Getting Better

best practices for your best practices

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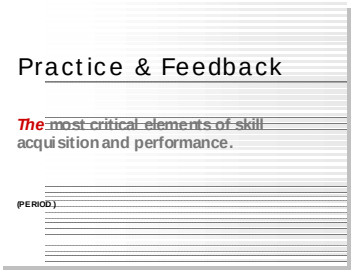
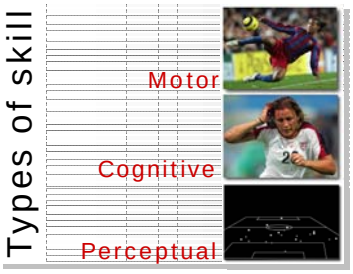
There are exactly two things which contribute more to the development of skill and human performance than anything else. These two things are **practice** and **feedback**. Without one, the other is ineffective and in some cases can be completely useless. And, it is important to note that not all types of practices and not all sources or methods of delivering feedback are equally effective. My talk today was designed to provide you with the most relevant, up-to-date understanding of how you can apply the most established principles of feedback and practice design to maximize the development of the athletes you coach.



Skill and Skill Development

I define skill as an ability that has been developed by practice, training or by experience (which likely includes both of the former). From the research (and perhaps from common sense), we know that skilled performers tend to demonstrate focused, goal-oriented behavior; they improve with practice (and they practice "deliberately"); and they actively seek and can effectively use feedback to improve performance.

While these definitions may seem pretty benign, it is also important to recognize within any given "skilled performance", there are at least three important types of skill that may come into play: motor skill, cognitive skill, and perceptual skill. And, like *any* skill, each may be improved with practice and feedback.



Motor skills are probably the most familiar to us. These skills include the physical acts of doing things in our sport: running, dribbling, passing, shooting, heading, diving, punting.

Cognitive skills include things like managing stress, visualization, and the development of tactics and strategies that we'll use during a performance or over the course of a competition. Cognitive skills would include the development of a plan to help deal with increased pressures or unfamiliar environments.

Perceptual skills include the ability of the athlete to perceive, detect, and identify cues and characteristics of the environment in which they are performing. Doing so allows skilled performers to more quickly and accurately make decisions. Essentially, we can think of perceptual skills as "field or game sense". Perceptual skills include things like identification of postural cues or movement patterns which may indicate an impending action. They also include our ability to recognize patterns, trends, or tendencies, particularly in consideration of game- or player-specific situational probabilities.

Taken together, we should recognize that to perform at progressively higher levels, we must become more effective at developing and integrating each of these types of skills into our overall performance and performance development programs.

An important point here. My guess is that many of you have considered these skill components in the context of the athletes you train. However, consideration and development of these skills is equally important for coaches and program organizers. And, this is true for the remainder of the

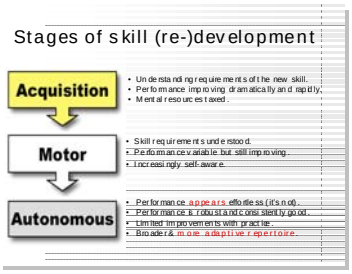
For an excellent introduction to the ideas and research behind perceptual and visual search skills, see the work of Dr. Mark Williams. I recommend, in order:

Williams, A.M & Grant, A. (1999). Training perceptual skill in sport. *International Journal of Sport Psychology*, **30**, 194-220.

Williams, A.M. (2000). Perceptual skill in soccer: Implications for talent identification and development. *Journal of Sports Sciences*, **18**, 727-750.

Williams, A.M, et al. (1994). Visual search strategies of experienced and inexperienced soccer players. *Research Quarterly for Exercise and Sport*, **65**, 127-135.

presentation. Anything that applies to the development of skill among athletes, also applies to the development of skill among coaches.

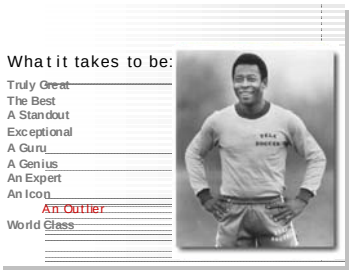


There is considerable disagreement in the literature as to the exact processing and learning mechanisms that contribute to the development of skill. However, most researchers acknowledge that three general phases of skill development can be identified: the acquisition phase, the motor phase, and the autonomous phase. Despite the (unfortunate) use of the word "motor" here, note that the stages of skill development seem to apply for each type of skill: motor, cognitive, and perceptual.

