Preperformance State, Routines, and Automaticity: What Does it Take to Realize Expertise in Self-Paced Events?

Robert N. Singer
University of Florida

To execute flawlessly and automatically in sports competition is the goal of any serious athlete. Automaticity suggests nonconscious attention to the act itself while executing, and not being aware of and therefore vulnerable to external and internal distractors. Self-paced sports and events in sports allow time for preparing to perform in a stable and predictable situation. More recently, cognitive, behavioral, and psychophysiological measures associated with developing and realizing proficiency in such acts have become increasingly identified. Many themes associated with these topics appear in the scholarly literature: conscious vs. nonconscious, controlled vs. automatic, voluntary vs. involuntary, explicit vs. implicit, systematic vs. heuristic, willed vs. nonwilled, aware vs. unaware, internal vs. externally oriented, and intentional vs. unintentional behaviors. Implications are being made about ways to influence the learning process by modeling expertise behaviors, as well as enhancing the performance of elite athletes. Of particular importance is the immediate preperformance and during-performance routine that serves as a mechanism for self-regulation of arousal level, thoughts, performance expectancy, and attentional focus.

Key Words: self-paced tasks, readiness state, self-regulation, excellence

Sport competition at the highest level requires a great amount of precision in movement execution demonstrated repeatedly over many occasions, against a variety of opponents, and in various environments. Of interest here are self-paced events in which preparation time for performing an act is adequate and environmental conditions are stable and predictable. Typically, target aiming is involved. Consistency in performing with proficiency apparently requires sufficient dedicated practice at developing a preperformance routine as well as the act of executing the movement (e.g., Singer, 1988; 2000). Consequently, the ability to self-regulate arousal level, expectations and confidence, and attention immediately prior to and during performance may be as critical as becoming skilled in carrying out the act itself. A stronger perspective is that in the absence of a meaningful and trusted readying protocol, athletes decrease the probability of perform-
ing well, and consistently well, across competitions. Another perspective is that learners can acquire certain behaviors that experts use, thereby leading to faster realization of success.

In more recent years, separate bodies of literature have emerged dealing with psychophysiological correlates of performance as well as cognitive/behavioral correlates of performance in self-paced situations. Implications may be drawn about the ideal immediate readiness state for executing an act. Likewise, research on preperformance routines suggests how to attain an optimal internal state in order to realize maximal potential. Research findings suggest determinants of and relationships with what is regularly described as peak performance, or an optimal performance state. Therefore, the purposes of this paper are to address achieving at one’s performance potential in self-paced target aiming tasks with regard to demands on cognition and attention by: (a) describing perspectives on expertise considering the transition from conscious deliberation to automaticity in orienting attention; (b) profiling the optimal psychophysiological indicants for excelling; (c) offering evidence for cognitive and attentional correlates of proficiency; (d) focusing on the ideal preperformance state and on routines that might maximize the acquiring and maintaining of skill by contributing to a state of automaticity; and (e) suggesting implications for describing the peak performance state.

Examples abound of sports and events within sports in which there is sufficient time to analyze circumstances and to determine one’s intentions with regard to performing the subsequent act. These are self-paced situations. In many of them, the target is stationary (e.g., the bowling pins, the archery target, the basketball rim for the free-throw shooter, and the spot where the golfer intends to hit the ball). Although adequate preparation time can be a blessing, it can also lead to overthinking, distraction, perceptions of inadequacy, overly elevated emotions such as anxiety or fear of failure, and possibly even lead to the activation of ironic processes. An example would be thinking about what one does not want to do, such as a golfer thinking about not hitting the ball into a sand-trap near the green before driving the ball—and then doing just that! (Janelle, 1999; Wegner, 1994).

Furthermore, under intense and personally meaningful competition, there is a tendency for anxiety/arousal to be heightened to such a degree that controlled (conscious and deliberate) processing sometimes takes over from automatic processing. Even changing from an unconsciousness state to a conscious state while performing can yield dire consequences for performance. When anxiety increases too much, an athlete becomes more aware of the situation, the intended action, and the consequences for poor performance. Even highly skilled or elite athletes are not immune from such occurrences.

