
CHARLIEFRANCIS.COM
THE STRUCTURE OF TRAINING FOR SPEED

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PRESENTS

STRUCTURE OF TRAINING FOR SPEED

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THE TRAINING "PROBLEM"

Training for any sport is a complex process. The novice athlete may not know where to start; the intermediate athlete often gets "stuck" at that intermediate level; and even the most advanced athlete is almost always subject to certain poor training practices that distract from the training goal and inhibit his ability to achieve an elite status in his given sport.

Training for any sport is equally an involved, interdependent, and multi-dimensional process. Body mechanics, speed and strength considerations, and techniques particular to each sport all factor into the training equation, and no successful athlete ever succeeded without mastering each one of those elements. But before we examine the details, there *is* a clear place to start any discussion on speed training.

This is the training problem, the question of how and when we should train, and why we should do it in this way. The structure of a particular program always varies athlete to athlete, sport to sport, but the fundamentals of speed are essentially inalienable. Unfortunately, coaches and athletes are constantly either uninformed or misinformed – hence, the training "problem." The correction of the bigger picture, and an understanding of the theory behind it, is absolutely necessary before the smaller details can be perfected. Good power and technique out of the starting blocks is useless if the sprinter is fatigued on competition day. Superb endurance is rendered virtually useless if the swimmer's top speed is simply not up to par with competing athletes.

When discussing different successful training programs, there is no "right" or "wrong." Comparing successful programs should be a history lesson, not a debate. Any change to a successful program carries with it the risk of introducing undesirable side effects. Athletes are "plastic" to training input. That is, while we can exchange ideas based on successful training programs from the past, any recommendations for change with top athletes bear the risk and potential for ruin.

This guide to the structure of training for speed will outline the mistakes (historical and personal) commonly made by athletes and coaches. Then, it will suggest a *proven* solution to the training "problem."

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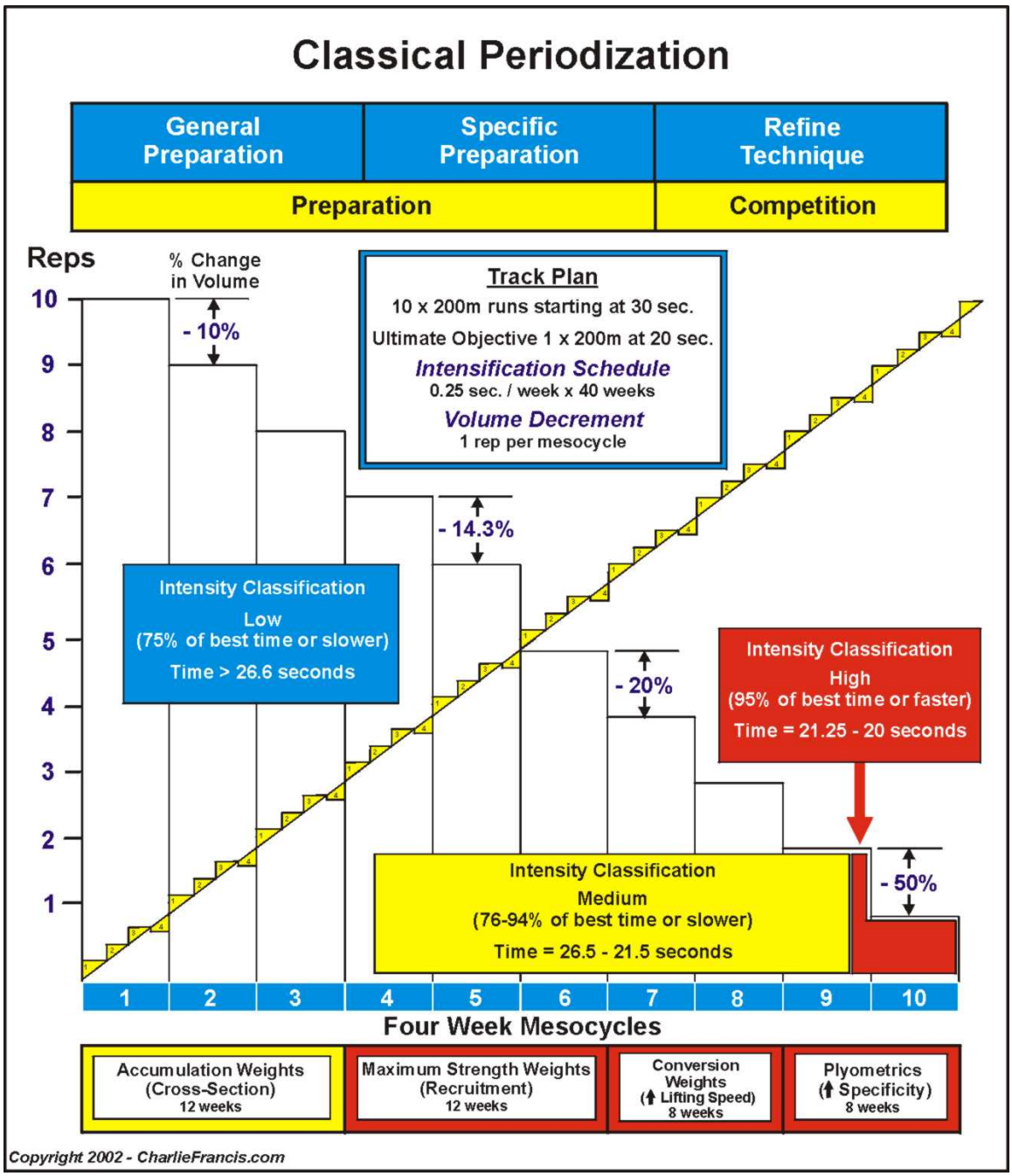
CLASSICAL PERIODIZATION: THE ROOT OF THE PROBLEM



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An Introduction to the Model

Intuitively, the concept of classical periodization makes relative sense. Its dual tenets – general improvement and specific perfection – are ultimately the goal of any athlete. However, while such an oversimplified, underdeveloped training program may have been adequate in the 1920's, it is implicitly clear that such a scheme is inadequate for today's athlete, in today's competition.

Yet still in various track and field programs around the world, classical periodization models are followed for advanced athletes. In professional, college, and amateur sports in Canada and the United States, coaches are saturated constantly and from the start of their careers by misinformation that leads them to follow and preach the so-called benefits of classical periodization. And so the cycle continues: athletes injured, confused and unable to perform to their personal potential.

The diagram on classical periodization outlines a rather simplistic program of classical periodization. The first and primary view of classical periodization is a shift from general preparation to specific preparation (and ultimately to the refining of technique), as well as a shift from slower to faster, less intense to more intense, simple to complex. In its simplest terms, classical periodization is a shift from worse to better – a reasonable goal – but is problematic in the *means* by which "better" is achieved as well as the *limitations* it imposes as to how much better an athlete can perform.

The shift from general to specific is clearly evident in team sports such as gymnastics, where gymnasts first focus on general fitness, before perfecting the individual components and disciplines of a routine, and finally refining technique and combining the perfected components to perform a polished routine. As with a gymnast, a sprinter would refine technique mostly during what is called the *competition phase*, a period where training continues but is interspersed with actual competitions. Of course, the lines between general and specific preparation, specific preparation and refining technique, are somewhat blurred, and there could certainly be some specific preparation in the competition phase or several sessions where technique is refined during the preparation phase.

The Volume-Intensity Equation

Clearly there is more to classical periodization than simply shifting training from general to specific. In the diagram, a sprinter has the goal of improving his 200 metre time to 20 seconds, through a strict schedule of intensification. Each four-week *mesocycle* (from the Greek *meso* meaning moderate), the athlete is scheduled to improve by one second. Each weeklong *microcycle*, the athlete then, is expected to progress by an average of .25 of a second, although there would be little if any improvement over the final week of the mesocycle, which is intended for stabilization and consolidation, and involves little intense work. Thus with a one second improvement per mesocycle, the athlete has the objective of

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intensifying from a 30 second 200-metre time at the start of the training period to being capable of running a 20 second 200-metre race at the end.

While the intensity will be increased each mesocycle, the volume that the athlete runs will be sharply decreased over the training period. The athlete starts by running ten repetitions at 30 seconds per training day, but will decrease his volume by one repetition each mesocycle, thus running nine repetitions at 29 seconds, eight at 28 seconds, and so on, eventually running just one repetition per training day at 20 second intensity. This volume-intensity tradeoff theoretically is what allows the athlete to improve his 200-metre time without feeling "burned out." Proponents of the classical periodization scheme explain that intensity has a markedly larger effect on the CNS than volume, and cite this as rationale for decreasing the volume of work so drastically as intensity increases.

