



Finding the Appropriate Balance Between Technical and *Outcomes-Based* Instruction

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The ability to learn skills for complex movement is key to success in many disciplines, from aviation to carpentry, from surgery to music, from sculpture to sport. A lot of resources have been invested in improving our understanding of what makes an expert, and in investigating the mix of training and genetics that enables people to achieve peak performance on the international stage.

Elite performers, however, make up less than 1% of participants in sport and music. We still know relatively little about the optimal development pathway for the typical performer. Over the last few years, Canadian sport has been aligning with a framework known as 'Long Term Athlete Development' (LTAD). The alignment is, in part, an attempt to address this issue of optimal development for the typical performer. It is also an attempt to promote lifelong involvement in sport, which is thought to be one of the strongest predictors of healthy and successful aging.

LTAD is an exciting development for Canadian sport. It takes insights from the fields of sport science, psychology, development,

neuroscience, biology, physiology, and many others and blends these insights with hard-won knowledge from expert coaches and other specialist practitioners to produce both generic and sport-specific guidelines for optimal development. These guidelines are being implemented across Canadian sport in all its contexts.

Interestingly, many of the concepts in LTAD are not new. They have in fact been common practice in sport for many years now. The power of the LTAD approach, however, lies in its systemic implementation that addresses every layer and level of sport. This implementation helps link sport and recreational activities to school, university, community, provincial, and national programs in an integrative manner. An interesting byproduct of the LTAD approach has been a general increase in knowledge about development amongst coaches, athletes, and parents. LTAD has also stimulated debate that has challenged notions about what is important at different stages of development—and how what is important changes with

training context, training goals, and the development of both athletes and coaches.

At the forefront of this debate are methods of teaching and emphases of training—specifically, what approaches are best for our athletes at different stages of development? This is one of the most critical issues for us to understand as coaches. There is general agreement that to be competitively successful in a combative sport, athletes need to have a solid technical foundation and also the tactical wherewithal to be able to take advantage of it. By tactical wherewithal, we mean “the necessary skills to be able to successfully implement their technical abilities”. These skills have both physical and psychological elements. The goal of all competitive coaches is to balance the development of these qualities with technical development in a synchronized program that allows athletes to peak at the proper times both within each season and across their careers.

The optimal approach at the start of training is clear: for children to be able to learn and perform complex motor skills, they need to have excellent physical



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literacy. Without solid basic motor patterning and fundamental movement skills, it's harder for them to adopt more complex skills (Bar, 1996; Sonnadara and Elliott, 2007). This is one of the central tenets of the LTAD framework (Higgs, Balyi & Way, 2008). Once the athlete has attained basic physical literacy, however, the 'ideal' path is much less clear.

In the literature on learning complex motor skills, we can distinguish two categories of pedagogical methods: those that focus on the proper execution of the movements, and those that focus on the final result or outcomes of those movements. The popular press has many competing reports promoting 'the best method' for teaching complex-movement skills, particularly to children. Interestingly, the scientific literature presents equally diverse accounts. Some authors suggest that an early focus on proper form is vital to long-term success. Others suggest that too early a focus on proper form can impede success and may in fact dissuade people from participation in a new activity; they suggest that the focus should be on the outcome of the learner's movements. Clearly there are many factors that we need to consider when teaching complex skills. As coaches and educators, how do we navigate the best course between these two approaches that seem diametrically opposed?

A key difference between these two approaches is where the athlete's attention is directed. Attention, a somewhat nebulous concept, has been studied for well over a century now. Although experts still struggle to agree on a single definition, two well-accepted working definitions are "how perceptual and cognitive resources are allocated" and "the



Coach Amy Lillico works with Hamilton fencer Tia Gayowsky to help correct her lunge.

focus of our perceptual and cognitive resources at any given moment". Instructional methods that focus the learner on technical form can be thought of as 'internally focused' (IF), because attention tends to be directed toward cues related to the process of executing the skill, such as body position, tension in muscles, sequencing between different limb segments, fluidity of movement, and so on. Instructional methods that focus the learner on the outcome of the movement can be described as 'externally focused' (EF), because they typically focus the learner on information external to his or her own body (such as the path that an object takes to reach a target).