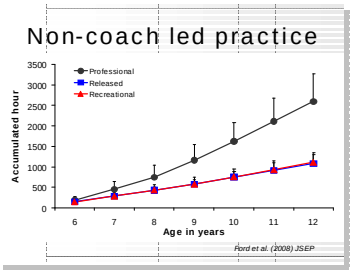
In the **acquisition phase** an individual is simply trying to understand the requirements of a new activity. An individual in the acquisition phase is still learning the task and has low levels of task specific proficiency. Performances are slow and inaccurate. In addition, mental or cognitive resources are limited because the individual must continuously process the activity requirements in their working memory.

The second phase, the **motor or compilation phase**, recognizes that the individual has a (more) complete understanding of the task requirements and performance improves. In this phase, proficiency in the activity has increased but processing requirements still dominate working memory. During this stage, performance improves rapidly but can be inconsistent as athletes explore different and progressively more efficient ways to execute the skill. Subtle changes in timing, tempo, or situation may result in significant disruptions in performance. Athletes in the motor stage also become more adept at picking up on internal and external cues that serve to further guide performance improvements.

During the **autonomous phase**, which is considered the last step in the development of skill, performance has reached a level where it *appears* to be effortless, where performance is almost always accurate, and where additional practice seems to make little additional improvement. In this phase, the activity seems to be performed automatically and cognitive processing requirements are low thereby freeing up mental resources for other activities. While performance in this final phase is typically referred to as "skilled", it is important to recognize that each phase represents a different level in the continuum of skill development.



So, what then does it take to become really, really good at something? To become an expert? To be the best in the world? The answer may not surprise you as you've heard it here before: feedback and practice. And lots and lots of it. How much? Research from decades of work on expertise and expert performance put the total number of accumulated practice hours necessary to achieve this status as somewhere around **10,000**. This is not a hard and fixed number, but one that has manifest itself in areas as diverse as music, chess, mathematics, and sport.

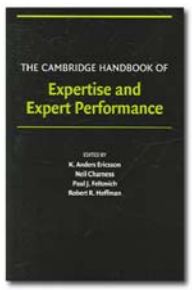


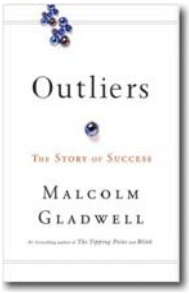
Importantly, it is not IQ, early precociousness, genetics, or "natural ability" that accounts for exceptional human performance. It is accumulated hours of what Dr. K. Anders Ericsson refers to as "deliberate practice". This is the kind of error-focused, hard, effortful work that only those who are supremely motivated to excel will do. Included in this time is the time spent away from organized coach-led practice. In fact, recent work has demonstrated that one of the strongest differentiators among young athletes who later went on to become professionals versus those who did not achieve that level was simply the number of hours spent playing pick up games or "street soccer".

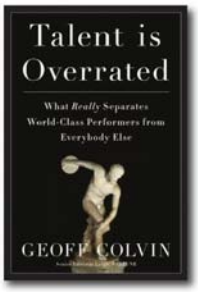
As a brief aside, I'd like to mention that there are a number of outstanding resources available on the topics of expertise and expert performance. The contemporary guru in this area is the aforementioned Dr. Ericsson. His masterwork, "The Cambridge Handbook of Expertise and Expert Performance", compiles a vast array of the most comprehensive, up-to-date, state-of-the-art research on the subject. This past year has also seen three new books published in the mainstream media. Each has something to offer and I'd recommend them strongly. If pressed for a favorite, I would offer Dan Coyle's "The Talent Code: Greatness Isn't Born. It's Grown. Here's How.".

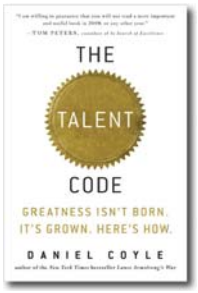
Dan Coyle maintains a very interesting website in support of his book. The site includes videos and descriptions of other talent hotbeds and as he describes it, "deep practice".

http://www.thetalentcode.com





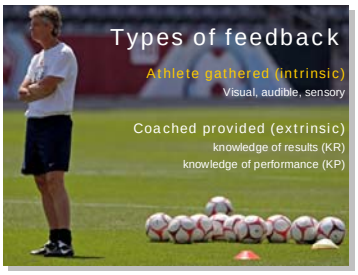




FEEDBACK

By way of a general definition, feedback may be described as information about a performance outcome or result and the factors responsible for it. This information may come from many sources, and in order for feedback to be utilized effectively, it is important to understand what those sources are and what kinds of information they may provide.

