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INTRODUCTION

In their article, Greenwood et al. present interview data to demonstrate coaches' insights into factors influencing athletes' performance, and they suggest that researchers utilize coaches' knowledge when planning and designing studies related to learning and performance in sports. As evidence for coaches' unique insight into factors relevant to athletic performance, Greenwood et al. cite coaches' observations related to the run-up (e.g., track and field, gymnastics), the interaction of various constraints during performance (e.g., weather, fatigue, arousal), and individual differences (e.g., physical, cognitive, emotional). There may indeed be many instances in which contributions to knowledge in general, and an athlete's or team's success specifically, would be enhanced by paying close attention to experienced and expert observers such as coaches or athletes. Thus, I agree that their observations may well provide ideas for research studies. I also see some potential limitations, however. My thoughts related to the arguments put forward by Greenwood et al. are related primarily to two issues: a) the fact that coaches' observations seem to be shared by others, and b) that potentially false assumptions should be considered when designing research studies based on practitioners' knowledge.

SHARED OBSERVATIONS

One example for coaches' experiential knowledge cited by Greenwood et al. is their awareness of step length adjustments in the run-up based on visual cues. Yet, it appears that it does not really require someone working with elite athletes to realize that people are easily able to adjust their step length in situations in which accurate foot placement is necessary. Most people will probably have noticed a similar phenomenon when approaching an escalator, a puddle of water, or walking on uneven terrain. Also, researchers have long been aware of people's ability to easily adjust step length, and studies related to the regulation of gait as a function of visual information go back at least three decades [1].

Furthermore, it would be surprising if coaches were *not* aware of the many factors influencing sports performance. Researchers are usually not naïve and unaware of those interdependencies either – with many of them having extensive experience as motor performers and learners themselves. Movement scientists and sport psychologists have

therefore been able to elucidate many of the variables affecting motor performance, including high-level sports performance. Although, one might ask whether in any given instance we have truly identified linchpin factors, let alone ones that are modifiable.

Finally, the existence of individual differences will not surprise anyone. Even though there seems to be a universal desire to find predictability by way of individual differences, the general search for personality effects in sport and elsewhere has not met with much success over the decades. Also, the existence of physical, personality or other differences among individuals does not necessarily mean that training methods need to be tailored to individuals' idiosyncrasies, although they might be at times. A goal of empirical research is to generate principles of learning that hold irrespective of individual differences. No doubt, such principles may not always generalize to all skill levels, and studies examining the influence of various factors across skill levels should be encouraged [2]. More importantly, from a practical point of view, there is also a potential risk of placing too much emphasis on individual differences – with the often implicit assumption that those differences are of a relatively permanent and substantial nature (see below).

COUNTERINTUITIVE FINDINGS AND FALSE ASSUMPTIONS

Coaches most likely have a good understanding of factors that have (immediate) performance-enhancing or degrading effects and, if they are keen observers, may factor long-term effects into their personal models. However, there may also be a potential danger in practitioners' focus on training or practice methods that enhance performance. An intuitive approach might be to compare different practice methods in terms of the immediate effects on performance. Such an approach has significant shortcomings, however. It can only demonstrate how short-term performance is influenced by certain training methods – which may, or may not, have anything to do with how much is actually learned. Learning is typically defined as a relatively permanent change in a person's capability to perform a skill (e.g., [3]) and is measured experimentally by delayed retention or transfer tests and practically by intervening time and differing conditions and task circumstances (e.g., a taller opponent who forces a different angle of ball release). It is well-known that it is not uncommon for practice conditions that facilitate, or prop up, performance during practice – such as a blocked versus random task order, or concurrent versus delayed feedback (provided by simulators, for instance) – to result in less effective learning, and vice versa. Thus, although counterintuitive, one cannot infer that the most rapid change in performance – under practice conditions in which augmented feedback, guidance, modeling, or other interventions are still present – constitutes true learning in the sense of retained or generalizable skill or knowledge. Clearly, the ultimate goal of training in sports is not to facilitate performance during practice, but to enhance the learning and transferability of motor skills for flexible and fluid use during competition or other performances.

Another possible limitation of utilizing coaches' experiential knowledge when studying motor performance and learning may be their potential reliance on “traditional” instructional methods, including those they may have experienced in their own careers as athletes, or those that make “intuitive” sense. Modeling and observation, without alternative perspectives or objective evidence of effects, can be a powerful influence. For example, instructions and feedback referring to body movements are still common place in coaching [4], even though for more than a decade studies have consistently shown their relative ineffectiveness, in contrast to instructions or feedback directing attention to the desired movement effect (inducing an external focus of attention) [5]. Some coaches may indeed have realized that detailed instructions related to the coordination of body movements are relatively futile, as

noted by Greenwood et al. Yet, the best solution to this problem is not necessarily the abandonment of instructions and their replacement with tasks that will hopefully lead to the desired coordination patterns. As numerous studies have shown, giving the *right* instructions – that is, those promoting an external focus – enables the motor system to produce effective and efficient movement patterns. This involves, among other things, optimized coordination within and among muscles, the unlocking of degrees of freedom, and increased functional variability [6, 7]. An important contribution coaches could make in this regard is to help identify optimal external foci for different sports depending on the athletes' skill level. Thus, rather than searching solely for “individualized approaches”, the search for general principles of learning and performance through empirical research appears to be a more efficient endeavor.

Finally, there appears to be a potential risk in over-emphasizing individual differences. While they obviously exist, practitioners sometimes have the propensity to view certain individual differences as fixed assets or liabilities, and personality characteristics as “traits” that are relatively unchangeable, rather than considering situation-specific triggers for certain behaviors. This is exemplified by phrases such as “natural athlete” and “athletic talent” that are common in sport settings. Those terms reflect the underlying assumption that motor abilities are relatively permanent and difficult to change – and that they determine an individual's potential for achieving success in sport. This notion corresponds to the old view of motor abilities held by scientists (see [3]). Yet, not only is there little evidence that inherent abilities limit an individual's level of achievement (e.g., [8]), but people's beliefs about the malleability or stability of key abilities have been shown to affect their success on a given task (e.g., [9]), as well as their motivation to continue to perform those tasks (e.g., [10]). More specifically, coaches' or athletes' conceptions of ability as inherent and relatively fixed might promote the interpretation of lack of success as evidence for insufficient ability – and, on the athlete's part, as a threat to the self. The consequences of such beliefs are often less effort and persistence in difficult situations, and sometimes even the avoidance of situations that might reveal the extent of one's abilities, or lack thereof. In contrast, a more incremental view of abilities as amenable to change with experience, practice, and effort has been shown to be associated with a greater focus on learning and improving performance, enhanced intrinsic motivation, and increased effort in challenging situations (see [12]). It has also been shown to enhance motor learning [9]. Thus, the prevailing view of individual differences in sports as being relatively fixed and stable not only bears the risk of limiting athletes' potential, but would also put researchers buying into that notion on the wrong track.

CONCLUSION

Elite coaches undoubtedly have unique insights into athletic performance and how it is influenced by various factors. Thus, their knowledge may well inspire empirical studies. Yet, scientists are usually not naïve with regard to the subject of their inquiries either. More theoretically based studies with relatively simple, “artificial” tasks and designs are often followed by studies using more complex, real-life skills in more applied settings, as we have seen in many lines of research (e.g., contextual interference, augmented feedback, observational learning, attentional focus). Such a systematic progression is the basis for a more complete understanding of different variables, and their interactions, that contribute to long-term changes in behavior (i.e., learning) and psychological well-being. Combining the expertise of scientists and coaches might further enhance the development of our knowledge, particularly that related to highly skilled performance.

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