One of the early writings on the importance of attentional focus comes from James Cattell, who in 1893 wrote:

So, in piano playing, the beginner may attend to his fingers but the practiced player attends only to the notes or to the melody. In speaking, writing and reading aloud, and in games and manual work, attention is always directed to the goal, never to the movement. In fact, as soon as attention is directed to the movement, this becomes less automatic and less dependable.

Cattell, then, is one of the first to report that the focus of attention may shift with practice, and that a focus on the outcome, rather than the process of making the movement, may lead

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and perform complex motor skills, physical literacy.

to the best results. Many still hold this viewpoint. Dr. Gabriele Wulf, a leading skill-acquisition researcher, has an extensive body of work showing that participants who learn a new skill through externally focused methods can perform significantly better under conditions of stress than those who learn the same skill through more internally focused methods (e.g. Wulf & Wiegelt, 1997). Several other researchers have reported similar findings, suggesting that for new tasks, paying attention to instructions that focus on the mechanics of a movement may in fact interrupt cognitive resources required for learning the skill (e.g. Hodges and Franks, 1999, Hodges and Franks, 2001 Sonnadara and Elliott, 2007).

Other researchers, however, have reported the opposite, namely that promoting an internal focus may be a more effective approach to teaching and performing new skills. Researchers have studied this using distraction techniques. For example, in one study by Beilock, Carr, MacMahon and Starkes (2002), novice and expert right-footed soccer players dribbled a soccer ball around a series of cones. The soccer players were asked to dribble with either their right (dominant) or left (non-dominant) foot, while at the same time performing another activity which either turned their attention towards or away from the task. In the task-focused trials, a tone was randomly played while the players were dribbling the ball, and on hearing the tone, they were asked to identify whether the inside or outside of the foot had been in contact with the ball when the tone sounded. This additional demand forced players to focus attention on the task itself. During the task-distraction trials, a tape of spoken words was played

while players were dribbling, and players were asked to identify certain target words. This forced players to allocate attention away from the soccer task in order to concentrate on the words being played to them. This study reported that the novice players performed much better when they were paying attention to the dribbling task than when their attention was focused elsewhere. The expert players, however, performed better with their dominant foot when their attention was directed away from the task, and better with their non-dominant foot when their attention was directed towards the task. Similar reports have emerged from studies of golf putting (Beilock, Wierenga and Carr, 2002) and baseball batting (Gray, 2004).

One of the leading models of skill acquisition is the 'three stages of learning model', first proposed by Fitts and Posner (1967). In this model, the learning of skills is divided into three distinct phases, the cognitive phase, the associative phase, and the autonomous phase. During the cognitive phase, learners build a mental representation of the skill by deconstructing the skill into component parts. During the associative phase, the distinct component parts are linked together into a 'smooth' action; learners make heavy use of both internal and external cues to refine the skill. In the autonomous phase, the parts are grouped together into 'executable units' that can be initiated with very little cognitive load, freeing up resources so that a person can focus on other things. Beilock and others suggest that the decline in performance observed when experts focus on the execution of a skill is due to the interruption of executable units which operate largely in the absence of external information once initiated.

Much of the recent work on expertise has derived from this model. The frequently cited '10,000 hours' thought to be required for elite performance is based on the minimum number of hours considered necessary for people to spend in deliberate practice in order to reach the autonomous phase (e.g. Ericsson, Krampe & Tesch-Romer, 1993).

The externally focused approach identified by Cattell, however, seems to rely on a different mechanism of learning known as Schema Theory. This theory suggests that instead of storing sequences of actions, we derive rules about movement based on our previous experience. These rules can be turned into motor schemes or programs. Since rules are derived from the outcomes of previous movements and get refined with each repetition of a movement, maintaining a focus on outcomes facilitates the construction of motor programs.

Given the wealth of evidence to support both models for learning—and the body's incredible ability to adapt and optimize itself to the challenges it faces—it seems likely that we draw on both internally focused and externally focused approaches to learning new skills, perhaps relying on the most effective approach at the time. How then, as coaches, do we balance the two approaches when training our athletes?