First and foremost, it is important for us to understand that athletes themselves have access to a great deal of information directly. The literature calls this "intrinsic" feedback although I find it effective to describe this as "athlete gathered" feedback. Our athletes can see, hear, feel, smell, and taste. And, believe it or not, most of them were born with the ability to do this all on their own! They likely know before you do whether they struck a ball solidly or imparted the intended trajectory and spin.



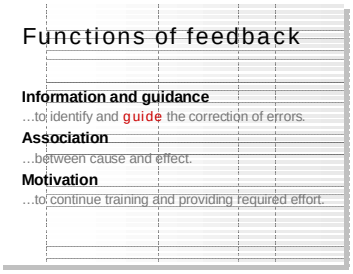
Extrinsic, or coach provided, feedback is that which that is external to the athlete and therefore is or must be supplied to them by something or someone else. Although applicable to both intrinsic and extrinsic sources of feedback, two terms: knowledge of results (KR) and knowledge of performance (KP), are most typically described in the context of extrinsic feedback.

KR describes information about the result of the performance with no real reference to how the result was achieved. In soccer, examples of KR may be the result of a pass or whether the passed ball was properly brought under control. Note that the athlete will almost always have access to this information as well, and for KR to be utilized effectively, the coach should limit themselves to providing information about the result that was not obtained by the athlete directly.

"Knowledge of performance" or KP represents something quite different. KP provides information about *how* the result was actually achieved. Here, the coach may have much more useful and/or accurate information than the athlete about things like technique, timing, or other elements that cannot be easily observed or perceived.

Now that I've introduced what feedback is and what types of feedback are available to the athlete and coach, it is useful to discuss what feedback actually does and why it is so important to the development of skill.

Feedback provides at least three important functions.

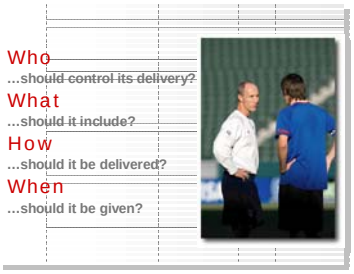


1. **Information and guidance**: Feedback provides information that can be used to identify errors and guide improvements in performance.
2. **Association**: Feedback can be used to create associations between stimulus and response. That is, feedback has the potential to help the athlete develop an understanding of cause and effect. "If I strike the ball to the left of center, the ball will bend to the right".
3. **Motivation**: The motivating effects of feedback are well documented and when properly integrated into a training program, can help athletes pull through long or challenging training blocks or fight through periods of apathy or uncertainty.

The important thing to bring up at this stage is that while we can appreciate how feedback can have powerful and positive effects on our athletes, this exact power can also be the downfall of using it. In a way, feedback can be almost drug-like in that your athletes can become dependent upon it. It can become addictive. The problem comes when the feedback that has been so heavily relied upon becomes unavailable. If, for example, an athlete is so accustomed to getting feedback from their coach after each set piece in practice, then if this becomes unavailable during competition, the performance of the athlete will greatly suffer.

With this in mind, the remainder of this presentation focuses on how to use feedback appropriately and how we can design practices that complement and not defeat its appropriate use.

Suffice it to say, the scientific and coaching literature is packed with research and anecdotes about feedback. In this literature, you'll encounter dozens of hypotheses, "paradigms", and a jargon all its own. But, when all is said and done, all of this work can be addressed in the context of four simple questions:



1. **Who** should control feedback?
2. **What** should the feedback include?
3. **How** should feedback be delivered? and,
4. **When** should feedback be given?

Who. Who should control the delivery of feedback?

Research has shown convincingly that when athletes seek and can control the content and delivery of feedback, performance improves. However, in the real world, this result is affected strongly by the experience, maturity, and skill level of the athlete as well as by the complexity of the skill being performed (which itself may be relative to the experience, maturity, and skill level of the athlete).

What we can tell is that novice performers will likely need and will take better advantage of feedback when delivered (appropriately) by the coach. More experienced performers should be encouraged to think about and understand their own performances and the information that can be derived from them so that they eventually need less and less coach-controlled feedback.

The goal here is autonomy. Self sufficiency. I often say, somewhat tongue-in-cheek, that the job of a coach is to make him or herself obsolete. In reality, there will always be critical functions for a coach to perform and new athletes to work with. But, the point of my message should be clear: athletes should be active, involved, and knowledgeable in critical self-assessment of their own performances.

