CONNECTICUT INTERSCHOLASTIC ATHLETIC CONFERENCE

CIAC COACHES UPDATE

VOLUME II, ISSUE III *Dr. Bob Lehr, Editor* NOVEMBER 2011

SOME PRINCIPLES OF PRACTICE

Practice! Ah, the best part of the day. A time to teach the sport you love, to impart your knowledge to impressionable student-athletes, and to help them realize the potential that they have been given. No one would question the importance of practicing; however, how many times do you leave your practice venue with a sense that the practice just did not go well, that many of the things you planned for the day went without satisfying your objective for the practice? Perhaps there are ways that you can improve your practice plan to maximize the time available to you and your charges. The following article may cause you to stop and re-evaluate your practice regimen. I hope that you find it valuable to your efforts.

If you are a winter sports coach, good luck in your forthcoming season! If you are in the midst of CIAC tournament play, or if you recently completed your season, I hope that you found the season rewarding.

Bob Lehr, Editor

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Some Principles of Practice

Richard A. Schmidt Human Performance Research

Experimental psychologists, kinesiologists, and other scientists have been working for many decades trying to understand how it is that some people can perform at incredibly high levels of skill, and how to practice so as to maximize performance. This is of great interest in countless practical applications. In this brief article, I outline some of the fundamental principles that form our understanding of how and when to practice.

First of all, it should come as no surprise that the most important thing one can do to improve performance is to practice. Psychologists call this "deliberate practice." There is no doubt that the best performers in sport have spent incredible amounts of time at their craft. Be aware that the gains from practicing when one is already at a high level are small and difficult to achieve. I'm reminded of a study of industrial cigar makers who were still improving in time/cigar even after 10 years or 7,000,000 cigars! The key principle here is to practice-and practice lots.

OK, we all know that. But now the question is how to practice, what do to, when (how often) to do it, how to use teachers/coaches, and how to evaluate the products of your efforts. I think these questions are often best answered by understanding a few, key points about performance and learning, discussed next. I'd rather not give a list of do's and don'ts for practice. Instead, if you understand some of these principles, you can design effective practices for yourself.

The champions do it this way. In discussing learning and sport, I often hear people say that so-and-so champion does it this way, so that must be optimal. After all, how did they become a champion if he/she did not practice nearly optimally? This kind of approach simply ignores 100+ years of research and scientific study of these issues. In many ways, this approach to practice is probably adequate. But in many other ways, common-sense views about how and when to practice are contradicted by careful research. Several of these findings can make a large difference in the effectiveness of practice.

Learning-performance distinction. Perhaps the most important principle is the distinction between learning and performance. Learning can only be measured by changes in performance. During practice, two kinds of results happen. Practice itself can produce effects in us that are relatively permanent; this is what we want, and we call it "learning." But practice also produces temporary effects on performance. Sometimes these are positive, so performance is facilitated during practice (e.g., feedback from coaches, repetition of a skill); sometimes these are negative (e.g., fatigue, distraction), so performance is depressed during practice. The mistake we often make is to consider skill gains in practice as necessarily due to (relatively permanent) learning, when they might only be the result of temporary factors. However, when skill is evaluated on a subsequent day, or in an important contest, the temporary effects of practice will have dissipated, leaving one with a different level of performance than experienced during practice. If the practice method facilitates performance temporarily (e.g., feedback from a coach), then performance will drop when measured later. I'll have more to say about this later.

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Goals of practice. Perhaps it is obvious, but we do deliberate practice so that the effects can be evidenced on some "test," such as the next competition or the Olympic trials. Strictly, we don't care very much about our performance during practice, so long as our performance on the "test" is maximized. The problem is that many methods of practice facilitate performance temporarily (giving a false sense of accomplishment), and then these gains dissipate by the time of the "test" is performed, producing disappointing performance when it is needed most.

The best example of this is repetitive practice at a driving range in golf (or repeating hundreds of free-throws in basketball, or hundreds of jibes in a row in sailing). Repetition produces temporary gains in performance, and gives a strong sense of accomplishment. When asked, learners have strong confidence in what they think they have learned. But, when the later "test" comes (e.g., a round of golf, a basketball game, or a sailboat race), these gains often disappear, showing that their confidence was ill-founded. For scientists in this area, the driving range in golf represents the "classic" misconception about how to practice.

