Starting Strength

The Two Factor Model of Sports Performance

by

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The role of strength in athletics has been discussed quite a bit by us, and never enough by anybody else. Strength is the application of force against an external resistance, and since athletics always involves movement against some sort of external resistance, force production is the common denominator of all sports. But strength is not the only component of athletic performance. This essay will explore the essence of preparation for an athletic performance, and will propose a new paradigm for the process.

There are two components to the effective preparation for improved performance in the vast majority of athletic events – a "*performance*" being defined as a specific point in time when an athletic event will occur and for which an athlete prepares to demonstrate the best effort possible under the scrutiny of judges or against direct competition. Regardless of whether the sport is endurance-based, like certain field positions in soccer, strength-based, as in Olympic weightlifting, or a combination of the two, like Rugby Union, whether the sport involves non-repetitive motor pathways, like downhill skiing, or repetitive motor pathways, like powerlifting, two separate forms of preparation are require for winning performances: *Training* and *Practice*.

Training is the process of accumulating a specific *physiological adaptation* or adaptations necessary for improved performance in an athletic event. These adaptations depend entirely upon the physical nature of the performance in question. They may be predominantly metabolic (involving changes to the chemistry in operation within existing tissue) as in endurance-based sports, or structural (involving the growth of new contractile/connective tissue and bone densification) as in sports involving maximal effort, or a combination of the two.

These physiological adaptations are not dependent on any specific movement pattern or patterns – in fact, they are general adaptations across the entire body, and are totally non-specific to any particular neuromuscular pattern or pathway. And they are best developed using the movement patterns that most effectively apply the stress – *not the ones that look the most like the sport in which the adaptation will be used.* In other words, you don't squat in your lineman stance; you squat in your squat stance, because it's better for squatting heavier weights, and then you play lineman in your lineman stance because it's better for lineman-ing. All you have to do is remember where you are.

The *process* of training is the systematic approach by which current capacity is assessed, a plan is made for the improvement of that capacity over a period of time that usually culminates in a performance, and the execution of that plan using a series of programmed efforts – "workouts." Within a training program, each workout is valuable in that it contributes the proper stress to the process of

accumulating the physiological adaptation required for improved performance. The effect the workout has on you today is relevant *only* in that it adds to the long-term accumulation of adaptation to the stress.

For a few sports, primarily the distance events, endurance training is the main concern. But for all sports, strength training is of benefit at some level. Strength is the ability to produce muscular force against an external resistance, and is the basis for the body's interaction with the environment. Every sport depends on an interaction between the athlete and his external environment, be it the ground, the water, an opponent, or various physical objects used in the competition – balls, racquets, bats, javelins, shot, or barbells.

For sports dependent on repeated submaximal efforts, an increase in strength ensures that the submaximal effort involved is even more submaximal, and is therefore easier to prolong or increase in intensity if necessary. Road cycling, soccer, tennis, and American football form a continuum of activities that depend on submaximal effort punctuated by increasingly higher-intensity efforts during the performance. None of these sports utilize 1RM-level force production in their performances, but as absolute strength increases, the ability to express strength at *all* submaximal intensities increases at the same time. If you increase your deadlift from 300 to 450, a 200-pound effort gets much easier to perform, either once or multiple times.

Everybody seems to understand how this capacity improves football, since it lies at the higher end of the intensity continuum. Usually unappreciated is the effect the same process has on cyclists, soccer players, and tennis players, all of which benefit when submaximal strength increases. The simple nature of gradually and progressively loading the basic barbell exercises, the lack of complexity and the straightforward process by which a strength adaptation accumulates over a relatively short period of time, and the immediate performance improvements it can make in sports not traditionally approached this way seems insufficiently complicated. For some odd reason, people like complexity.