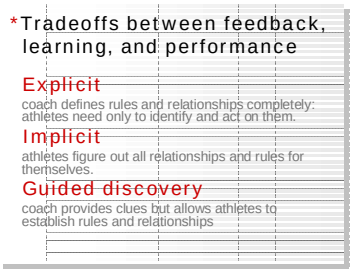
There are, however, a few issues that should be considered when encouraging athletes to seek and control the delivery of feedback.

1. The feedback should be accessible. If an athlete wants to review game footage, they should be able to get into the video room. They should also be able to use, without stress or excessive training, any associated equipment.
2. The feedback should be understandable. Whatever information the athlete is seeking and using, it should be easily understood and correctly interpretable.
3. The feedback should be actionable. That is, based on what information the athlete uses and how it is interpreted, they must be capable of acting upon it. Implicit in this statement is a consideration of the time frame over which any change is intended to occur. This is important and should be discussed directly between coach and athlete to establish and manage expectations.
4. The feedback should be compatible. Video and other sources of feedback can be excellent ways for coaches to help athletes understand that the feedback you provide and what they sometimes feel/interpret are not always aligned. Say an athlete tends to miss too many shots on goal high. You state, "you're leaning back too far". The athlete counters, "no I'm not". The videotape confirms your view and a correction can be made. However, if the opposite should ever happen (the athlete is actually correct), you may have an issue on your hands.

What. What should feedback include?

Recall that athletes can usually and directly gather (intrinsic) feedback about the results of their motor skill performances and in some cases, how these results were achieved. With this in mind, *useful feedback should include specific information the athlete cannot gather or accurately interpret on their own.*

Regardless of how it is presented, *feedback will only be impactful if it contains information on something that actually contributes to the performance outcome*. This implies that the coach must have some level of prerequisite knowledge of the factors *known* to influence the outcome of the skill being performed and assessed. *The feedback must be limited to factors the athlete can actually control or modify*. The time frame allowed as well as the sensitivity or malleability of the factor(s) needing modification must be considered.



As discussed, any of these styles may have use for coaches and performers, alike. However, when evaluated in the context of retention and learning, implicit and guided discovery are far superior. Guided discovery has an advantage in that the time required for learning may be shorter than an implicit approach.

Effective teachers and coaches are those who understand that not all learners are the same but somehow find a way, using different methods for different learners, to impart their knowledge and instill their lessons. With this in mind, cues, analogies, and anecdotes can be effective ways to deliver your message with relevance and meaning.

Last, increasing the precision of feedback can be useful to more experienced athletes. And, these athletes seem to demonstrate a sort of filtering ability whereby they can "round down" from higher levels of precision without any additional difficulty. I am sure there are limits to this, but in general, more experienced athletes can handle more precise feedback (note that I did not say "MORE", I said, "More Precise").

How. How should feedback be given?

While brilliant, the video segment clearly provides an example of a coach going way over the top with communication. Too much. Too fast. The effect on his athlete is likely to be "paralysis by analysis". So, how do we avoid this? While communicating with your athletes is likely to be very much tailored to the individual, some robust guidelines regarding the delivery of feedback are provided

I have been told by reliable sources that JC Anderson performance this segment in exactly one take. Now, *that's* impressive (and clearly the result of some effective practice)!

below.

Limit your cues and feedback phrases to "7 ± 2" chunks of information. Cues and key word phrases should be short and effective. "7 ± 2" pertains to our ability as humans to process information. The rule states that people can effectively handle 5 to 9 bits of information. What's a bit? Well, it depends. It can be described as a chunk of information that may comprise a single number or letter or it could involve a lengthy sequence of letters or phrases. The most salient aspect of this is to be specific and concise: Specificity is important. But, so is brevity.

As an example of the 7 ± 2 rule, think of how you first learned your SSN (or worse, your spouse's). At first, you probably tried to memorize each number as a separate element. 9 bits. Then, you probably grouped them as they are grouped on our cards (by design, by the way, as are our phone numbers). The first three numbers become one chunk; the next two become the second chunk; and the last four numbers become the third chunk. Notice that you've gone from 9 bits of information to three chunks. Last, of course, you may have memorized the entire sequence effectively storing this as one meaningful chunk of information.

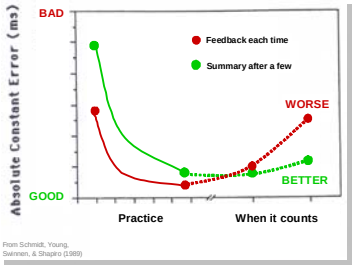
Word your phrases in the affirmative and keep them action oriented. Use statements of the form, "do this" rather than "don't do that".