The message is to consider what the context is that you want to maximize, and then design practice so as to mimic that to the greatest extent possible

How learning is evaluated. I hope it is clear from the above that the amount one has learned should not be evaluated during the practice session. Many factors either enhance or depress performance during practice, giving a false picture of how much learning has occurred. As a result, learning is measured on some subsequent "test" of retention, after the temporary effects have dissipated. This "test" is whatever it is that one wants to optimize by practicing (e.g., next weekend's competition).

This is the way we do it in the laboratory, too. We might study different methods of practicing. These produce a mixture of relatively permanent and temporary effects during practice. Then, we give a "test" several days later. The method that produces the best performance on the "test" is the one that has produced the most learning. Again, we do NOT measure learning based on the performance during the practice phase--just as the swimmer would not measure gains in fitness during a swimming workout, but rather would wait for recovery from fatigue.

When these methods are used in the research, we find that some methods produce strong gains in performance during practice, but do not last until the test. In fact, we find sometimes that, of two methods, the one that produces the better performance during practice produces the poorer performance on the test. This is critical, because our whole goal in doing deliberate practice is to enhance the test performance. Below are some examples of this principle.

Specificity of learning principle. One of the things we know is that the products of learning are very specific to the particular skill and context in which we perform. In one form, we all know this. If we want to race in 20-knot breezes, in chop, in a Laser, then we would practice in 20 -knot breezes, in chop, in a Laser. What we forget sometimes, is that the practice methods we use often deviate significantly from the context that is the ultimate goal of practice, and this is an important consideration.

Consider repetition of golf shots at the driving range, or of free-throws in basketball. In golf, we never hit the same shot twice in a row (unless we cheat). In sailing, we seldom do many tacks or jibes in a row, rather these are separated in time by other things. Practicing many tacks in a row, or hours of downwind sailing at a stretch, both deviate from what we do in a typical race. The message is to consider what the context is that you want to maximize, and then design practice so as to mimic that to the greatest extent possible.

This is also related to drills. Coaches often generate special drills to exercise some particular skill. We need to ask whether that drill is sufficiently similar to the skill that we really want to learn so that transfer to that skill will occur. Some drills are great, but some have too many differences from the real thing that they are probably not effective.

Practice scheduling. How do I decide when to practice? Consider two methods of practicing three skills (e.g., jibe, tack, straight-line speed). A common-sense method for practicing is to mass practice: do 100 jibes, then 100 tacks, and then 30 minutes of speed practice. This is called "blocked practice." An alternative would be to do one jibe, one tack, one minute of speed practice, then one tack, then one jibe, etc., never repeating the same skill twice in a row. This is called "random practice."

Much research since the late-1970s has shown that, during practice, blocked performance is far superior to random performance, which is not surprising. But what was surprising was the discovery that, for performance on a test given on the next day (e.g., next competition), random practice was better than blocked. That is, a condition that made performance worse in practice (random practice) increased learning as measured on a retention

test. Sometimes this effect is small, but sometimes it is huge--and always in favor of random practice. This is counter to common sense. It occurs with cognitive and motor tasks, young and old subjects, skilled and unskilled learners, etc. What's going on here?

One thing going on is that blocked practice does not mimic the real context that the learner will use on his own "test." For example, blocked practice at the driving range does not mimic the game of golf very well. Doing hours of downwind practice does not mimic buoy racing very well. One thing missing in blocked practice is the transition from one skill to the next and back again that is present in the actual test of interest.

Another thing missing in blocked practice is that the performance on one attempt provides very much assistance in performing the next attempt. Small adjustments are made from trial to trial. One thing this does is to provide "the solution" of the problem for the learner on the next attempt rather than forcing the learner to generate it him/herself. Consider this example. You are in 5th grade, and you want to learn to do long division "in your head." In deliberate blocked practice I ask you, "What's 36 divided by 12?" You struggle, finally coming to the answer "3." On the next trial, I ask you, "What's 36 divided by 12?" Your performance is facilitated now because you remember the answer you just gave, so you don't have to generate the answer again. If I gave you 10 of these in a row, your performance would be perfect (or nearly so), but you would not be exercising the generation of the solution, only the repetition of the remembered answer. This is an example where a factor that facilitates performance in practice (blocked repetitions of a particular division problem) is detrimental (as compared to a randomized presentation of several problems) to learning and measured on tomorrow's test.