In this instance, the runner likely already has the capability of running 20.5 to 21 second 200-metre sprints at the start of the training period. Thus at approximately 26.5 seconds and slower, the sprinter would be running at less than 75% of their best time, their maximum. Runs done at this speed could be termed *tempo* runs, as they would not directly tax the CNS. Between 26.5 and 21.5 seconds, 76%-94% of their best time, the sprinter would be running at medium intensity. It would not be until the last one or two mesocycles that the sprinter would actually be running at over 95% of their best time; that is, running at high intensity.

Strength Training in Classical Periodization

Of course, weight training plays a vital role in sprinting as in most other sports. The periodization of weight training is an important component of the classical periodization model. In the diagram, the athlete works on accumulation weights for three mesocycles. Accumulation weights improve the cross-section of the muscle and add general bulk and power. They are customarily performed at medium intensity, with fairly numerous repetitions.

Maximum strength weights are also lifted for three mesocycles, at high intensities and low repetitions. They change the composition of the muscles, and the cross-linking between muscle fibers. While overall bulk might not be increased during the maximum strength phase, muscle density almost certainly will.

The next phase is that of conversion weights, lasting two mesocycles. The goal of lifting conversion weights is to offer a speed transition in weight training that mirrors the speed transition in running. In theory, because during the conversion phase weights are lifted at a higher velocity (often a 20% increase in velocity countered by a 20% reduction in mass), the sprinter will be better equipped to adjust to the increased speed demands forced on his body on the track.

The final two-mesocycle phase is *plyometrics training*. Plyometrics are any exercise where the muscle is contracted eccentrically then immediately, concentrically. They are an excellent way to increase power, especially out of the starting blocks, and include explosive hops, jumps, and skips.

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Classical Vertical Integration

Inherent in any classical periodization scheme is the training theory of vertical integration. Classical vertical integration specifies that high-intensity work in the various training components (plyometrics, maximum strength weights, speed work etc.) be spread out so that no two high-intensity elements are performed at the same time.

The theory itself is in essence a logical one: too much overlap of high-intensity components results in muscular and CNS fatigue. As much as an athlete might like to perform twenty bench presses at maximum after running ten 70-metre sprints at 95% or over, this is simply not feasible. The athlete's CNS will be overloaded, recovery time will be inordinately lengthy, and the athlete will risk serious injury in the process.

As you can see in the diagram, the classical periodization model attempts to subscribe to the benefits of vertical integration. The first three mesocycles feature little high-intensity work, and are engineered to improve overall fitness and strength. There would be little risk of CNS overload. The next three mesocycles involve maximum strength weights, which indeed would tax the CNS and result in muscular fatigue.

But proponents of the classical periodization scheme would suggest that because the speed work is being performed at below high-intensity, the athlete would be able to withstand the high-intensity weightlifting. Indeed, muscular density gains in this period of classical periodization have proven to be quite dramatic, for the simple reason that nothing is present to obstruct the weightlifting work. It follows then for the final four mesocycles that as high-intensity speed work is introduced, the intensity of weight work (conversion weights and then plyometrics) is reduced. Ergo (according to the party line), the athlete is able to maintain his strength through a lower intensity of weight training, but is also able to make relatively unobstructed speed gains. QED?

Not exactly, not nearly. There are several glaring drawbacks to the classical periodization model, problems that still often occur in other more modern, advanced training programs.

The Volume Problem

The first problem is in respect to the volume of training, or more accurately, the loss of volume in classical periodization that allows for the target intensification. As the diagram illustrates, 10% of total volume is lost when the repetitions are dropped from ten to nine after the first mesocycle, 14.3% of total volume is lost between the fourth and fifth mesocycles, 20% is lost between the sixth and seventh mesocycles, and a startling 50% of total volume is lost when the athlete performs one repetition instead of two in the final mesocycle.

The total drop – 90% – is dramatic, but so are the individual reductions. The implications of such reductions are enormous: even if such a scheme could theoretically work, it could only work for a brief period. The reductions in workload are so substantial, in order to create the intensification, that by the time

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the athlete has reached his target intensity his overall fitness would be threatened, and he would be able to withstand that intensity for no more than two weeks.

A second equally serious drawback is the sheer lack of volume that results from a classical periodization scheme. Call the intensity-volume tradeoff whatever you want, classical periodization – and any other training program that follows similar philosophies – still waves a warning banner that reads “Not Enough.” It is unfortunate that more coaches and athletes do not pay heed to this banner.

Doing a simple calculation, even if the high-intensity speed work was performed six days per week over four or five weeks (a dangerous but not unlikely proposition), the athlete would only be running 1,200 metres per week, or just 4,800-6,000 metres per season at high intensity. Contrast this with Ben Johnson, who ran between 60,000 and 70,000 metres per season at high intensity, and one wonders how a sprinter under the classical periodization scheme could ever compete.

The answer of course, with few exceptions, is that he cannot. Perfection requires adequate exposure, and while large volumes of practice may not lead to perfection if the practice is of poor quality, poor quality of practice *and* low volumes will *certainly* never result in perfection.

Similarly, speed improvement is simply too technical for the simplicity of classical periodization. While in theory technique is refined over the final period (with the 4,800 metres of high-intensity work) in classical periodization schemes, Ben would have had his technique refined and his speed improved over 70,000 metres and an entire season. If an athlete is capable of running somewhere near a ten second 100-metre race, a substantial gain over a season would be a tenth of a second: one percent of his time. Clearly the benefits of a season of practice over a month would be enormous in finding the correct formula that would lead to these speed gains. They would not appear spontaneously after a month of training.

Moreover, an extended training period *at high intensity* provides for more learning opportunities. Just as a 100-metre race is run very differently and with different technique than an 800-metre race, a sprinter’s technique will likely evolve (and devolve) at high intensity versus low or medium intensity. Corrections of technique are almost unfeasible with classical periodization because they would need to occur over the space of little more than a single mesocycle, when he is running at high intensity and his actual race form is evident and on display.

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Intensification and the Training Goal

Another issue with the classical periodization scheme is the steeper intensification curve it requires for each component. While it might seem that any intensification is done gradually, in fact individual components are not spread out over the entire training period and therefore must be intensified rapidly. For example, because maximum strength weights are lifted over only three mesocycles, they must be intensified very steeply for there to be any effect. And in fact, the actually speed work is intensified extremely quickly, because the aforementioned .1 of a second gain must be achieved in the space of four weeks. While the injury risks posed by classical periodization will be examined in detail shortly, clearly a steeper intensification curve will be dangerous for an athlete.

This brings into question the overall relevance of the classical periodization model. To put it succinctly, the scheme is in the most part quite irrelevant; in other words, is generally not contributing to the target goal: a speed gain. While the classical periodization model may be of use to a beginner athlete, who needs to develop general fitness and strength over a protracted period, and who has never been able to run with quality technique or in competitive times at high intensity, it is of little benefit to an advanced athlete who already has the ability to run fast times. If the athlete already has the capability of running a 20.1 second 200-metre race, why spend the vast majority of the season running between 22 and 30 seconds? This will not, ever, improve his time.

In respect to relevance this is clearly the larger picture, but one should also note the relevance of the weight-training exercises. Some who argue in favour of classical periodization insist that it allows athletes to perfect their, say, maximum strength weightlifting, because that is the sole high-intensity exercise during the period. Well, maybe so, but what runner needs to be a perfect weightlifter?

At a testing center with the best track and field athletes in each discipline, the shot-putters would likely win the standing long jump, measuring strength, and the distance runner would likely win the VO2 Max. test, measuring endurance. The sprinter needs only to be capable in these exercises of fitness and strength. Conversely, every runner should aspire to be the fastest, reach the highest speeds. The only component that needs to be perfected, then, is speed work.

Retention of Training Components

Another drawback to the classical periodization model is the retention of training components, or lack thereof. Just as high-intensity elements result in more rapid gains, these gains are more rapidly lost. So while performing high-intensity elements during the middle of the training period may have benefit for that period and shortly thereafter, the benefits will certainly not accrue and be maintained for the entire training period and into the competition phase.

In the sample scheme, maximum strength weights are lifted for twelve weeks. The most liberal estimate to which point the strength acquired could be maintained is a further twelve weeks. At this point, though, it is clear that the athlete is just beginning high-intensity speed work, and the competition phase

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has not yet begun. By the time meaningful competitions are scheduled, the athlete's strength will have deteriorated to the point that he might as well not have done the maximum strength work in the middle of the season.