Baumeister (1984) proposed a self-focus model of choking under pressure. Presumably, conscious attention turns to the process of performing the act or an awareness of its significance, resulting in compromised performance. Baumeister’s work, and that of others cited in this article, strongly supports the idea of letting a movement happen automatically without trying to consciously control and direct it. It has also been theorized that a reinvestment in controlled processing occurs (Maxwell, Masters, & Eves, 2000), which has been labeled as the choking phenomenon. Fluid and automatically activated behaviors that contribute to effective performance are presumably undermined when too much self- and situational awareness occurs, leading to self-doubts. Yet the very nature of automated performance is unclear.
In reality, many daily choices and acts become automatic. They are probably not consciously designed through a series of computational steps or conscious internal stages. Bargh and Chartrand (1999) suggest there are many examples of automatic self-regulation in regard to “(a) the automatic effect of perception on action, (b) automatic goal pursuit, and (c) the continual automatic evaluation of one’s experience” (p. 462). They raise the issue of whether mental processes and movement skills are activated by features of the environment and operate outside of conscious awareness, or whether people consciously control nonconscious processes; they argue convincingly for the former position. Bargh and Chartrand’s article primarily addresses everyday activities and events involving judgments, evaluations, and routine behaviors. Interestingly, omitted is any discussion of ecological models (dynamical systems, perception-action) (e.g., Kelso, 1995; Michaels & Beck, 1996) which seem to fit nicely in describing these examples, as would neobehaviorist and modified cognitive psychology models.

Ecological models emphasize self-organization capabilities through the interaction of self with environment which lead to the coordination and control of movement. The role of cognitions and intentions is minimized. Biological, neurological, and computational sciences are depended upon to explain a tight coupling between perception and action subsystems. Classic behaviorist theory proposed that behavior is influenced by environmental events and is not under conscious control. Classic cognitive models are associated with computer analogies to describe hypothetical stages and hierarchical control processes that operate serially to influence behavior. More contemporary models (neobehaviorist, cognitive) tend to incorporate additional considerations to describe the locus of control as being “determined jointly by processes set into motion directly by one’s environment [automatically] and by processes instigated by acts of conscious choice and will” (Bargh & Chartrand, 1999, p. 463.) Perspectives and contrasts related to these models and movement skills are provided by Davids, Williams, Button, and Court (2001). Nonetheless, interesting questions arise concerning automaticity in the performance of complex skills, what it is, and how it develops.

**Perspectives on Expertise, and Gaining It**

The notion that expertise is associated with economy of effort and automated execution—not having to pay attention to what one is doing—has been around at least since James addressed the topic in 1890. More contemporary scholars (e.g., Sparrow, 1983) have also advocated this view and how economy of effort is manifest in various biophysical domains related to skilled performance. According to Sparrow, “efficiency in performance may be a basic organizing principle of human movement which specifies the observed biokinematic organization” (p. 257). There is little doubt that sufficient goal-directed practice is needed to perform complex sport skills efficiently and habit-like.

Fitts and Posner (1967) popularized the skills area and research related to achievement from an information processing perspective. They described three learning phases involved in the acquisition of complex skills, from the early (cognitive) phase to the intermediate (association) phase to the final (autonomous) phase. In other words, conscious learning prevails at first, with nonconscious performance demonstrated at the highest level of proficiency. However, Strayer and Kramer (1994) warned that skill and automaticity do not necessarily refer to the
same state. They suggested that automatic processing is associated with very specific information processing operations, whereas skill encompasses the coordination of component automatic processes that enable complex skills to be performed. In addition, a person can execute an act with flaws, and do it repeatedly in an automated state, thus refining a dysfunctional movement and developing bad habits.

Related to the concept of automaticity is the role of selective and concentrated attention. Complex skills initially require conscious attention to what needs to be attended to and what needs to be done. One learns what not to attend to, be they irrelevant situational cues or irrelevant thoughts. Schneider and Shiffrin (1977) coined the terms controlled versus automatic processing as features associated with beginners and more advanced performers, respectively. Automatic processing is rapid, effortless, autonomous, and consistent, among other characteristic dissimilarities with controlled processing (Logan, 1988a). Difficult tasks, or those that are not familiar to the learner, require controlled processing.

Automatic processing is thought of as processing without conscious attention. Capacity demands diminish with practice, and “most of the properties emerge through practice in consistent environments” (Logan, 1988a, p. 584.). Practice in consistent task environments, which allows relevant cues to be mapped repeatedly to the same execution demands, leads to automaticity. A popular view is that “once a well-learned sequence is initiated, it moves on to completion without deliberate intent or purposeful attention” (Kimble, 2000, p. 210). Explaining why or how this happens has led to differing perspectives. First, automaticity could be explained as overcoming resource limitations by the gradual withdrawal of deliberate attention. Second, automaticity could be explained by the acquisition of a domain-specific knowledge base and the ability to retrieve memory-stored instances (Logan, 1988b). In either case, sufficient quality practice would be needed for automaticity to occur.