The only exception to this principle is related to beginners at a skill. The learner has to be able to get through the skill at some, minimal level before random practice can be beneficial. So teachers often use blocked practice only at first, until the person can just do the task, and then practice is switched to random. This level of skill is very low at this point, however, and it is clear that most subsequent practice is more effective under randomized conditions.

As applied to sailing, one could assess what goal performance he/she wanted to optimize. Say it's getting around the buoys in a dinghy race, including tacking, jibing, straight-line speed, etc. A typical method would be to set up a small course and sail it. Inherent in this is a mixture of skills from moment to moment, minimal repetition of a given skill, and duplication of the conditions in the actual race.

Feedback. We have known for many decades that feedback about errors, combined with instruction as to how to eliminate the errors, is a critical variable for learning. This information is called "feedback." Coaches can give valuable information that facilitates performance during practice. In fact, without this information, mere practice under some conditions can be useless.

But let's go back to the principles. In the test, the coach is not present to give feedback. If the learner listens to the feedback, responds to it, listens again, responds to it, etc., the learner will be improving performance at a furious rate.

But is the learner really using the processes that would be used when the feedback was not present? Probably not. So, we must generate a way to allow the learner to use the guidance from the coach without coming to rely on this feedback.

Some experiments have shown recently that giving feedback after every attempt (100%) is far better for performance during practice than giving it after every other attempt (50%). But on tests of retention given the next day without any feedback, the subjects with only 50% feedback performed better than those who had practiced with 100% feedback. One interpretation was that feedback after every trial was used as a kind of "crutch," so that the learner was unable to perform effectively when the "crutch" was removed in the test. Other than reducing the amount of feedback given, here are a couple of other things a coach could do with feedback, all supported by the research.

Many practice methods that seem, on the surface, to be beneficial are effective for performance at the moment, but are not effective for the highly critical test later on.

First, ask the learner to generate his/her own feedback. "What went wrong with your tack that time"? This forces the learner to evaluate their own internal feedback (how it looked, felt, sounded), and prevents the learner from relying too heavily on the coach's feedback. One time we gave starting practice for the bow person to evaluate how far the boat was from the line at the gun. We'd do one exercise, ask the learner for the estimate, then tell the learner what it was, then repeat the process, or even switch to another type of task.

Second, take videos of performance form for 20 minutes, then play it back to the learner with the coach's commentary. Note that this prevents feedback after each attempt. Also, the coach could direct the learner to the aspect of the skill that needs work. "Look where your feet were that time." Simply viewing videos without a coach's instruction has been shown not to be very effective for learning.

Third, a coach could watch the team for a while, making mental notes about what is going on. We all know that just about any kind of error can happen once, and the coach's goal would be to evaluate what the performer's general pattern of skill is. Then, after watching a while, the coach could stop and say, "OK, what I see is this. Try it like that." This prevents the learner from being dependent on the feedback, and prevents the correction of every little error that might not ever happen again.

Fourth, I have seen guest experts come and basically run things. Performance generally becomes very good. But, the question is really related to how well that athlete or team will do next time, when the expert is not there. It is easy for a coach to do/say too much so that the learners do not acquire the capability to perform on their own.

Summary

There are many more principles for practice, but space is short here. But many of these are understandable from just these few principles about learning. A key point is to practice. Beyond that, a key point is not to be fooled by your performance during practice. Many practice methods that seem, on the surface, to be beneficial are effective for performance at the moment, but are not effective for the highly critical test later on. I have given several examples here. And, it is remarkable how many of these principles are not what we would have guessed, and are certainly not based on what some particular champion did in his/her practice.

I suspect you won't be convinced by what you have read here, so I invite you to check the sources for yourselves. These principles are summarized and explained in our textbooks. The Schmidt and Wrisberg (2004) book is intended for beginners in teaching, whereas the Schmidt and Lee (1999) is more research-oriented. I have also included a copy of a paper by Schmidt and Bjork (1992) which gives some of the evidence for this way of thinking.

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