On a macro-level, there are further drawbacks. If the athlete performs under the classical periodization scheme for several seasons, the nature of the scheme is such that he will lose his strength and speed from a previous season. Under other models, where maximum-intensity speed work is run almost immediately, even at lesser volumes, the athlete will retain much of the speed from the previous year. Under this model though, the athlete will be unable to retain his speed; he does not even have a chance to, because he is running at such low intensity for the start of the season.

The muscular composition also suffers by the classical periodization scheme. Because the athlete is engaged in a substantial volume of medium-intensity work, some of his white-muscle fibres (used for speed and power) will be translated into red-muscle fibres (used for endurance). It is extremely difficult to shift muscle composition in the reverse direction, and overexposure to medium-intensity work could cause irrevocable damage to a sprinter's power potential.

Injury Risks and Recovery Inadequacies

A final, broad category of risk involved in the scheme is indeed that of injury. There are several categories of risk, which should be broadly outlined. The first was mentioned earlier: a steeper intensification curve. The steeper the intensification curve, the less time the body has to adjust to the increased force, the increased power that it needs to produce at output.

Another injury risk is involved in the final intensification period. If (as earlier suggested) an athlete attempted to perform high-intensity speed work every day (in order to have a chance to record the target speed gains), he would risk injury and be guaranteed of debilitating CNS fatigue. At a minimum, an athlete needs 48 hours to recover from CNS-taxing exercises; to expect him to do these exercises eighteen days out of twenty-one is fairly ludicrous.

But perhaps the most dangerous aspect of the classical periodization model is the transitions required between the strength phases. Because each component is not being performed at all times, there are fairly clear and sudden transitions. And while the transition between accumulation and maximum strength weights would not be overly problematic, the transition between maximum strength and conversion weights would be much more so, and from conversion weights to plyometrics, more still.

The injury risk lies in the conversion of the way the muscles are operated from phase to phase. When an athlete becomes stiff (as he invariably will become with the transition), it means his muscles are held in spasm. When muscles are held in spasm, they cannot contract, and thus cannot work to adapt to the altered workload. The objective benefits of the new strength element might be felt through the crossover effect, but even if injury does not result, the sudden transitions and resultant stiffness will leave the athlete unable to directly benefit for at least a week until the stiffness recedes. Perhaps most troubling is that the

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risk increases as the athlete nears competition period, just when he can afford it the least.

Having demonstrated that classical periodization is a faulty model for all but the beginner athlete, it logically follows to determine a more amenable solution to the training problem.

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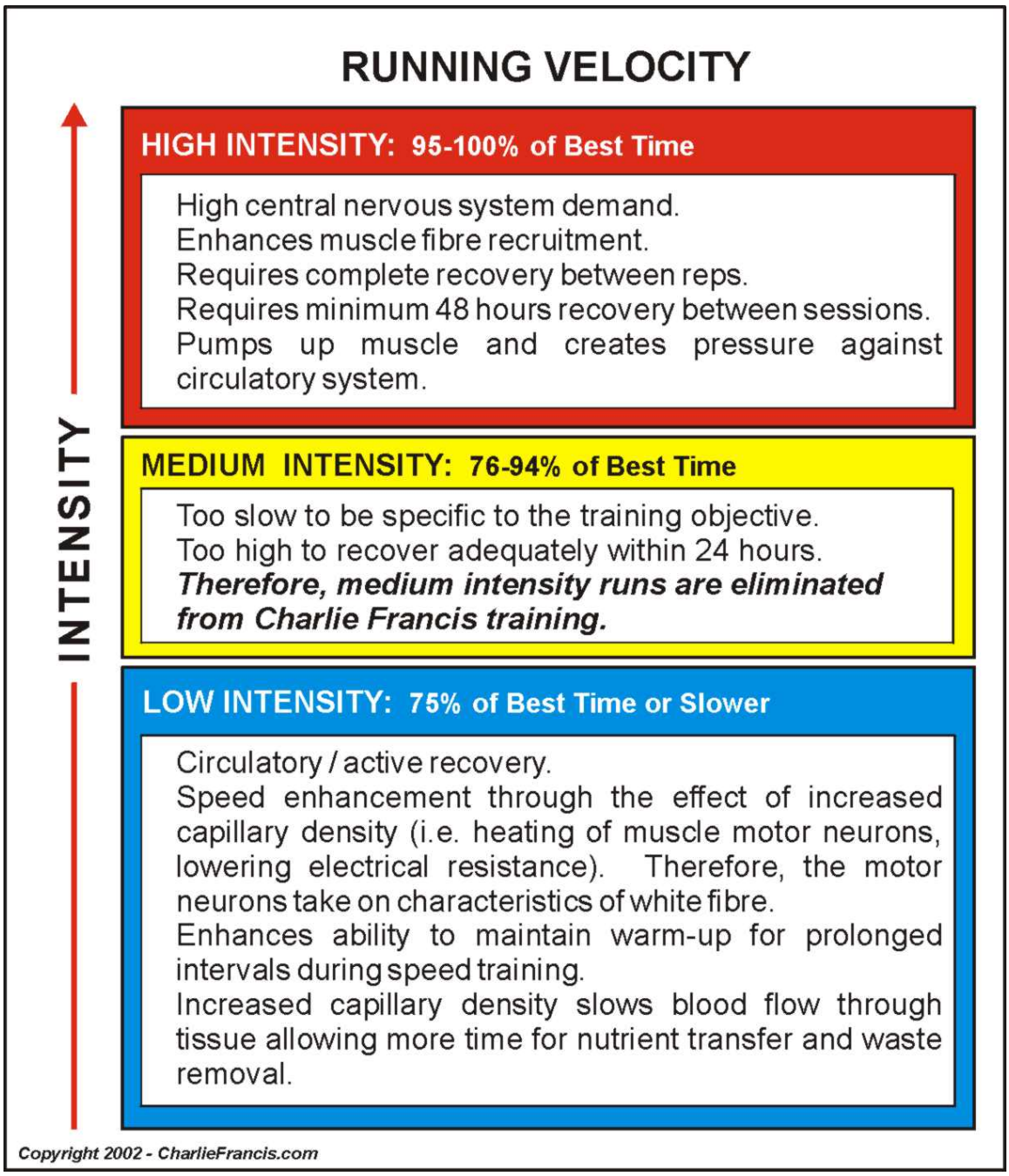
TRAINING INTENSITY



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The Intensity Problem

Once you have a talented athlete with the potential for improvement, and you have found a training program that works for that athlete, you simply go back and repeat the process. However, the intensity of the work will continue to increase. Once the quality of performance (in training and competition) is clearly increasing, you need to adjust carefully to how the athlete is reacting. We will repeat again and again the importance of intensification. While this is clearly intuitive, the concept of intensification is also vastly misunderstood.

Clearly the most integral part of a training system that is intended to improve speed is exactly that, the speed work. In the classical periodization scheme, there is a uniformly shifting running velocity: that is, during a given week, there is no variation between low and high intensity runs. Between weeks, there is little variation, and always in a trend of increasing velocity. The fact is, an athlete would likely feel no different strain on her CNS or muscular system running at 27 seconds versus 28 seconds.

It is simplest to classify running intensities in three groups: aptly named low, medium, and high intensity. Low intensity runs will be classified as those that do not tax the CNS, and thus need 24 hours or less of recovery time. Runs performed at less than 75% of maximum (best time) are low intensity. Runs performed between 75% and 80% of maximum reside in a transition zone. They will not have large effect on the central nervous system, and an athlete may be able to recover from their effects within 24 hours. Generally, however, it is safer to term any run performed between 76% and 94% of the athlete's best time, "medium intensity." These runs may tax the central nervous system, not necessarily to a great degree, but enough to require more than a 24hour recovery time. The final category of runs is labeled "high intensity." High intensity runs are performed at 95% of maximum or over, and will tax the central nervous system quite appreciably, necessitating at least 48 hours of recovery time.

In the diagram of classical periodization, it is apparent that approximately 35% of the weeks involve runs that are performed at low intensity (runs performed at over 26.5 seconds). Then, 50% of weeks involve runs performed at medium intensity (26.5 to 21.5 seconds). Finally, the runs performed at 21.25 seconds and lower are of the high intensity category. These make up just 15% of the total weeks, including recovery weeks. If volume is taken into account, approximately 109,800 metres are performed at low intensity, 84,600 metres are performed at medium intensity, and just 4,800 metres are performed at high intensity. Unbelievably, in the classical periodization scheme that was illustrated, less than 2.5% of the total volume is performed at high intensity, specific to the training objective.