In self-paced sports events, the ideal occurrence is one in which the situation automatically triggers behaviors that are related to an optimal performance functional state (traditionally referred to as flow, “the zone,” or peak performance in the sports world) immediately prior to and during the act. For exceptional mastery of a complex skill, much organized and dedicated practice of that skill (or variations of it, as in golf and bowling) is necessary to attain the desired consistent automatic state to execute exceptionally well (Ericsson, 1996). With more dedicated practice, a transition is made from consciously activated task-related behaviors to automaticity in execution. As Hatfield and Hillman (2001) propose, “This state seems to be characterized by efficient allocation of psychological resources such that the athlete’s thoughts are limited to task-relevant processes” (p. 362). Furthermore, higher levels of expertise attained require roughly an order of magnitude of more time and effort than that of the next lower level (Nunez, 1995).

**Psychophysiological Correlates to Best Performance**

During the past two decades, psychophysiological evidence, primarily obtained in aiming sports, suggests that outstanding performers can be distinguished from other performers in their preperformance state. Such data point to an optimal self-regulated state prior to execution, no doubt facilitated by an effective pre-performance routine. Measures such as EEG activity (usually alpha and beta frequencies of electrical activity in each cerebral hemisphere), heart rate, and visual
gaze patterns (usually fixation duration and location at a target) have tended to
differentiate elite athletes from other athletes (see Hatfield & Hillman, 2001, for
an excellent review).

In a recent study (Janelle, Hillman, Apparies, et al., 2000), expert marksmen
exhibited a significant increase in left hemisphere alpha power (more relaxed state)
compared with the right hemisphere, as well as asymmetrical patterns of alpha and
beta activity in both hemispheres. Shooters at a lower skill level showed similar
patterns, but to a lesser extent. The data suggest that decreased controlled process-
ing occurs, as verbal/analytical processes are associated with activity in the left
hemisphere and are germane to conscious learning. In an interesting study of stages
in learning archery, Landers, Han, Salazar, et al. (1994) found equal amounts of
alpha activity across both hemispheres at the beginning of learning. However, as
the participants became more skilled, an increase in alpha activity was evident in
the left hemisphere while activity in the right hemisphere remained constant.

In their overview of research in which EEG activity in high-level athletes
has been of interest, Lawton, Hung, Saarela, and Hatfield (1998) concluded that
there is a fairly widespread decrease in cerebral activity when preparing immedi-
ately to perform. In a study reported by Haufler, Spalding, SantaMaria, and Hatfield
(2000), it was clearly shown that there was higher power in the alpha frequency
band and decreased power in the beta and gamma bands in expert marksmen relative
to novices during the aiming period for target shooting. Such group differ-
ences were not observed during comparative control tasks. Therefore, the study
provides strong evidence of a relative economy of cortical processes associated
with higher levels of skill.

In addition, Hillman, Apparies, Janelle, and Hatfield (2000) showed that
even with skilled marksmen, EEG patterns are dissimilar immediately prior to
execution when shooters decide to execute or to reject the shots. Rejection occurs
when marksmen decide to withdraw their rifle rather than actually shoot. Prior to
rejection, alpha activity was found to be unexpectedly high. Typically, increased
alpha power in the left hemisphere of elite marksmen has been interpreted as de-
creased cerebral activation and a reduction in verbal/analytic processes, such as
self-talk. In the Hillman et al. study, an increased alpha power (and beta power) in
both cerebral hemispheres was observed for rejected as compared to executed shots.
It is possible that the increase in alpha power was too excessive, resulting in an
inappropriate allocation of the neural resources associated with execution and in
the challenge of aiming and pulling the trigger. The implication is that there might
be an optimal level of alpha power, and when it is below or above that optimal
level, performance potential is hindered.

Willingham (1998, 1999) has addressed issues as to the existence of a neural
base in the brain for the learning and mastering of motor skills. Four processes that
seemingly support motor control were proposed: (a) strategic, selecting a goal of
the movement in the environment; (b) perceptual-motor integration, selecting the
spatial target or targets; (c) sequencing, the ordering of spatial targets in correct
sequence; and (d) dynamic, translating egocentric spatial targets and a pattern, or
coordination, of muscle firing. Willingham suggests different anatomic loci in the
brain associated with each process: strategic (dorsolateral frontal cortex); percep-
tual-motor integration (premotor cortex, posterior parietal cortex); sequencing (basal
ganglia, supplementary motor cortex); and dynamic (spinal interneurons). The
performer may use a conscious mode in the learning state and an unconscious
mode of operation later when the act is mastered. Willingham’s work is interesting and provocative, but empirical verification of the role of the brain regions as he specifies still needs to be substantiated.

