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Training Advancement and Adaptation

Mark Rippetoe

The most fundamental concept in exercise is adaptation, the response of the human body to physical stress. And the most fundamental concept in exercise programming is the way adaptation varies among athletes at different levels of training advancement. The only thing hard to understand about them is why these two perfectly obvious principles go largely ignored by the vast majority of people who practice within the field of exercise programming. Strength coaches and personal trainers, exercise physiologists, physical therapists, and athletic trainers routinely "plan" exercise programs for people with no regard for these most logical and obvious derivatives of the basic nature of animal physiology. This must stop. We will stop it.

The term "stress" is quite familiar to those of us with a job, responsibilities that are sometimes difficult to fulfill, or three girlfriends. In physics, stress is the force that causes deformation in a system, and the deformation is referred to as "strain." The stress may be the force of a snatch dropped on the platform from overhead, and the strain may be a bent Eleiko bar (but wait, that just cannot happen). In physiology, stress is that which causes an adaptation in a system. The adaptation to the stress of a shovel handle might be calluses where the handle rubs. But blisters might also form, which would indicate a stress that exceeds the capacity for adaptation. Notice that neither calluses nor blisters form on the other side of the hand—stress, and the adaptation to it, are specific. The phenomenon of adaptation to stress was first described in 1936 by Dr. Hans Selye in a paper that appeared in the journal *Nature*. The basic gist of the paper is that when stress is applied to a viable physiological system, the response is either adaptation through supercompensation (calluses when the stress is of a magnitude that can be adapted to) or a failure to adapt (blisters where the calluses would have formed if you weren't so pig-headed about insisting on wearing your gloves). In dire circumstances, failure to adapt means the death of the organism. For athletes, it usually just means overtraining, a mere inconvenience in the grand scheme of things unless an endorsement or a pro contract is lost in the process.

So, the process by which strength and performance are accumulated is one of stress and adaptation. As is true with most systems that improve with accumulated change, the farther away from the predetermined limits of potential improvement the system is, the more easily and rapidly the system improves. And conversely, the closer the system is to that limit, the harder and slower improvement occurs. Predetermined limits to improvement within a mechanical system are due to the physics that govern the operation of the system; for a physiologic system the limits are genetic.

In either case, the approach to these limits is asymptotic: the closer you get to the limit, the harder it is to get closer, the longer it takes, and the more it costs in terms of effort and (usually) expense (see figure). The time between not knowing how to write your name and being able to compose a complete paragraph is only about six years; it has taken another forty or so to achieve the high pinnacle of literary ability evidenced herein by your author. A much, much, much better

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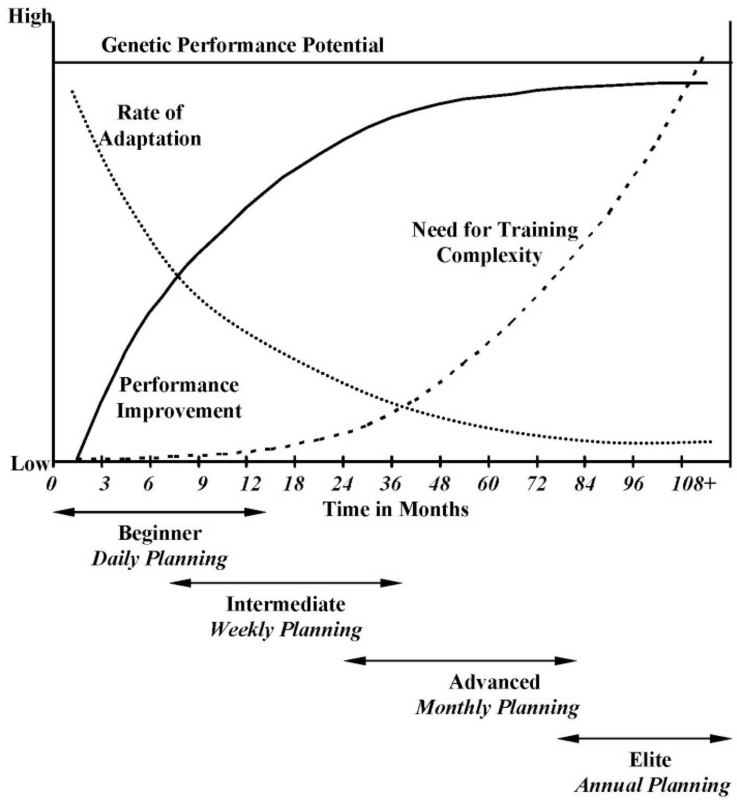
illustration is automotive performance. Factory spec is often 130 mph these days, with 160 attainable with the purchase of some extra stuff. If 180 is the goal, way more stuff is necessary, and 185 requires more stuff than most people can afford; 200 is unattainable by a production chassis and drive train.