So what is a more relevant system? What is a more effective balance of speed intensities? And *why* is this system better?

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Characteristics of Speed Intensities

High intensity runs are, essentially, the training component that results in speed improvement. They are intended to simulate a race environment, in that they are performed at a working intensity 95% or higher of that which would be run in a race. As noted, they have a high demand on the CNS, and require at least 48 hours of recovery between sessions. However, when performed properly, with adequate recovery, they have a number of benefits, including the rehearsal of high-speed components, the enhancement of muscle fibre recruitment, and, eventually, the expansion of the athlete's alactic envelope.

An athlete runs a different race at different velocities; indeed, there is a drastic change in biomechanics between a runner performing at 96% and 91%. At the greater velocity for example, a sprinter will feature greater leg extension, hips raised higher, and much briefer ground contact. Because the biomechanics are so different depending on the velocity, an athlete can only properly train for competitions by simulating high speed runs in training. In respect to muscle fibre recruitment, high intensity speed work increases the number of fibres involved in any given contraction, so with each step, the athlete is able to summon more force to accelerate or maintain high speeds. High intensity runs would make a significant percentage of a sprinter's training, approximately 35% of speed work, depending on the athlete's CNS capacity and discipline(s).

Medium intensity runs are involved in many training systems, including the classical periodization scheme examined earlier. However, their effect is almost exclusively detrimental and they should be eliminated from any athlete's training regimen. They will never be specific to a training objective simply because a sprinter will never win a race at 85 or 90% of her best time; nor will a defensive lineman be able to get off the line quickly enough to reach the quarterback using 80% of his power. Moreover, they will almost certainly tax the athlete's biomechanical functions enough that the athlete will be unable to perform high or medium intensity drills the next day. The athlete has a continuum of exercise, and if she uses too much of her energy in endurance-type efforts, her power and pure speed will be adversely affected. Her muscles will not be able to adequately recover within 24 hours.

Also worrying is that medium-intensity runs may translate white-muscle fibres into red-muscle fibres, because they most closely simulate endurance efforts. Medium intensity runs preserve none of the benefits of high intensity runs, but maintain many of the risks and invent more besides. If an athlete is ready to peak, runs performed at 95% intensity are easy yet still in the high intensity category, meaning that relevant foot contact times, hip rotations and other technical elements would all be rehearsed.

Experiments in 1980 into the benefits of medium intensity runs confirmed this hypothesis. Intermediate speed work caused interference with the quality of special endurance runs and caused too much volume on the track, as medium intensity runs were too fast to be done on grass. While you should expressly discouraged from performing medium intensity speed work, if you decide for whatever reason to venture into the intermediate speed area, you should make sure that they are performed in place of a high intensity session, rather than a

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tempo session. There is no way an athlete can recover from intermediate speed work to perform high intensity speed work the following day.

Low intensity (tempo) runs *are* a vital component of a speed training system. They do not tax the CNS, and result in little muscular fatigue as well. Although some claim that because they are not specific to a training objective, low intensity runs may also be eliminated from a training system, they have proven to have a number of training benefits.

The first is recovery; performed on “low” days, low intensity runs aid in CNS recovery by abetting circulation and engaging muscles. But low intensity runs can also have benefit in respect to speed enhancement. Low intensity runs increase capillary density, which performs two functions: like tributaries of a river, burgeoning capillaries offer more routes deeper through the tissue, can generate more heat through all of the muscle areas, so exercise is more likely to affect all of the neurons; and like tributaries of a river, the blood is forced to move more slowly, facilitating waste removal and nutrient transfer, because the blood has more exposure time on the tissue. In many situations, low intensity runs can enhance an athlete’s ability to maintain their warm-up for prolonged intervals, improving training performance and diminishing the risk of injury. The enhanced circulatory system allows more blood to be pumped for a prolonged period, allowing more heat to be generated, and allowing it to be maintained for a longer period of time.

An athlete that was not extremely fit and has not performed significant quantities of low intensity work would not be able to tolerate Olympic conditions, where the athlete is forced to wait for extended intervals between warm-up and races. Low intensity runs often make up approximately 65% of a sprinter’s speed work in training.

High intensity runs are the “bread and butter” of a speed regimen, but low intensity runs play an important role on “low” days in that 48hour minimum recovery interval. Medium intensity runs, again, have no place in sprint training.

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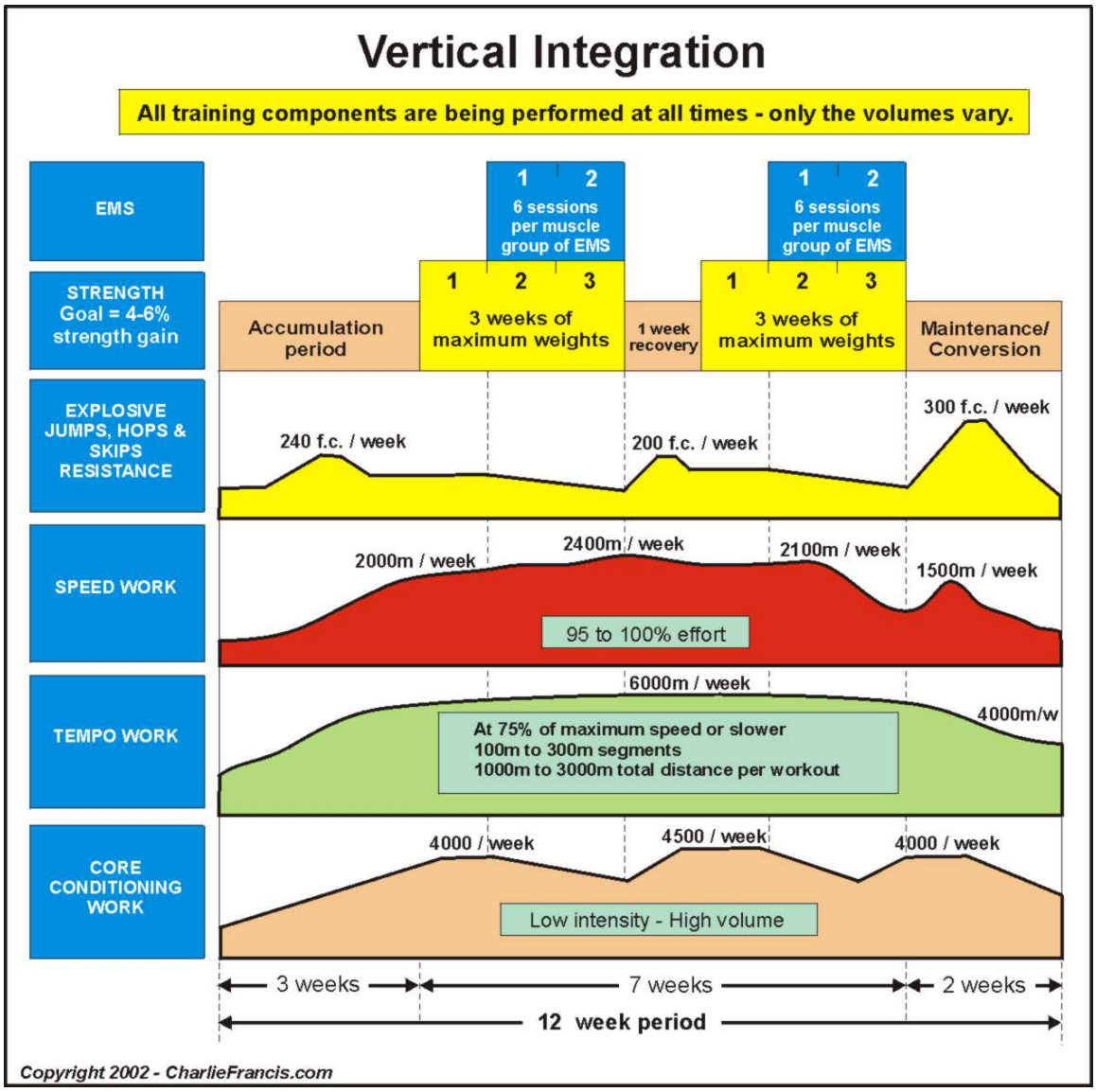
THE CHARLIE FRANCIS VERTICAL INTEGRATION MODEL



The Key to the Program

Vertical integration refers to the staggering of training components, intended to balance intensity and volume. In the classical periodization scheme, generally only one high intensity element was performed at a given time: when the athlete was lifting maximum strength weights, he was doing only medium or low intensity speed work, and when he was performing high intensity speed work, he was lifting no high intensity weights. However, as demonstrated earlier, such a vertical integration scheme is ineffective because it allows athletes to lose the capacities they had gained through work in high intensity elements.