It appears there are changes in specific areas of the brain associated with expertise. Increased cortical representation of the fingers of the left hand of experienced musicians (string players), as compared to non-musicians, has been reported with the use of magnetic resonance imaging (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995). Elbert et al. considered the possibility of a genetic advantage, that a predetermined large cortical representation of finger digits contributes to making superior string players who will probably continue with their musical training because they are more likely to realize success. However, on the basis of research with animals under similar conditions of increased use of some part of the anatomy which resulted in enlargements of associated areas in the cortex, Elbert et al. favor the notion of use and adaptive changes in the brain. Other data, with amputees, also indicate neural plasticity; that is, the neural system can be modified as it adapts to circumstances. With skill learning, large regions of the primary motor cortex are modified, which Sanes and Donoghue (2000) attribute to the existence of distributed networks and representations in the motor cortex.

Heart rate (HR) level prior to performance may also be related to cortical activity and achievement. Lacey (1967) proposed the intake-rejection hypothesis, wherein HR deceleration results in decreased cortical activity immediately before a skilled performer initiates an act that requires an external attentional focus, as in a target-aiming task. Likewise, when the act requires an internal attentional focus, HR acceleration results in greater cortical activity. These observations have been verified in recent years, to some degree. For example, Radlo, Steinberg, Singer, Barba, and Melnikov (2002) examined electrocortical activity, HR, and performance in dart-throwing under conditions of either internal or external attentional strategies. Regarding HR, participants using the external focusing strategy experienced a deceleration immediately prior to dart release, while those using the internal focusing strategy showed an increase. Also, the external group performed better than the internal group.

Visual gaze or search behaviors have also been assessed in activities such as free-throw shooting in basketball, billiards, shooting, and putting in golf. Fixation duration and location data imply degree of focus of attention (concentration) on a target immediately before and during the act. Typically reported is that longer quiet eye periods immediately prior to executing are associated with better performance (Janelle et al., 2000; Williams, Singer, & Frehlich, 2002). Vickers (1996) proposed the term “quiet eye duration” to explain this period, and suggests that movement requirements are set during this time, with more cognitive processing needed for more complex tasks. An alternative or complementary explanation is that the longer target fixation period serves primarily as a means of self-regulation to enter and sustain an optimal attentional state for performing; thus it is part of the skilled athlete’s preperformance routine. The performer fixates his or her visual attention on the target but does not activate the action system until everything feels right. Even though the sport act may be quite complex, it appears that the skilled performer does not require more cognitive processing with longer fixation duration when the processing is performed under an automatic attention mode.

An exception can be found in golf or billiards, where different opportunities as to greater or lesser shot difficulty require more or less planning about what to do...
(see Williams et al., 2002). Gaze patterns shift back and forth between the target and the ball. Experts show longer fixations and fewer shifts in fixation than the less-skilled, a strategy that signifies increased benefit and decreased cost-of-attention energy. More difficult shots lead to a longer quiet time. It is unclear whether this longer time contributes to a more elaborate and perfected plan for execution, or whether it is used to generate a more perfect preperformance state through a more elaborate process of self-regulation and readiness. Perhaps this period of time serves both purposes.

The measures described in this section paint one aspect of the characteristics of the expert performer. Obviously, cognitive/behavioral and psychological factors associated with consistently effective execution have to be personally regulated, controlled, and directed.

Cognitive and Attentional State

Even the most capable person may not reach the highest level of expertise, due to many factors. Differences in the control over cognitive and attentional processes between experts and beginners, or those who are more successful versus those who are less successful in performing a skill, are somewhat apparent. The terms presented in Figure 1 represent those that are typically associated with being a novice or beginner versus being highly skilled or expert. The terms range from those used in a popular sense to those coined by scientists in their research. A major practical question that has emerged is whether novices can adopt cognitive strategies earlier in practice that might more closely resemble what experts use, therefore expediting the time it takes to acquire skill.