Every pedal stroke, every stride, every swing, every snap off the line is a submaximal "rep," and the best way to make submax reps at any intensity easier is to increase your strength at higher intensities. There seems to be some level of understanding of this in S&C for sports, since "Strength" and Conditioning is worthy of an office in the building, but a profound misunderstanding exists about how to acquire strength. The current dogma is that strength – even though it is a general physiological adaptation in which the entire body gets better at producing more force – must be acquired using the same movement pattern in which that strength will be expressed on the field. So, the current dogma holds that squats must be done in your lineman stance. Nothing could be more wrong, and the reason involves a misunderstanding of the second aspect of performance preparation: *Practice*.

Practice is the repetitive execution of movements that depend on *accuracy* and *precision* under the conditions in which they will be displayed during the performance. Accuracy and precision are usually used synonymously in the common vernacular, but they have different technical meanings in both science and statistics. When referring to measuring instruments, for example, accuracy means the correct measurement of the value against an objective standard, while precision means the ability to measure the value at very fine margins of error. For our purposes, *accuracy* means the degree of

closeness to a standard of perfect execution, and *precision* means the ability to repeat this degree of closeness during subsequent executions. Since perfect execution is assessed during the performance, practice must of course be specific to that which will be displayed during the performance.

The effectiveness of practice is dependent on the athlete's ability to accumulate experience with the movement patterns to be displayed in the performance, in order to embed the motor pathways that generate these movement patterns. Accuracy is therefore exquisitely dependent on the nature of the performance, and precision (outside the context of practice) is dependent on the requirement for multiple efforts. In repetitive motor pathway sports like diving and gymnastics, the standard of execution is fixed by the rules and can be practiced effectively well in advance. In non-repeating motor pathway sports like judo and fencing, the movement patterns that have been practiced individually are assembled into the performance as it happens by the athlete, with the ability to effectively do so determining the result of the event.

The ability to execute movement patterns with accuracy and precision is *skill*. The development of skill is the purpose of *practice*. Together with *training*, these two quite separate preparatory mechanisms are used by athletes to improve their performances. Talented, gifted athletes can accomplish more with training and practice than their less-fortunate fellows, but the more effective the approach to both training and practice, the more efficient the results for all athletes.

Baseball provides an excellent illustration of the concept. A baseball is 9.00 to 9.25 inches in circumference and weighs 5.00 to 5.25 ounces. A bat varies in length and weight, but it may be no more than 2.75 inches in diameter and 42 inches long, at a weight constrained by the wooden composition at these dimensions, usually no more than 36 ounces. Pitching *practice* is therefore accomplished with a 5-ounce baseball and batting *practice* with a 34-ounce bat – the tools used in the performance.

However, there are schools of thought that hold otherwise. Heavy baseballs are available, as are bat weights (the donut-looking things) that can be slipped on from the handle, the idea being that throwing or swinging heavy improves throwing or swinging strength. However, throwing or swinging heavy is also throwing and swinging *slower*, and is therefore not *practice* for the movement patterns used in the performance with regulation equipment – if anything, it is practice for the wrong movement pattern.

More importantly, it is not *training* either. Strength cannot be improved by adding 2, 3, or 4 ounces to a 5-ounce baseball or 1 pound to a bat, because an additional 3 ounces or a pound is not enough weight to improve the force production capacity of the muscles involved in throwing or hitting a baseball. Throwing and hitting is a whole-body movement pattern – a universally recognized observation – and strength for the whole body certainly as hell cannot be improved by adding 50 grams to a baseball or 1 pound to a bat.

On the other hand, adding 50 pounds to your press, 85 pounds to your bench press, 150 pounds to your squat, and 200 pounds to your deadlift can markedly affect this strength, in a controlled, programmable fashion. The barbell approach has the added value of not interfering with the motor pathway used in the pitch, since it is *not* an altered version of the specific movement used in the performance. This is very important: strength is best acquired using barbell movements, because

barbells can actually be *trained* progressively, and the strength thus acquired can be applied directly to the movement pattern during *practice* with the baseballs and bats that actually win the game.