An ideal vertical integration scheme is displayed in diagram 1.3, at right. It shows seven different categories of training, three of which – strength, explosive

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jumps (plyometrics), and speed work – constitute high intensity work with CNS demand. The electric current that is released in EMS (although the stimulation itself is intense) bypasses the central nervous system and thus has no CNS effect.

The key to this vertical integration scheme is that *all training components are being performed simultaneously, at all times*, and *only the volumes vary*, from week to week, from mesocycle to mesocycle. When speed work is at its maximum, and high-intensity plyometrics are being performed at significant volume, we observe that high-intensity strength components are being performed lightly, or are in the recovery stage. Similarly, when maximum strength weights become of greater focus, plyometrics are reduced and speed work is no longer at maximum volume.

Volume-Intensity Benefits of the Model

The benefit of maintaining all high intensity elements at all times should be obvious: firstly, it guarantees that strength or speed or power accrued will not be lost due to a prolonged downtime; and secondly, it allows for a longer period for improvement at each element. When high intensity speed work is performed for a short period of time in classical periodization, it restricts learning opportunities and curbs efforts to improve technique. But in this vertical integration scheme, deficiencies in technique can be assessed immediately, and practiced and improved for the entire training session.

Opportunity for advancement in speed, unlike the classical periodization scheme, exists over the entire training period, and so the athlete is realistically able to achieve the objective speed gains without risking injury in the intensification.

The positive aspects of the classical periodization scheme are kept on a smaller scale in this vertical integration model. On the micro level, there will always be some small intensification happening within each of the high intensity components. For example, the high intensity speed work would likely start in the majority with runs at 95% of maximum, best time. The runs will gradually increase in intensity until the first maximum strength weightlifting phase, when the intensity will stabilize and the volume will decrease in order for some CNS capacity to be freed up for strength gains. Then as volume of high intensity weights is tapered, concentration will be placed again on speed improvements and intensity will be increased. This intensification cycle will continue until the sprinter is performing all runs at close to 100%, when once again the volume will decrease substantially leading into competition period, allowing for maximum recovery.

In this way the positive benefits of gradual intensification are maintained, while also preserving the relevance of high intensity speed work. In fact, in this case, the intensification is many times more gradual than it was in the classical periodization scheme, when the athlete is expected to intensify in the order of ten seconds in just forty weeks.

Another somewhat obvious advantage of this vertical integration scheme compared to the classical periodization scheme is the sheer additional volume

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that can be achieved. Because the athlete is continuously performing high intensity speed work, over a twelve-week session he might perform over 20,000 metres of running specific to his training objective. This, in twelve weeks, while classical periodization might net him less than 5,000 metres of high intensity speed work over forty weeks.

Risk Maintenance and Observation

Earlier the dangers of injury risk in the classical periodization scheme were discussed. One of the most glaring involves the transition from weight-lifting phase to weight-lifting phase, high intensity element to other high intensity element. In particular, the transition from conversion weights to plyometrics is very risky. With these transitions, almost the best-case scenario has the athlete feeling prolonged stiffness, and being unable to train at high intensity for at least a week. Clearly the worst-case scenario has the athlete incurring a devastating injury, right near the competition phase.

But one of the principal gains by this vertical integration scheme is the athlete avoiding the stiffness that occurs during the adaptation to any new component by having each component always present, as opposed to simply adding them serially, resulting in a stiffness as one component replaces another in the training program. So even though at a given time a high intensity component could be performed at very low volume, so that it would not interfere with other high intensity components, there will be no stiffness when the component is reintroduced on a larger scale.

This vertical integration scheme also allows for increased exposure of fibre: exposing as much muscle as possible to each element of work. When a muscle is tight, a large percentage of its fibre will be contracted, meaning that it will benefit only indirectly through recovery mechanics and the crossover effect, but not directly from training element. But since the muscle will generally be looser in this vertical integration scheme, there will be significant direct exposure *at all times*.

The exact amounts of training required for a given athlete must be assessed intuitively, and through observation. There are several telltale signs that reveal that an athlete is at her limit for a given practice. One of the most important is the force at which her feet are hitting the ground: heavier than normal footfalls indicate that the hip is being raised too low off the ground, which suggests muscular fatigue. Other physical signs – poor form or posture, tense running etc. – can also let the coach know what the athlete will likely never tell him. But more subtle and nonphysical signs can be equally valuable in recognizing CNS fatigue. An athlete whose eyes are wandering or who is having difficulty following commands or responding to instruction is likely taxed to the edge of her CNS limit.

So no formula can supplant training presence and observation, and a keen eye for fatigue and muscle tightness. However, the principle behind this scheme – maintaining all elements while adjusting the demand of a given element – is universally applicable.

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FORMULATING A WEEKLY WORKOUT SCHEDULE

Sample Weekly Workout Schedule

HIGH	LOW	HIGH	LOW	HIGH	LOW	OFF
MON	TUES	WED	THUR	FRI	SAT	SUN

Weekly schedule with three high intensity days

MON	TUES	WED	THUR	FRI	SAT	SUN
Warm-up I & II Speed Work Starts & Runs up to 60m Explosive Med-Ball Plyos Weights	Warm-up I Tempo Runs Approx. 2000m Med-ball core work Ab session multi-pos'n	Warm-up I & II Speed Work Starts & Special Endurance 2 x 250m Plyos Weights	Warm-up I Tempo Runs Approx. 2000m Med-ball core work Ab session timed 30s on/30s off	Warm-up I & II Speed Work Starts & Runs at 80, 100, 120m Explosive Med-Ball Plyos Weights	Warm-up I Tempo Runs Approx. 2000m Hurdle walk-overs & overs-unders Ab session multi-pos'n	

HIGH	LOW	LOW	HIGH	LOW	LOW	OFF
MON	TUES	WED	THUR	FRI	SAT	SUN

Weekly schedule with two high intensity days

MON	TUES	WED	THUR	FRI	SAT	SUN
Warm-up I & II Speed Work Starts & Runs up to 80m Explosive Med-Ball Plyos Weights	Warm-up I Tempo Runs Approx. 1000m Hurdle walk-overs & overs-unders Ab session multi-pos'n	Warm-up I Tempo Runs Approx. 2000m Ab session timed 30s on/30s off	Warm-up I & II Speed Work Starts & Special Endurance Explosive Med-Ball Plyos Weights	Warm-up I Tempo Runs Approx. 1000m Hurdle walk-overs & overs-unders Ab session multi-pos'n	Warm-up I Tempo Runs Approx. 2000m Ab session timed 30s on/30s off	

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The Microcycle

One of the most shocking aspects of the classical periodization scheme outlined earlier is the demands that it will place on the athlete in the final high intensity phase. Although volume is reduced significantly, it is still extremely doubtful that an athlete could recover from such high intensity work in the space of 24 hours, day after day.

Vertical integration applies to the greater picture of the macrocycle; the decision to train for three – or two – weeks and follow this with a one week "rest and recovery" break constitutes the mesocycle. But without a straightforward plan for the one-week microcycle, all of the larger preparations and schemes are of little value. Too often a complete and straightforward season plan is defeated by a poorly-designed and inflexible weekly arrangement.

Diagrammed at right are several sample weekly workout schedules. These sample weeks would fall under the category of "specific preparation period" where the athlete focuses on more drills specific to the training objective. Days in the week are marked as "high" and "low." High days are those that incorporate a significant portion of high intensity work into the training. Low days are intended for recovery and involve greater quantities of tempo runs and core conditioning work. Of course, not all of the high days (or the low days) involve exactly the same exercises. In the two high intensity day schedule, Monday is devoted to short-distance speed work while Thursday is planned for speed endurance. Every schedule plans an "off" day on Sunday.

But two important questions still clearly need to be asked: first, which schedule do I choose? And second, how closely do I adhere to the written plan and when and how do I deviate from it?

Choosing the Right Schedule for the Individual

The former deserves a rather comprehensive answer. It is easy to say: "Use the three high intensity day schedule because it has worked for my athletes," but clearly it does not work for every athlete, in every situation. However, the three high intensity day schedule does offer some obvious benefits. It offers a balance between low and high days, three each, and thus allows for the 48hour necessary recovery between high intensity sessions. At the end of the week, when the athlete is likely most fatigued, the off day occurs naturally.