This is an example of the principle of diminishing returns, immediately recognizable in nature as a rather common thing. It applies quite specifically to physical training, and is obvious to anyone who has trained athletes through the progression from novice to advanced. Novice trainees get strong/fast/quick/agile/skilled very rapidly; intermediate-level trainees improve more slowly; and advanced athletes, who have begun to closely approach their genetic potential for development and improvement, progress even more slowly.

If we are going to postulate a pattern of approach to a predetermined genetic limit, we'd better define what a genetic limit might be. Genetic potential could be understood as the inherited ability to adapt to a certain level of imposed stress, a capacity that will permit a commensurate level of performance. Individuals with a high level of genetic potential to perform under particular types of stress can excel in sports or activities that demand a high level of adaptation to those stresses. A person with a high percentage of fast-twitch muscle fiber, a dense neuromuscular system (a high density of motor neurons to muscle fibers), advantageous anthropometry that provides for efficient leverage against external resistance, a natural psychological capacity for pain tolerance and adherence to a task (personality being a strongly genetically-influenced trait), and a good enough cardiovascular capacity to function under the conditions that exist at high peak loading would be said to have "good genetics" for Olympic weightlifting. This same genetic profile in a person of exceptional size, with the added benefit of big hands and an ability to handle a lot of Scotch whisky, would indicate "good genetics" for Highland Games competition. Conversely, a person with a high percentage of slow-twitch fiber, a naturally high aerobic capacity (composed of several different characteristics that contribute to the ability to transport and metabolize both O_2 and metabolic substrate), an average stature and fine skeletal structure would have "good genetics" for race walking. Genetic potential is specific to the activity that the genetic capacity predisposes toward. Quite obviously, the more pronounced the degree of skew toward either the aerobic or anaerobic end of the metabolic continuum, the less capable the individual would be at anything else. Elite weightlifters make lousy marathon runners, and this is good.

Many individual aspects of performance ability are a function of genetic endowment. Neuromuscular quality is probably the easiest to observe. The ability to recruit motor units into contraction is largely determined by the number of motor neurons that are hooked up to the muscle fibers and the percentage of these fibers that are classified as type IIb, the permanent fast-twitch variety. This morphological feature cannot be altered by training any more than eye color can. Vertical jump is an excellent test of this inborn characteristic, and kids with very efficient neuromuscular systems will display an above-average vertical jump at an early

age. Individuals with a preponderance of slow-twitch, sparsely-innervated muscle will display poor vertical jumping ability forever, and no amount of training can change this. A person with a 10" vertical will never have a 30" vertical, and most likely never even get to 15". My guess is that vertical jump can be improved about 25%, but I'm not a track coach and other more qualified people might have a better handle on it. But I'll bet I'm not far off.

The principle of diminishing returns leads to some obvious conclusions about training. For instance, changes in the rate of progression from novice to advanced might not be quite so obvious to coaches who work only with advanced athletes, since they have no experience with the process. The strength coach who has developed his programs having only worked with college athletes at the D1 level may very well have no appreciation of the fact that most 15-year-old kids can add ten pounds to their squat every workout for two months, and should do so to take advantage of this ability while they have it. The strength coach who started at the college level and moved to the rather rarified ranks of professional sports may be under the impression that machine training is actually useful for sports performance. Such a coach has never worked with anyone other than advanced or elite athletes of exceptional genetic potential and therefore sees a decidedly unrepresentative sample of the population. He may very well have no idea of the vast gulf that separates exceptional native ability from performance earned the hard way by those of more average genetic capacity—people he'll never see on his team. He may actually think his athletes are strong because his one-set-to-failure Hammer Strength machine program works so well.