Dicotomizing

Cognitive and Attentional Processes

<table>
<thead>
<tr>
<th>Beginner</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>conscious</td>
<td>non-conscious</td>
</tr>
<tr>
<td>controlled</td>
<td>automatic</td>
</tr>
<tr>
<td>voluntary</td>
<td>involuntary</td>
</tr>
<tr>
<td>think about it</td>
<td>Just do it</td>
</tr>
<tr>
<td>explicit</td>
<td>implicit</td>
</tr>
<tr>
<td>systematic</td>
<td>heuristic</td>
</tr>
<tr>
<td>will</td>
<td>non-willed</td>
</tr>
<tr>
<td>aware (internal focus)</td>
<td>non-aware (external cue focus)</td>
</tr>
<tr>
<td>intentional</td>
<td>intentional</td>
</tr>
</tbody>
</table>

Figure 1 — Terms in the literature related to the distinction between conscious and nonconscious learning and performance.
It may be inevitable that for very complex acts, learners must start with controlled processing. With sufficient practice they make the transition to automatic processing (Schneider & Shiffrin, 1977). Conscious intentions of the goal of the act and the process of doing it typically preclude the development of skill. Saying it another way, explicit learning paves the way for implicit performance to occur; self-awareness for nonawareness; willed for nonwilled; and intentional for nonintentional behaviors. (However, arguments have been made as to whether behaviors that even appear to be automatic and nonconscious have to be intentionally willed, even if at a subconscious level [e.g., Bargh & Chartrand, 1999].)

Yet, exceptions can be found as to the desirability and even the necessity of beginners having to go through such transitions. For example, consider the goal of a learning situation: to master an initial task or be able to adapt to similar tasks and situations in the future. In an early review of the literature (Singer, 1977) and with experimental evidence (e.g., Singer & Gaines, 1975), highly prompted and guided learning was shown to be most effective for primary task mastery, but discovery and problem-solving learning in the same task led to better transfer, hence achievement in subsequent tasks and related situations. None of the participants in these studies were informed about subsequent learning conditions. Consequently, they may have inadvertently learned more about cues in the situations and various modes of responding through exploration. In addition, class subject matter has been shown to benefit more from the teaching of heuristics (general rules that can be applied across tasks) or by teaching metacognitive behaviors (Alexander & Judy, 1988) rather than systematically teaching each aspect of the subject matter. In other words, being aware of rules and possessing executive learning skills and how to apply them are more helpful in the long run. Educators (e.g., Deery & Murphy, 1986) warn, however, that such learning is not trained easily.

Some aspects of the nature of expertise, like being in a “just do it” mode of operation, without self-awareness and guided with implicit knowledge, are currently being investigated with beginners in certain sports or sport-type acts. Generally the data seem to indicate an advantage in learning while attempting to adopt such strategies. For example, Singer, Lidor, and Cauraugh (1993) and Radlo et al. (2002) reported the effectiveness of an external attentional focus strategy (to the target) as compared with a self-directed strategy (focus on parts of the body and on positions during execution). A novel ball-tossing task was used in the first study while dart tossing was used in the second study. A self-aware strategy is typically suggested for those learning sport and dance skills. However, it does not appear that outstanding athletes focus their attention on what they are doing when they perform at their best.

Wulf, Höß, and Prinz (1998) studied the effects of an external focus as compared with an internal focus on performance with a ski-simulator and then with a stabilometer (balance board). External focus instructions were related to the performer’s actions on the environment. By example, their orientation was directed to equipment or apparatus (e.g., skis, stabilometer) to be manipulated by their ongoing movements, which in turn was affected by these movements. In both the research by Singer et al. and Wulf et al., an external focus of attention, although differing in emphasis, still led to best achievement compared to the self-awareness or control manipulations.

Lack of awareness of rules and knowledge one possesses to perform a task is associated with implicitly held knowledge. Explicit knowledge relates to conscious-
ness of what is involved in performing a task. Implicit processes are believed to be more durable than explicit processes in complex tasks, and therefore resistant to the effects of stress. An expert's knowledge is characterized as being implicit in nature, while performance appears to also occur implicitly. In research where performance under stress was of concern, Masters (1992) showed that consciously processing explicit knowledge can disrupt automaticity and lead to failure while learning a golf-putting skill. A larger pool of explicit knowledge leads to a higher likelihood of failing under pressure.

Hardy, Mullen, and Jones (1996) supported the explicit-knowledge hypothesis. They also suggested that implicit strategies be studied more to examine their value in teaching and coaching environments. However, Willingham and Goedert-Eschmann (1999) make the case that “the conscious, explicit process supports behavior until the simultaneously acquired implicit representation is sufficiently well-developed to support behavior, at which time the explicit process is simply not used any longer; it does not transform into another representation” (p. 534). In other words, explicit conditions are taken over by implicit processes when the behaviors of interest are well learned.