This schedule is of particular benefit for athletes requiring some speed endurance, but whose primary goal is pure speed: this applies to many sports, including the 100metre. Just as a runner uses different form at low intensity versus at high intensity, clearly a sprinter is going to run differently when performing longer-distance runs versus short runs. And if the athlete's event involves short distances, benefit derived from special endurance runs is evident but also limited.

As you can see, in the three high intensity day schedule, two of the high days are devoted to speed and power speed, while just one is devoted to special endurance. Of course, with the two high intensity day scheme or any other, volumes of speed endurance could be adjusted to place a greater priority on pure

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speed, but the three high intensity day schedule places the emphasis on speed from the start.

Although in comparison to the two high intensity day schedule, three days per week of high intensity work may seem intense, in reality the athlete is usually able to handle the three day schedule. The special endurance day, while it is of high intensity, taxes the athlete's CNS less than on the high intensity speed days. Thus even if the athlete is not completely recovered on Wednesday from Monday's workout, he will manage to perform at least some quantities of special endurance. Likewise, the Friday session is usually manageable because the special endurance work on Wednesday does not have as severe an effect on the athlete's CNS.

This knowledge, that the special endurance day has a lesser effect on the CNS, has often been disputed. One season, Angela Bailey participated in a study at the University of Toronto intended to measure recovery and the conditions that facilitated it. The researchers found that Angela was feeling better, and in general more recovered, when her lactic acid levels were higher. The researchers were shocked: lactic acid is released only during special endurance runs, and they expected that she would be able to recover faster from short-distance speed work. But common sense supports these results; in performing 600 metres of speed work, when does an athlete feel more tired: after two repetitions of three hundred metres or after ten repetitions of sixty metres? Anyone who has ever trained would know that clearly 10x60 is more taxing on the central nervous system.

The two high intensity day schedule can also be very useful. Generally, it should be used when an athlete is recovering from an injury, when she is going through a period of high stress and fatigue, or when high degrees of flexibility are desired.

Allowing 72 hours between high intensity sessions offers clear advantages but can also offer clear disadvantages. On one side, the athlete is almost sure to be recovered and is exposed to a reduced injury risk. On the other, of course, the athlete by virtue of training on fewer days per week has less opportunity for refining of technique, practice, and learning new elements.

The four high intensity day schedule certainly has its proponents, but it also the riskiest schedule. Naturally, the athlete gains from the same opportunities that the two high intensity day athlete sacrificed. However, scheduling two high intensity sessions on successive days is very problematic: either the athlete will not have adequate time to recover and will risk injury, or else workload will have to be reduced so substantially on one of those days that there really will be no derived benefit from the extra day.

Sometimes, coaches who think their athletes are "behind" will use the four high intensity day schedule. And while this can be quite dangerous, when monitored closely, an athlete may receive some gains from this more intensive schedule. The mesocycle with a four high intensity day schedule would most likely have to follow the 2-1 work-recovery scheme, or the athlete would be substantially overloaded with high intensity work.

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Variations Within the Microcycle

If one communication needs to be made regarding the weekly schedule, it is this: do not regard any of the schedules on the opposite page, your own schedule, or anyone else's, as some sort of divine gospel. If an athlete looks tired and feels tired, she is probably tired, irrespective of whether she has finished all ten bench presses or performed every one of the pre-mandated special endurance runs. There is absolutely no reason to "just finish this set" or "give it one last push;" the athlete has much more to lose by overstretching her capacity than to gain by running another 150 metres.

Another common error is postponing work that was not completed. That is, if Sally did not finish all twenty of her starts, she will simply do more of them the next day, or the next high intensity day. Unfortunately, Sally, just like any other human, has a finite capacity for exercise, a finite amount of energy. If she was unable to complete the work one day, there was a reason: she did not have the necessary energy! Once a day is gone, it is gone; Sally and her coach must simply cut their losses and move on.

Of course, schedule flexibility should extend to removing entire days from the athlete's schedule, or shifting days around if the athlete needs more recovery time. High intensity work requires a *minimum* of 48 hours of recovery; sometimes, depending on the circumstances, the athlete will need more than one low intensity or off day to recover from it.

The off day has always posed an interesting dilemma for many coaches: since high intensity work is the only work specific to the training capacity, why shouldn't the athlete simply eliminate low intensity days from the schedule and convert every low intensity day to an off day? Of course, we have already explored the benefits of low intensity work in the section on running velocity.

Although as always, the schedule should be flexible, the most probable place where off days and low intensity days would be switched would be on the four high intensity day schedule, when low intensity work would replace the off day. In the four day schedule, an athlete would likely have a greater need for fast and complete recovery, and a properly-designed low intensity day will facilitate recovery more than an off day ever will. The value of low intensity days should never be underestimated; the benefit of an off day in any schedule is more as a mental break from training – a day off work, so to speak.

Even the weekly cycle need not be set in stone. A common variation of the two high intensity day schedule has the athlete negating the Sunday off day and using that as a high intensity day. Then, the following week, Monday and Tuesday would become low days and Wednesday a high intensity day… and the pattern would continue. In this variation the mesocycle would still follow the three-one or two-one work-recovery scheme, but the weeks themselves within the mesocycle would each be different.

In other cases, an athlete is realistically unable to train all seven days of the week – perhaps, like Angella Issajenko, she has a child that needs to be taken care of; perhaps the athlete takes college classes three days a week, or has a job – in such cases, high intensity sessions are the number one priority and some or all of the low intensity days are transformed into off days.

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Realistically, too, outside stresses on a given day will play a major part in an athlete's workout. Few athletes are millionaires, and even then money alone has not been proven to cure all of life's petty ailments. Breakups, money troubles, even bad traffic, can impact an athlete's tolerance for CNS activity, and must be taken into account when designing and adapting a weekly workout schedule. The worst type of weekly scheduling is invariably the most prescriptive.

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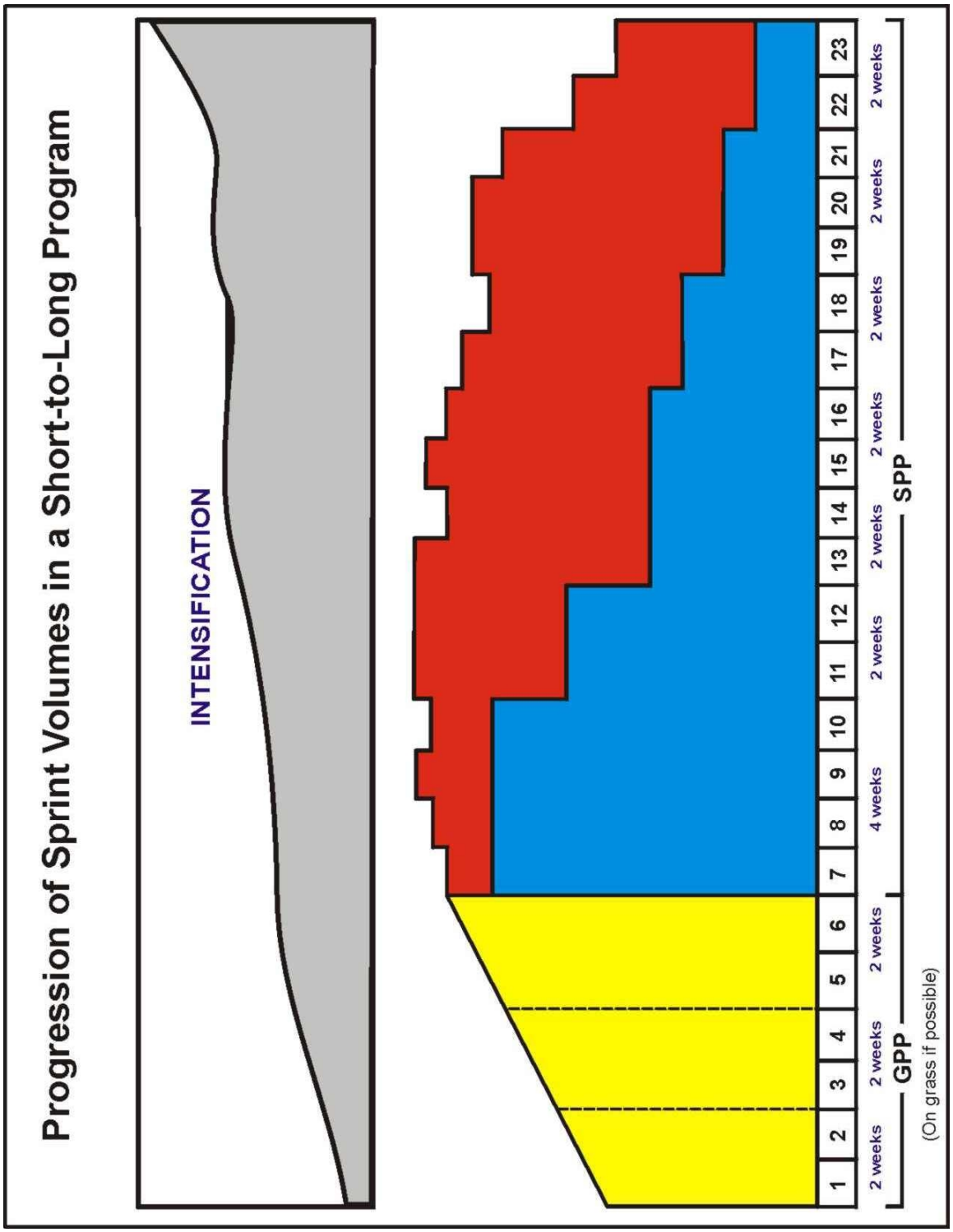
THE BIG PICTURE: SPEED EMPHASIS AND TRAINING SCHEMES