This misunderstanding is at the heart of the dysfunction in the modern conception of S&C, where it has been decided that weight room activities must look familiar to the Head Sports Coach, using light dumbbells and unstable surfaces. And the kids, being athletes, would rather "play" than train. This approach provides neither training nor practice, since such activities are not hard enough or progressive enough to produce an accumulating physiological adaptation in either strength or endurance, and their movement patterns are not specific to any sport – unless the sport is light dumbbells on unstable surfaces.

They replace the basic lifts that *can* be programmed for a long-term strength increase with a wide variety of athletic-looking exercises that *cannot* be trained for strength and that are not practice either. The result is a few talented athletes with a huge amount of undeveloped potential, wasting time merely displaying the athletic ability that got them recruited, and lots of average athletes who desperately need the help that would be provided by the marked increase in strength their coaches don't know how to provide.

The love for athletic-looking exercises stems from another fundamental misunderstanding: athletic ability, i.e. explosiveness, reaction time, agility, and their associated characteristics are not really trainable in the sense that they can be improved more than just getting stronger provides. For exactly the same reason that the standing vertical jump is not very trainable – and by that I mean 10–15%, perhaps 20% in exceptional circumstances – athletic ability isn't either; it is exquisitely dependent on genetic endowment and the inherited neuromuscular characteristics provided thereby. There are no examples of athletes training from a 26-inch to a 36-inch SVJ, and this is why.

The current rage is Rate of Force Development (RFD) "training," the practice of movements that display reaction time, explosion, and direction change, all while using valuable weight room time that could be better devoted to getting stronger. Again, it is the display of the capacities recruited athletes already possess. It's not *training* at all. It is *practice*, although it is specific to no particular sport, and no one ever improves more than 10–15% since it is not capable of being programmed progressively.

From the website Science for Sport: *"So whilst numerous training methods have been shown to improve RFD in untrained and elderly males and females, little research has shown RFD improvements in trained or athletic subjects."* Further, the point is made that only resistance training and loaded ballistic training have been shown to improve RFD in these athletes.

This is an elegant ("whilst") way of saying that RFD cannot be improved by *practicing* RFD, because it is controlled by genetics, that getting stronger is the only way to improve it, and that it doesn't improve very much even when you do. Yet RFD continues to grow in popularity while the *training* of squats and deadlifts remain merely uncomplicated, straightforward, difficult, and far more productive. Once again, the utility of the distinction between *training* and *practice* is obvious.

To further explore our new vocabulary and its usefulness, let's examine a couple of other sports under this lens. Distance events like the marathon and the 10,000-meter run are examples of sports in which training and practice are essentially the same. There are no skills involved that training time

does not provide practice for. Powerlifting is the closest example on the other end of the bioenergetics spectrum in which training and practice are essentially the same, depending upon which federation's rules you are competing under – there may be equipment used in the performance which is not normally used in training and which must be practiced with before the event.

Olympic weightlifting presents an opportunity for a closer examination of our model. The training/practice paradigm reveals some interesting facts about this barbell sport, among them the fact that training and practice are quite separate concepts, even though this is counterintuitive, especially to most Olympic weightlifting coaches. The snatch and the clean & jerk are explosive technical movements that are dependent on the efficient mechanical expression of power. A heavy barbell must be accelerated so that the load's momentum carries it upward sufficiently between the force application phase and the catch phase that it is high enough to rack, either overhead or on the shoulders.

All three movements display this characteristic – acceleration, which is a function of power. Power is strength displayed quickly. Strength is force production, and acceleration is entirely a function of force production. No way around it: to snatch and clean & jerk heavy weights, you have to be strong. As long as the heaviest weight wins the event, Olympic weightlifting will be a strength sport. Rational people do not dispute this fact.

Disagreement arises when we discuss the methods by which weightlifters should get strong. For powerlifters, the basic strength exercises are the contested events in the performance. Olympic lifters perform three movements that are *dependent* on strength but that are *limited by* technique and the ability to accelerate. The snatch and clean & jerk cannot train maximum force production because of the fact that *maximum force production and maximum power cannot be expressed at the same time*.