These and other studies show great promise in the value of teaching expert-like strategies to beginners, enabling them to be more successful, and allowing them to use their time more efficiently. Such strategies can be expanded upon and included in the bigger picture of what goes into the immediate preparatory state to performance itself. A preperformance routine, of which there are many versions, should “package” a series of strategies so that they complement each other and comprise the totality of the preperformance routine. Indeed, the preperformance state is a crucial contributor to performing at one’s best.

Preperformance Routines

A general analysis of the ideal preperformance state for self-paced events suggests that it involves: (a) self-regulation of thoughts and emotions so that they are compatible with what needs to be done; (b) narrow, deep, and sustained concentration; (c) ideal self-efficacy and high but attainable performance expectancies; (d) optimal distribution in level and type of cortical activation in certain locations of the brain, indicating a quiet mind; (e) optimal visual orientation to the target (frequency and duration of fixations), indicative of direction of attention; (f) consistency in generating a routine in attaining pre- and during-performance states that facilitate performance; and (g) automaticity in activating those processes that enable one to perform effortlessly, effectively, and successfully.

In order to develop these characteristics, the ultimate challenge is to generate a self-styled consistent preperformance routine, somewhat automatically, under different situations and conditions. The general purpose of any routine associated with performing is to put oneself in an optimal emotional, high self-expectant, confident, and focused state immediately prior to execution, and to remain that way during the act. Self-regulatory techniques are essential (Carver & Scheier, 1998; Crews, Lochbaum, & Koroly, 2001; Hardy & Nelson, 1988) in that they are enablers; they enable an athlete to control and direct emotions, thoughts, and attention. What is usually referred to as staying focused, being under control, or being in a state of flow is the goal.
Associated with these objectives, and assuming that sport skills are well learned, the athlete who can execute automatically has an advantage against opponents. How to do this on a regular basis is the challenge. To establish an optimal performance state, an effective preperformance routine is a likely prerequisite. In the research literature and in the sports world, such a routine has been termed a plan, a strategy, a protocol, a procedure, a technique, a preshot routine, or even a ritual (Lidor & Singer, in press). Contributors to an effective preperformance routine have been studied scientifically so as to determine which ones can facilitate a sequence of internal processes associated with becoming more successful in self-paced events or acts. When combined as a routine, the goal is to facilitate learning, performance, and achievement (Cohen, 1990). Either deliberately or subconsciously, depending on level of skill, a routine becomes an integral part of the sport act itself. In a sense it impacts not only on the preparatory state of the athlete but also on the performance itself, which it is intended to do. One example of a potentially effective routine is the five-step strategy (Singer, 1988, 2000); this global strategy covers the preperformance state as well as the actual performance state.

Briefly the five steps, as illustrated in Figure 2, are: “(1) readying by establishing a routine that involves optimal positioning of the body, confidence, expectations, and emotions; (2) imaging a picture and the feeling of performing an act at one’s best; (3) focusing attention on a relevant external cue or thought; (4) executing with a quiet mind; and (5) evaluating (if time permits) the quality of execution of the act and the outcome as well as the implementation of the previous four strategies” (Singer, 2000, p. 1669). The five-step strategy has been shown to facilitate achievement across a number of laboratory and field studies (e.g., Singer, Defrancesco, & Randall, 1989; Singer & Suwanthada, 1986; Singer et al., 1993). Mesagno (2001) has shown the benefits of the strategy with an explicit learning approach to enhance bowling under stress-imposed circumstances, and de la Pena (2001) has shown its benefits with anxiety-symptomatic imagery to improve golf chip-shot performance under competitive pressure.

Figure 2 — The Five-Step Strategy for self-paced skills.
Mesagno formed seven groups in order to compare the effects of implicit versus explicit learning, with and without the five-step strategy, under competitive stress or no stress, on bowling performance. The bowlers took 80 shots over 2 days. Among the conclusions was that such a strategy should be incorporated into an explicit learning situation to help overcome choking under pressure by contributing to implicit performance. In the study by de la Pena, four groups were formed. The five-step strategy was modified and used with three of the groups, with type of imagery manipulated. Golf-chip performances under competitive and pressure conditions were compared using anxiety-symptomatic imagery, arousal-control imagery, and no imagery. De la Pena speculated that the advantage of using anxiety-symptomatic imagery with the five-step strategy could be attributed to fostering self-trust under pressure situations.