Encourage active learning and estimation. Ask your athletes questions. Work with them so that they can progress from being passive recipients of your feedback to active diagnosticians then insightful prognosticators of their own performances. In all cases, work to ensure that athletes do not become dependent on your feedback. Feedback should be presented in ways that encourage the athlete to see, hear, feel, and interpret things for themselves.

When (at last). When should feedback be given?

The traditional view on feedback is that immediate and frequent is best. After all, what better way to fortify the associative role of feedback? In some contexts, research has in fact shown this to be true. However, the superiority of frequent and immediate has been largely limited to situations involving novice performers and complex skills. Frequent and immediate feedback is also usually associated with improvements in performance during early stages of skill acquisition. However, as we'll see later, performance during "acquisition" does not always carry over to performance when it really matters most.

What research has shown is that delaying feedback (making it *not* as immediate), reducing the frequency of feedback, and providing summaries of several performances instead of feedback after every performance tend to lead to better long-term performance. Stated different, it improves learning and retention.



Modifying the delivery of feedback so that it is provided more frequently during the acquisition phase and is then "faded out" as performance becomes more proficient is more effective than giving more feedback consistently (and frequently) throughout practice. Similarly, the idea of providing feedback only when the performance falls outside of a certain 'bandwidth" (think "range of correctness" or "range of acceptable performance?") leads to better performance than more frequent and uniform feedback schedules.

Before I summarize what we've discussed so far, I'd like to take a few minutes to talk about the important process of prioritizing feedback. We're probably quite adept at identifying several things in any given skill that we'd like our athletes to improve. Say you've identified 10 such things. You know it is neither appropriate nor effective to introduce feedback on all 10 things at once. So, from all the information available to you, how do you sort through these 10 things and prioritize them so that maximize the performance of your athlete? Here are guidelines I like to use:

There are a number of approaches for identifying critical features. While beyond the scope of this presentation, I advocate a method called "deterministic modeling". This method and others are nicely described in "Qualitative Analysis of Human Movement" by Duane Knudson & Craig Morrison.

Critical features first: Identify factors that truly influence performance and focus only on those factors which are sensitive to training or maximize improvement

Account for relationship to previous actions: Recognize that some faults may in fact arise from others. For example, poor decision making (and the associated perceptual skills) can often lead to breakdowns in motor skill performance. Which

skill needs work?

Consider time frame/difficulty required to affect change: We all know that some changes are harder or take longer to realize. For example, it takes considerably more time and effort to improve vertical jumping performance than it does to correct a simple posture or technique flaw. This may have some value when trying to prioritize between-season vs within-competition feedback.

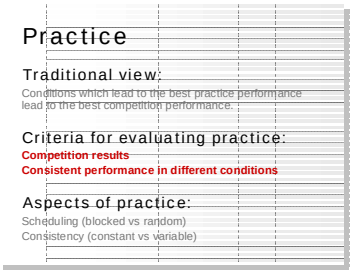
Do not discount motivational effects of goal setting and achievement: Easier to accomplish goals can enhance motivational aspects and improve the likelihood of being successful with more challenging aspects of performance.

Here are some take home points on feedback that what we've discussed so far.

- When ready, provide athletes opportunity to control delivery of feedback.
- Provide feedback athletes cannot obtain or interpret correctly themselves.
- Encourage athletes to "estimate" their own performances. Help them become (and stay) independent and able to self-assess.
- Be concise and specific with cues and phrases. Remember: 7±2. Provide feedback and instruction in affirmative, action-oriented phrases.
- Provide feedback more frequently early, less frequently later. Consider delayed, reduced frequency, summary, and bandwidth feedback.
- Provide feedback to maximize learning and competition performance.
- Prioritize feedback on performance-affecting factors and so it can be acted upon in the time frame considered.

PRACTICE

Now, we'll switch our attention to practice. The long-held view on practice is that conditions that result in the best practice performance will also result in the best competition performance. And, for a long time, research tended to support this idea.



However, when we begin to think of the criteria against which we should evaluate the effectiveness of our practices, we begin to see some real challenges to this assumption. Specifically, when we assert that we should really evaluate the effects of practice, NOT by performance in practice but by performance during competition, we really begin to see some differences. Also, when we look to see how practice affects our athlete's ability to generalize their performances in different competition conditions, we see again that what works great in practice may not work as well when it counts.