Maximum force production occurs only when maximum numbers of motor units are recruited into contraction, which cannot and does not happen during submaximal explosive contraction – maximum motor unit recruitment is a summation of neuromuscular activity, and that takes more time than is available during an explosive event, like a SVJ or the acceleration phase of a clean. Maximum force production occurs in a 1RM squat, bench press, or deadlift, and it is *trained* during heavy sets of 3–5 reps in these lifts. Maximum force production does not occur in a snatch. As the ability to produce force increases with training, the aspect of force production known as *power* can be displayed as a heavier snatch. Therefore, the snatch itself cannot be used to develop force production beyond that which can be attributed to the Novice Effect, but it must be practiced extensively even as strength increases.

Therefore, once a lifter is past the rank novice phase, strength must be *trained* for like all other athletes should train for it, using the squat, press, deadlift, and bench press in a deliberately progressively program. And since weightlifting is a strength sport, specialization in strength is required, far beyond that which is recommended for other sports. Technique must be *practiced*, just like it must be for any technically demanding sport, using the same movement patterns under the same circumstances as the performance at the meet demands. And this is the interesting part of Olympic weightlifting: practice must be specific, and this means more than just the barbell and the name of the lift.

A snatch, clean, or jerk is a system of movement in which the lifter and the barbell are the components of the system. Unlike a baseball batter, which is also a two-component system, the mechanical relationship within the lifter/barbell system changes as the mass of the bar increases on the way up from warmup to 3rd attempt. The Center of Mass (COM) of the lifter remains approximately the same at any given point in the pull, while the COM of the barbell is located in the middle of the bar. But the combined COM (CCOM) of the system – the calculated position of the average mass of the two components – changes as the weight goes up.

The heavier the mass of the barbell, the closer the CCOM of the system is to the bar during the movement. This changes the mechanics of each pull as the weight on the bar increases. You have noticed this yourself: the bar is not merely heavier – the whole effort is *different*, because the CCOM is in a different place during the pull each time the weight goes up.

And this has profound implications for the nature of *practice* in the two lifts. A 70% snatch is not practice for a new PR, or even a first attempt, because a 70% snatch and a 98% snatch *are two different mechanical events*. "Training" programs assembled from light partial movements, and even heavy assistance exercises, have wasted uncountable thousands of training hours, because practice for 98% efforts must take place at close to 98%, or it is not actually *practice*.

And since the snatch must be done with enough acceleration to generate enough momentum to rack it, as opposed to the heavy lifts where explosion is not inherent in the movement, it is even more important for snatch practice to be as close to the snatch *performance* as possible. This is one reason while the Bulgarian Method works as well as it does, and why the programs used at the USOTC for decades have produced such bad results in international competition.

Soccer is another sport that is normally approached in a way that doesn't make much sense. With a demanding array of field skills and complex strategy, along with a grueling physical game, the training/practice paradigm is in full operation here. *Practice*, beyond that which is necessary to teach kids basic ball handling, takes place on the field. This is, interestingly enough, called "soccer practice" here in the US. *Training* for the strength component of soccer is important too, especially for the prevention of the all-too-common injuries to ACLs that occur with a higher frequency in this sport than any other sport in the world. It should consist of squats, deadlifts, presses, and bench presses, just like it should for all other athletes in all other sports.

Training for soccer also must involve a conditioning component, since the game is long and involves running and sprinting. But soccer *practice* is also long, and involves running and sprinting, and games are usually weekly during season, if not more frequently. Both practice and performance therefore have a profound *training* effect for the conditioning aspect of the game that makes non-practice conditioning either unnecessary or counterproductive. For soccer, some aspects of *training* and *practice* can be successfully combined, and they should be – if done correctly, it saves time and prevents overtraining.

Any sport can be effectively analyzed using these simple vocabulary words defined this way. This model becomes a powerful tool for more effectively assessing performance preparation than the currently fashionable yet demonstrably ineffective tendency to simply mimic sports in the weightroom. I suggest you question this when you see it done, and be polite and helpful with your constructive suggestions.