In many other studies, each step of the five-step strategy has been examined separately (e.g., anxiety regulation as associated with a readying state to perform, imagery, self-expectations) and has been determined to be of value. Likewise, as noted in the previous section, studies comparing external and internal foci of attention toward enhancing achievement have come out in favor of an external orientation. Furthermore, the five-step strategy is merely representative of a number of routines proposed by other scholars and practitioners, experimentally or descriptively verified and intuitively appealing.

These steps are isolated here to give significance to each in its role as a learning/performance facilitator (see Singer, 1988, 2000, for more discussion). In fact, some steps may be integrated. Another way to think about the five-step strategy is in terms of the cognitive processes associated with one’s readiness to perform and the actual execution. Situational and self-analysis leads to intentions about performance and in turn to focused attention with an inhibition of external and internal distractors. When the performer feels right, “just do it” performance occurs. If time permits, the performer briefly assesses the strategy, the technique, and the performance outcome. It is likely the typical beginner does not know about such processes while the typical expert probably incorporates them automatically in his or her preperformance routine. However, the ability to generate an effective routine with skill does not suddenly become automatic.

Repeated goal-directed experiences in similar situations contribute to one’s attaining the ideal state of self-regulation and control in preparing for, and while executing, an act. Bargh and Chartrand (1999) illustrate the process of intentional and unintentional routes to the automatization of a psychological process. The intentional goal to acquire skill encourages frequent and consistent use of certain mental processes, which in turn leads to the removal of a conscious role in the process. Automatization occurs. Furthermore, situations at first require conscious choices of what to do (goal-activation) and how to do it (goal operation). With sufficient experiences, situations do not need to stimulate conscious decisions about intentions and actions. In other words, explicit learning, with sufficient repetitive practice, evolves to yield implicit performance.

Whether for the highly skilled, moderately proficient, or beginner, preperformance routines can enhance achievement (Lidor & Singer, 2000). For example, for a novel ball tossing task (Singer et al., 1993) or a basketball free throw (Southard, Miracle, & Landwer, 1989; Wrisberg & Anshel, 1989; Wrisberg & Pain, 1992), participants who were taught how to use a particular routine attained a higher level of skill than those who were not trained to use one. Perhaps
one reason is that the activation of a consistent routine associated with an act of skill provides the performer with perceptions of control, of being able to make something good happen.

Chen and Singer (1992; Singer & Chen, 1994) have offered suggestions for the use of cognitive strategies in contributing to self-regulation and perception of control prior to and during performance. In the first tutorial they discuss the nature of a good strategy user and considerations in the training of task-specific and more global strategies. They describe techniques and strategies for effective self-regulation, thereby enhancing learning and performance. In the second tutorial they propose a framework for classifying strategies that incorporate four criteria: source (externally imposed or self-generated; orientation (task or person); purpose (learning or performance); and scope (task-specificity or generality). Strategies for specific purposes may be more clearly understood and applied appropriately to fit certain objectives.

Psychophysiological factors have also been associated with performing well. It appears that experts and perhaps so-called fast learners in a particular activity may have learned, either unknowingly or with deliberate practice, how to implement a preperformance routine that maximizes performance. This seems to result in a regulation of conscious brain activity, heart rate, respiration rate, eye fixation patterns, and EMG activity, along with self-efficacy level, expectancies, motivation, and concentration. Learning time should be more efficient and performance more successful. The state of autonomous execution is realized more frequently with an effective preperformance routine, which ideally is automatic as well.

The refinement and somewhat automatic production of a preperformance routine and its execution suggests not only personal control over psychological/cognitive behaviors but also the regulation of psychophysiological measures related to brain activity and heart rate. The expert performer becomes more consistently efficient in the use of mental and physical resources (Hatfield & Hillman, 2001) and therefore can be consistently productive. The preperformance routine and extensive practice probably lead to the athlete’s ability to trigger task-relevant cortical resources, activating or suppressing relevant areas of the brain (Lawton et al., 1998). Research is needed to determine the effects of the five-step strategy or a specific strategy such as attentional focus (Radlo et al., 2002) on various psychophysiological measures as well as on performance.

**Peak Performance / The Zone**

The smooth integration of all these events may likely describe peak performance, the zone, or flow state, which presumably are associated with the ideal performance state. Superior athletes claim that when they perform at their best, they have much time to prepare to execute. Imagery is clear, confidence is high, emotions are ideal; their focus of attention is such that there is no awareness of external distracters or internal self-doubt and fears that can disrupt performance. Csikszentmihalyi (1990) has termed it “flow state,” although not necessarily the way it is typically used in high-level sport. For him the state of flow occurs when a person is immersed in a challenging activity, feels good about involvement, is very intrinsically motivated, and truly enjoys the experience.