There are only two aspects of practice that I want to touch on today. Scheduling and Consistency. Let's look at each of these.

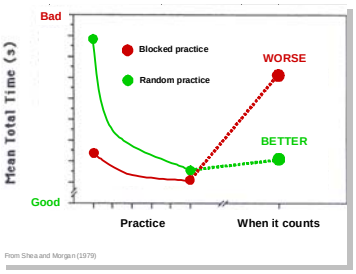
BLOCKED VERSUS RANDOM PRACTICE

Blocked practice is what we associate with simple drills. We ask our athletes to repeat the same task or play time and time again until they've had a certain number of repetitions or have done something for a set amount of time. If you are a golfer and like to practice at the driving range and hit 20 balls with your driver and then 20 balls with your 7 iron and then 20 balls with your 3 wood, you are doing blocked practice.

Dr. Richard Schmidt is credited with this concise description of one of the many advantages of random over blocked practice.

Random practice is quite different. Here we mix things up so that we never do the same thing consecutively – except if it happens randomly. Thinking of our golf example, if we take the same 60 balls we hit but now hit them randomly – driver, iron, wood, iron, driver, wood, etc. – this is random practice.

Research demonstrates conclusively that when viewed in the context of learned or retained performance, random practice is vastly superior to blocked practice. This appears true regardless of whether the actual performance is done in blocked (fixed distance, fixed condition sports like archery, range shooting, etc.) or random (dynamic, interactive sports like soccer, volleyball, boxing, etc.) situations.



You might anticipate, and rightly so, that there are some pragmatic issues associated with designing effective random practices. By comparison, blocked practices are easy. Random practices require consideration of transition times and any equipment or personnel changes that need to occur. But, if your goal is to maximize competition performance, aspects of practice should be randomized within and between sessions.

CONSTANT VERSUS VARIABLE PRACTICE

The last thing we'll discuss regarding practice is constant versus variable practice. Here, we're really talking about the conditions in which we have our athletes practice. Constant practice conditions don't change. If you always practice in a climate controlled indoor gym, you're likely practicing in constant conditions. If you always use the same balls, on the same field, at the same time of day, you are practicing in more constant-like conditions. Variable conditions, are, well, more variable. They change. If you always practice on an outdoor field, but do so at different times and all year long, you are certainly experiencing some variable conditions.

When we think of these conditions, we can certainly consider environment factors. Things like light, temperature, wind, humidity, altitude. But, we should also consider situational factors and those that we can manipulate somewhat artificially to create small but important changes in the practice conditions. Things like the field and field surface you play on, noise, fatigue, anxiety, pressure, ball type, ball inflation, etc. are things that might occur naturally in a competitive situation that we should consider incorporating into practice.

Some take home points on practice:

- Considering the success of your athlete's performance during practice can be misleading. Design practices to maximize learning and competition performance.
- Consider advantages of random versus blocked practice. Random practices seem to function similarly to summary or delayed feedback: it provides time and opportunity for the athlete to interpret their performance and adjust the most salient features of it.
- Consider the advantages of variable versus constant practice conditions. The goal in this is to create conditions which encourage and facilitate the development and execution of skill within a more comprehensive set of experiences. From stress to surfaces, introducing different conditions during practice will better prepare your athletes for these conditions when they arise during competition.

So, here it is. The leap of faith. I completely recognize that some of this stuff is scary to think about. Adopting this information means that you understand that by incorporating some of these ideas, you could actually see decrements in your athlete's performance during practice. However, the literature is compelling and there are advantages to these ideas for long-term performance. I'd only end with this. Like anything new, take time to learn more and introduce these ideas at an appropriate time. Certainly, introducing a new routine a month before a major competition is probably not a good idea. But,

planned appropriately, I'm confident some of these ideas can have a lasting and positive effect on your sport.

REFERENCES

If you're interested in reading more on motor learning, feedback, and the design of effective practices, there are a number of excellent and readily available sources. I've provided some key references that I'd be happy to recommend to you. The papers by Chen, Hastie & Hannan, and the last paper by Schmidt and Bjork are probably the most easily digestible. The papers by Magill, Newell, and Salmoni are excellent review papers but are written in more formal and technical tones. Again, if pressed for a favorite, I'd steer you toward Schmidt & Bjork.

Chen, D.D. (2001). Trends in augmented feedback research and tips for the practitioner, JOPERD, 72 (1), 32-36.

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Please do not hesitate to contact me with your questions, ideas, comments, and stories. I welcome them all.

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"To get the things we've never had, we must do the things we've never done."