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An Introduction to Short to Long, Long to Short, and Triple Periodization

Ben Johnson followed the short to long approach and the triple periodization scheme, and as he was one of the most successful athletes to ever race, and inarguably one of the fastest men ever to race on the planet. It would be easy to universally accept this approach, but in fact the distinctions between long to short and short to long are far more complex than one is "right" and the other is "wrong," and indeed even the triple periodization scheme is not right for everyone either.

The speed emphasis and the training scheme are closely linked. The speed emphasis for Ben was the "short to long" approach, and the training scheme is triple periodization. But what are these approaches? Are they ideal? And are they ideal for everyone?

The short to long speed approach very literally refers to a program that first focuses on short runs, and then later on long runs. This may seem at odds with the right to left approach, but in fact the two approaches do not conflict. The right to left approach explains that an average sprinter has more to gain by performing longer runs initially, because that is where the majority of his time differential from the top sprinter resides. This is still true. But the short to long approach is geared towards later in the career of a sprinter.

Certainly Ben, as an established elite sprinter, had no need to focus on a time differential due to lack of fitness or endurance; after a short general preparation period (at the start of training sessions), he would be as fit as any 100metre sprinter in the world.

The triple periodization model calls for, again quite literally, three periods of work. Each period is made up of a training period and competition period, with a recovery period between each training block. This recovery period, unlike the recovery week at the end of each mesocycle of training, would likely be simply a week to a month off. Because there is a prolonged period where the athlete will not be performing any activity, every training period requires a general preparation period and a specific preparation period.

Explaining the Periodization Models

In the first period (October to December) the general preparation period might be relatively long, because the athlete has potentially taken all of September off, and will not be in optimal form for high intensity work. The periods are governed and directed by the competition periods. The main reason for the first training period being the longest, and the second longer than the last, is simply the intervals between competitions. Logically, as the sprinter nears the end of his training, he should be at his peak for the training block. The benefits of training accrued, he is free to use them in competition.

Between the main outdoor meets in July and August – the ultimate goal – and the indoor meets in January, February, and March, there is a long period of time… so the training period is longer. Between the May/June meets and the July/August meets there is clearly less time for training, so the training period is shorter.

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In each training period of triple periodization there are the aforementioned mesocycles and weekly schedules (microcycles). Refer to the sample weekly workout schedules for information on a more limited time basis. Training is also continued in the competition phase, but a greater emphasis is put on active recovery between meets. The competition period is more of a phase for maintenance than for improvement, and volumes of high intensity work are reduced.

Triple periodization is really only ideal for short distance sprinters and hurdlers. A marathon runner might have one period, the shot-putter five or six. Refer to the graph on effective plateaus of high performance.

It takes relatively little time to plateau when performing strength and power work, with weights etc. Thus a shot-putter might have reached his training peak in eight weeks. There would be no reason for him to continue and fight to maintain this strength for another eight. Thus he would have a greater amount of periods in his annual plan, and likely a different scope of competitions.

The marathoner experiences the opposite training conditions: the elements that he requires, general endurance, fitness, even special endurance, require long periods for improvement and have extremely extended plateaus of high performance. Thus if it takes forty weeks to reach a plateau in all of his training components, the marathon runner would likely have just one period in his training plan.

Triple periodization works for sprinters because they require a large variety of training components to complete their arsenal of high performance abilities. Refer to the vertical integration scheme and you can see the interplay of high intensity and low intensity components… that vertical integration scheme – twelve weeks – might represent the middle training period.

However in some cases the periodization would simply need to be shifted. Most sprinters have no input in the decision of when competitions are held, nor are they able to shift competitions to fit their training scheme or periodization schedule. In some years the Olympics, or World Championships would be held in September, in others they would be held in July and competitions from May/June would be pushed to later on in the year. In such a situation it might make sense to operate under just two periodizations.

Common Ground between Triple Periodization and Short to Long

Triple periodization is also consistent with the short to long program. The most important part of a top sprinter's abilities – his top speed – is given greatest emphasis over a prolonged period of time. He has more time to potentially shift his alactic threshold over the first training block, and more time to develop correct techniques out of the training blocks.

Equally important is that because the strength, power, and power speed elements take a lesser amount of time to be developed, they maybe rotated over the training blocks, and perfected and refined again and again. That way the sprinter has the capability for peaking for each training period, and can quickly regain the most important element in the final, shorter training period.

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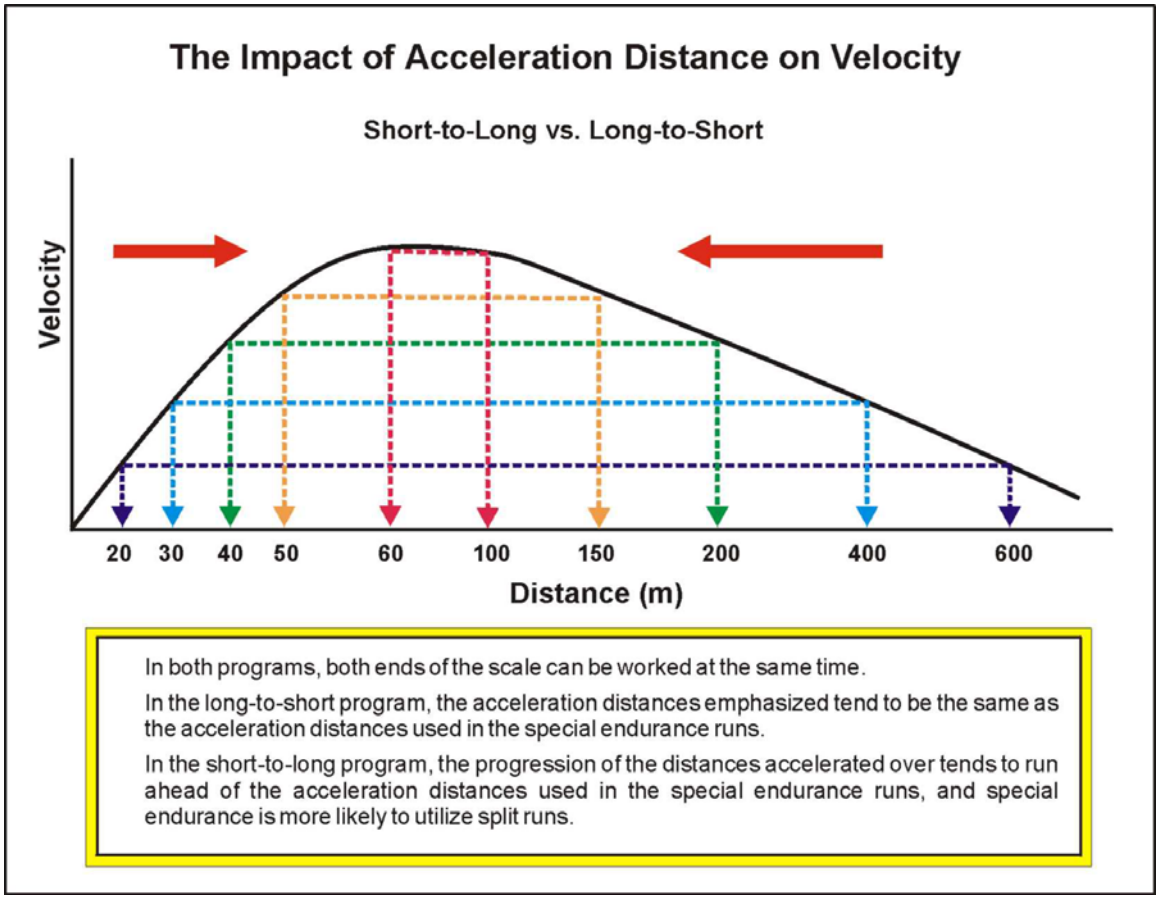
Fears that the final training period is too short to perform develop speed endurance would be unfounded. The sprinter will have already have performed significant amounts of speed endurance work in the first two training blocks, even when it was not the emphasis. The plateau is therefore not as hard to achieve as it would be starting from square one, in the first period.