Sport enthusiasts have interpreted the term somewhat differently. In sport, peak performance and being in a state of flow is usually associated with the best
Expertise in Self-Paced Events / 371

performance of an athlete who is typically considered to be exceptionally skilled anyway. For Csikszentmihalyi, level of skill is far less important. Rather it is fulfillment, immersion, intrinsic motivation, and joy that are of major interest. For athletes, peak performance and flow state typically represent their ability to achieve at their best, with the feeling that their performance was effortless, literally automatic, and effective.

Jackson (1992, 1995) has applied Csikszentmihalyi’s concepts of flow to sport situations (Jackson & Csikszentmihalyi, 1999), attempting to determine what conditions are needed for high-level athletes to optimize their chances of experiencing flow. The presence of psychological processes such as being confident and positive, feeling motivated to perform, and attaining an optimal readiness state to perform seem to be the critical flow factors described by high-level athletes (Jackson, Kimiecik, Ford, & Marsh, 1998). For the elite athlete, the flow state is thought to be an asset to striving for excellence in the framework of a positive psychological state.

In a recent study, Jackson, Thomas, Marsh, and Smethurst (2001) demonstrated a moderate relationship between self-assessment of flow and performance, and identified psychological factors related to optimal experience as well as performance. Competitive athletes in orienteering, surf life saving, and road cycling took part in the study; each activity involved a structured race format. Athletes reported that emotional control, appropriate activation level, and avoidance of negative thinking were related to flow. It may well be that such flow thoughts and feelings during performance could only come about by developing sufficient movement expertise for the self-paced sport, appropriate conditioning, continued good health, sustained motivation, and the ability to activate a relevant pre- and during-performance routine. The routine enables the successful execution of the skill by triggering optimal cognitive, behavioral, and psychophysiological processes. All this seems to occur without deliberate attention to generating the routine and performing the skill. The peak (optimal) performance state as associated with appropriate modifications in psychological/cognitive processes apparently is greatly influenced by the preperformance routine, which most likely facilitates experiences associated with the flow state (Jackson & Csikszentmihalyi, 1999) and contributes to one’s best performance.

Conclusions

The behavioral and psychophysiological indices of expertise, as well as experimental manipulations as to strategy or preperformance routines, suggest the following: Performance in brief self-paced events can be accounted for by modified cognitive models that allow for subconscious processes driven by environmental situations. A well-learned pre- and during-performance routine helps to integrate goal intention with visual and proprioceptive mechanisms, in turn enhancing decision-making, response selection, and action processes. Execution thus becomes effortless and effective, and expertise is achieved. Considering immediate preperformance visual gaze, EEG activity, and heart rate, a profile of expert performance emerges. The execution of a well-learned complex skill requires activation of the specific regions of the brain responsible for visuospatial processing, sequential planning of a movement, and possibly the development of cognitive strategies to master the act (Deeny, Hillman, Janelle, & Hatfield, in press). Refine-
ment in the controlled use of attentional processes through sufficient dedicated practice leads to automatically activated behaviors and higher levels of performance.

In summary, a profile of expertise in target-aiming events indicates the importance of psychological, cognitive, behavioral, and physiological measures. One must be in an optimal, self-regulated state in order to learn and perform at his or her best. Brain activity is critical. It appears that somewhat automated high-level performance is associated with a reduction in cortical associative processes (i.e., complexity) that could result in consistency in performance by simplifying the planning and executing of an action. Perfection in performing a complex self-paced act, as reflected by the somewhat automatic activation of internal processes and movement patterns, is due to sufficient and meaningful practice. Practice involves mastery over movement execution as well as an effective pre- and during-performance routine. This creates the ideal chemistry for achieving under a variety of conditions including highly stressful ones.

Certain expert-like behaviors may even be introduced to learners in order to expedite the acquisition of skill. For the expert, best performance is associated with the seemingly automatic optimal functioning and therefore self-regulation of behaviors relevant to success. Besides performance mechanisms, these include regulation over cognitions, self-expectancies, self-efficacy, arousal level, brain activity, and concentration. The superior athlete is able to realize the optimal functioning state over repeated occasions. The challenge for others is to attain such a state for themselves.

References


Acknowledgment

Appreciation is extended to Claire Calmels, Charles Hillman, Brady Byers, Steve Petruzzello, and an anonymous reviewer for helpful comments on earlier versions of this manuscript.

Manuscript submitted: March 1, 2001
Revision accepted: June 21, 2002