It is also true that the novice trainee who can add weight to each barbell exercise every workout is wasting time if this does not occur. The first part of the progression from novice to advanced takes place quite rapidly, precisely because the organism is so thoroughly unadapted to any stress at all. The difference between a completely unadapted trainee and that same individual at his advanced level varies with the genetic potential of the individual ("advanced" refers to training history, not absolute performance), but in every case the unadapted individual makes progress rapidly because any stress at all will cause an adaptation. Riding a bicycle will improve the rank novice's bench press, and jogging three miles will improve his squat, even though this obviously daft approach would never work for a more adapted trainee and would never work very long for anybody. Novices respond to everything precisely because they haven't adapted to anything yet, and any stress, even what will later be considered the wrong stress, will cause an adaptation toward greater fitness. Couple this with the fact that novices are not strong enough to use weights heavy enough to prevent rapid recovery (unless heinous abuse by an inexperienced or insecure coach occurs), and you have the perfect recipe for rapid progress.

This positive response of novices to nearly any physical stimulus has caused a lot of silly research to draw a lot of ridiculous conclusions. If your study population is untrained college freshman males with no previous sports background enrolled in a weight training class for the first time who volunteer for the study because they fit these criteria and are being given a better grade for participating, I submit that any exercise protocol you try on them will work pretty damned well. If your study population is untrained sedentary adult females between 55 and 65 years old, leg extensions and leg curls might very well appear to work (at least for strengthening the quads and hamstrings) as well as "squats." This is especially true if you think that "squats" are done to a nearly—but not quite—ninety-degree knee with the toes pointed forward while looking up at the ceiling, inhaling on the way down and exhaling on the way up. (It pisses me off to even write this.)

The progression from novice to advanced must necessarily go through an intermediate phase, during which some of the characteristics of novice-level adaptation ability are lost on the way up toward the limits of genetic potential. Novice training properly takes advantage of the unadapted organism by using rapid linear increases in training loads for the major exercises. The novice can recover well enough between workouts that more weight can be lifted each time, and is not strong enough to exceed his recovery capacity under the conditions that allow linear progress to occur. During this period, both strength and the ability to recover and adapt are developing. But when enough progress has taken place that the amount of work that can be administered during one workout is insufficient to stimulate further progress, and when the amount of work that would stimulate progress cannot be recovered from between two workouts, the trainee is an intermediate. At this level, the trainee has developed the ability to apply enough stress to the system that a

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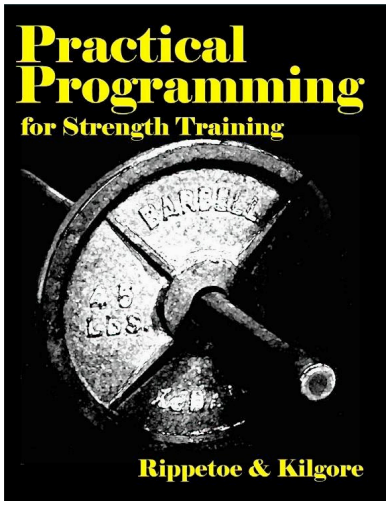
longer period of time is required for recovery than the two-day period between two workouts. Intermediate training utilizes weekly organization rather than workout-to-workout increases, enough time to apply sufficient stress to cause an adaptation as well as sufficient time for recovery.

Advanced athletes are those for whom more complex training than the weekly programming of the intermediate is necessary. They have chosen a sport in which they compete and are actively trying to win those competitions. Advanced athletes have made the commitment in time, money, and personal sacrifice for the sake of athletic excellence, and they have progressed to the point that the limits of genetic potential must seriously be considered, in terms of what can be accomplished and what the athlete is willing to do to accomplish it. Complex manipulation of all training variables is necessary to ensure the continued ability of these athletes to make progress; this progress is hard won and even harder to keep. The advanced athlete walks a razor-thin line between training at a level high enough to progress in tiny steps toward the best performance possible and the quite high probability of injury, overtraining, or both.

Most trainees are novices, since at any given time the greatest majority of the training population has just started. The sad fact is that 95% of all the people who start training with weights never advance beyond this level, most likely because their training is not managed correctly at this time, and they do not get the results they both want and need to stay motivated to continue. Novices make the most progress most rapidly; most of the people who ever lift weights will make most of the progress they ever make during the novice period of their training. Intermediate level trainees have specialized their training toward a sport or training style, and advanced athletes are by definition competitors in a sport; the vast majority of the human race will never achieve this level of training advancement, and has no desire to do so. So novice training is, and always will be, the most important training you either do or teach others to do.

These are the consequences of the fact that your response to training depends on where you are on the road from novice to advanced. Any plans, programs, or projections made without recognition of this fact will not work as intended. Any research conducted without deference to this fact is invalid. Most importantly, any athlete trained without respect to these principles will fail to achieve what he is capable of.



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