We suggest that for different classes of sports, the answers may be different. The challenges for some sports such as gymnastics and diving can be described as mainly technical, with a somewhat stable competition environment. Other sports—in particular those in which an athlete competes directly against another athlete, such as in squash or combative sports—have much more dynamic fields of play, requiring a



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different allocation of cognitive and perceptual resources. There is also a wealth of evidence to suggest that even within the same sport, not all athletes will respond equally to the same stimulus.

Fencing has several characteristics that make it very interesting for the study of skill acquisition. Fencers need to coordinate the gross motor skills required to cover the terrain with the fine skills necessary to deliver a touch to their opponents' target areas while at the same time countering their opponents' attempts to do the same to them. In addition, nearly all of the movements in fencing are novel, with very little transfer from more mainstream activities.

To study the effectiveness of internally versus externally focused instructional methodologies in this sport, we followed the progress of two groups of novice fencers over the course of a year. The first group was introduced to the sport using internally focused instruction, and the second was introduced using more externally-focused instruction. After the first week, both groups were integrated into a single class. In other words, the only systematic difference between the groups was the way in which they were introduced to the sport.

Our data tell a compelling story. Those fencers who were taught using externally focused instruction were more competitively successful in the first few weeks of training. However, by the end of the first year, the fencers taught using internally focused instruction were more successful, and also reported fewer injuries.

A parallel study looking at surgical trainees reported similar findings: 18 months into their training, new surgeons who spent a month at the start of their residency focusing on acquiring solid basic surgical


techniques were able to acquire complex surgical techniques much faster than their colleagues whose training followed a more outcomes-based approach (Sonnadara, van Vliet, Safir, Alman, Ferguson, Kraemer & Reznick, 2011; Sonnadara, Safir, Drozdal, Leung, Ferguson., Alman & Reznick, R., 2011).

Traditionally, we have considered the process of skill development as teaching and refining new skills. Perhaps it would be better if we saw skill development as helping our athletes efficiently internalize skills in ways that allow the athletes to use those skills in competition. It is important to be mindful of the work outlined above which shows that an inappropriate focus of attention can actually harm skill execution. Our work with both novice fencers and surgeons shows that an outcome-based approach seems to facilitate success in the earliest stages of training, but perhaps at the cost of longer-term success.

Our findings are consistent with teaching methodologies for fencing dating back to the 17th century: beginning fencers were often required to practice basic movement patterns for several weeks (sometimes even months) before being allowed to hold a weapon in their hands, and then several more months before sparring was permitted. These methodologies probably evolved in part due to an implicit sensitivity to the long term performance advantages of this approach, and in part due to a desire to prevent injuries in new athletes—improper form is one of the leading causes of injuries in sport. We see an early focus on proper form in many martial arts disciplines, and the practice is still not uncommon today in a number of sports. With the

ever-increasing need for immediate satisfaction, however, pedagogical ideals are increasingly taking a back seat to commercial realities.

It is important to remember that success is a powerful motivator for both young athletes and their parents. Perceived lack of success can easily send both running either towards other coaches or towards other activities. Perhaps what is important is not whether instruction and coaching need to be internally or externally focused per se, but rather that coaches, athletes, parents, and administrators all need to define and share a common vision of success at the different stages of training. It is success that keeps people coming through our doors and motivates our athletes to train harder. It is the pursuit of success that drives coaches to improve. For some athletes, this may require a more internally focused approach, for others, a more externally focused approach—and it's clear that the balance will change throughout the course of both biological and sport-specific development.

We have found strong evidence that even a small investment in technical training early in an athlete's career can pay enormous dividends down the road. As coaches, however, we must be sensitive to the individual differences that make each of our athletes unique as we seek to develop the qualities that will lead to success and longevity in sport. We must be mindful to use training paradigms that are most appropriate for each athlete and that draw on all available resources, balancing both the positive feedback that drives athletes to train and pursue our sport, and the technical and tactical groundwork that is necessary for long-term success in all its forms. 



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