetic' training (which involves paying heightened attention to and mastery of our
77 somatic functioning) is crucial for skill-learning and continuous improvement. The
78 empirical evidence comes mainly from studies of conscious 'fine-tuning' processes in
79 expert performers (e.g., see Collins, Morris, & Trower, 1999; Hanin, Korsus, Jouste, &
80 Baxter, 2002).

81 Shusterman's (2008, 2011) theory of bodily awareness is rooted in an
82 'embodiment' approach to the mind - the idea that cognitive representations are grounded
83 in, and stimulated by, sensorimotor processes (see more detailed discussion in Glenberg,
84 Witt, & Metcalfe, 2013; Laakso, 2011). According to Wilson and Golonka (2013), the
85 theory of embodied cognition is “the most exciting idea in cognitive science right now”
86 (p. 1) because it challenges us to consider the possibility that bodily processes rather than
87 brain states help us to achieve many of our everyday cognitive goals. In emphasizing that
88 human consciousness is grounded in bodily movements and awareness Shusterman
89 (2011) postulated that “heightened somatic consciousness can improve proficiency” (p.
90 321). What intrigues us about this embodiment proposal is that it runs counter to received

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

97 This latter idea is challenging for sport psychology because substantial evidence
98 indicates that implicit learning (i.e., where knowledge of bodily movement is inaccessible
99 to consciousness) can aid skill acquisition (see Masters, 2000; Masters & Maxwell, 2004)
100 and that any attempt to consciously monitor or control movement during *on-line*
101 performance is likely to result in the disruption of skilled performance (e.g., Beilock et al.
102 2002; Jackson, Ashford, & Norsworthy, 2006). Accordingly, researchers and sport
103 psychologists typically exhort performers to direct their attention *away* from bodily
104 movements in the practice context and to rely on spontaneity in guiding habitual
105 movement patterns during competitive performance (see Weiss & Reber, 2012). We
106 question this advice, however, and argue instead that although directing attention away
107 from the body may be acceptable when people are performing habitual movements in a
108 smooth and efficient manner, it is counterproductive in situations where performers'
109 movements have become problematic or inefficient. We further propose that these latter
110 difficulties are virtually inevitable at some point in every athlete's career - because we all
111 tend to "lapse into bad habits of performance or face new conditions of the self (through
112 injury, fatigue, growth, aging, and so on) and new environments in which we need to
113 correct, relearn, and adjust our habits of spontaneous performance" (Shusterman, 2008, p.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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