Another benefit of the triple periodization scheme is simply the exposure to competition that it allows. Classical periodization does not naturally allow for three blocks of competition; in triple periodization, the sprinter will not only be competing, but will be peaking each of those three times. The only true method of evaluation in sprinting is competition, and having three competitions can be invaluable in spotting weaknesses and refining technique for later in the season. Again, here, the short to long program meshes well. Indoor meets typically involve more runs at 60 metres, so the runs performed in the first period of training will have been specific to the training objective.

The short to long program is similarly effective in sprinting. Any time you are trying to perform a long to short program, you are trying to improve the two qualities simultaneously; that is, your maximum velocity at the same time you are trying to improve your endurance, which can be a very difficult task.

The Benefits of Short to Long and Long to Short



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In the short to long program, you focus on the velocity first, and once the maximum velocity is achieved, then the focus moves to sustaining the velocity over the full 100 metres, in Ben's case.

The short to long tactic is perhaps derived from swimming; training in swimming is engineered towards the short to long program. Just think: any eight year-old kid who has taken a couple of swimming lessons is capable of swimming back and forth the length of a pool. Of course, it would likely take him five minutes, while the champion swimmer would do it in forty seconds.

Swimming is the easiest sport in which to measure world record pace; the technology of the water treadmill allows the swimmer to first develop the speed, and then the capacity of maintaining that speed over the duration of his race. All the coach needs to do is set the opposing current at world record pace and make sure the swimmer stays in the same place for as long as possible. As long the swimmer is stationary, he is at world record pace… only later does he work on swimming for longer and longer at world record pace.

It is much easier in sprinting or in any sport where speed is the goal, to initially achieve a personal maximum speed, and then concentrate on maintaining that maximum speed over the duration of the event. All other considerations aside, when they run an effective race and stay relaxed, all top sprinters have the necessary endurance to maintain maximum speed over 100 metres. Not all have the same maximum speed.

Thus one of the keys to the short to long program is the "accelerate and maintain" drill. This series of drills involves a progression whereby the sprinter runs sixty metre repetitions, but increases the acceleration distances gradually. Initially, the sprinter might accelerate just 20 metres and maintain for the final forty. Later, the sprinter might sprint for 30 and maintain for 30, and so on.

This is based on the above principle that it is easier to gain maximum speed and extend it rather than the reverse. If a sprinter accelerated just ten metres to world record velocity, and maintained, he would be on pace for a world record in the 800 metres. If he accelerated for just 20 metres, he would be on pace for a world record 400. A 35-40 metre acceleration and maintain would provide a world record 200 metre time. This is why when it comes to pure speed it is often most effective to look towards the short to long program.

When top sprinters start dropping off significantly at the end of a race, as Desai Williams did at the Olympics in Seoul, it is rarely because they lack endurance. Desai certainly did not lack endurance, but his drop from second place to seventh was precipitated by a tightening of his hips and shoulders – in other words, running a race that was not relaxed.

This is generally the approach favoured by more powerful, stronger athletes, those who have the genetic build to be great starters and powerful accelerators over the first few metres of a race. The long to short approach in weight training is more commonly followed by lankier, leaner athletes, who will never be the best starter or quickest accelerator, and thus will be better served to focus on speed endurance qualities. The long to short program allows athletes with a lower CNS tolerance a longer time to become accustomed to high intensity work and also allows for intensification to occur more gradually.

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The Intensification/Volume/Capacity Problem

A simplified schedule for the long to short program might go as follows (weekly, on high intensity days): 600,600; 600,500; 500,500; 500,500; 500,400; 400,400; 400,300; 300,300; 300,250; 250,250. Obviously, volume is decreasing dramatically, from 1200 metres per session initially to just 500 metres in the final sessions. Meanwhile, intensity is increasing dramatically, and increased CNS demand from the shorter distances accounts for the drop in volume. A training equilibrium of sorts, then, is almost reached.

Of course the important consideration that many athletes leave out of the equation, especially when following the long to short program, is that capacity is also increasing over the course of the training program. Even if the intensity would increase dramatically, it would account only for the decreased volume and rarely for the increased capacity of the athlete. The risk at this juncture would be detraining: a failure to supercompensate effectively.

To supplement any long to short program, other, shorter high intensity work would also be performed. In this way, the final 250,250 section of the schedule would not actually result in just 500 metres of high intensity work.

If work is supplemented the volume curve would not resemble a uniformly sloped line downward. If it did, the athlete would risk detraining in much the same manner as he would under a classical periodization scheme, and would risk injury and invariably have a very small period for peaking. It is essential that small volumes of short high intensity speed work be performed in a long to short program. This would likely include acceleration drills and pure speed work up to sixty metres.

The short to long approach will also feature this problem. Volume decreases: 4(4x60); 4(3x60); 3(4x60); 3(3x60); 2(4x60); 2(3x60); (4x60). At the same time intensity increases dramatically. An although it is far easier to compensate for the increased capacity, it must of course be taken into account as with the long to short program by adding high intensity cone drills, pick-up drills etc.

Strength Work, the GPP and SPP

One of the large distinctions between the short to long and long to short approaches is in the transition between the general preparation period and the specific preparation period. Under both programs, the general preparation period becomes less of a priority as the career progresses. This applies to strength as well as to speed work: the beginner, likely along with lacking core conditioning endurance, and fitness, at the start of his career, will lack muscle bulk as well as density. Lifts that are at the lower end of high intensity, including some accumulation weights, might be integrated into the GPP to build overall body strength.

However as the athlete becomes more and more advanced, he will not require such a lengthy GPP because he will still have most of the core conditioning and general strength requirements from previous training periods.

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The long to short approach does put a much greater emphasis on the GPP. This is partly because the line between the GPP and SPP will be more blurred in the long to short program. The difference between long general endurance runs and long speed endurance runs is not so finely cut as the line between general endurance and high intensity 60metre runs.

So the move will be much more gradual towards the high intensity training component, performing some closer to medium intensity runs, and some lower intensity high intensity runs, before finally really focusing on speed endurance. And because the athlete is immediately moving towards longer high intensity runs, he will likely have a greater need for core conditioning and general endurance at the start of each training block. Short distance runs, although very demanding on the CNS, will not always require tremendous endurance. The endurance will also likely be built over the course of the training.

In addition, just as speed endurance takes a longer time to plateau than high intensity speed work, it also takes a longer time to prepare for. The adaptation period for speed endurance is longer than for short distance work, hence the longer GPP.

Capitalizing on Your Strengths

In many disciplines, it is often the instinct to attempt to correct the weakest aspect of technique or ability. In speed work, you are forced to deal with the genetic hand that you have been dealt, and build on your strengths instead of attempting often futilely to fix your weaknesses.

However, two important provisos do remain: first, that even the most powerful athlete will never get by on strength alone, nor will the weakest athlete ever be great with only speed endurance qualities – especially in the 100metre race. Every athlete must work on all training components; it is only the relative volumes that must be adjusted based on body type and build.

The second proviso lies in reference to those who suggest that there is only one build for sprinting, and that sprinters are born and not made. For every other Ben Johnson, sculpted and powerful, there is an equally successful Frankie Fredericks, lean and lanky and made for the latter stages of a race.

Hopefully the above has clarified somewhat the decision-making incumbent on the processes of short to long and long to short. An athlete need to think long and hard, especially in regards to strength training, on whether they want – and can be realistically known as – an athlete with paramount strength capabilities who places an emphasis on starts and acceleration, or conversely a speed endurance man. Generally, the undecided athlete should follow the short to long approach. Properly integrated, even large quantities of strength work can coexist with adequate amounts of high intensity speed training, as well as speed endurance.

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FORUM DISCUSSION

Structure of sprint training

Every "system" is successful only if it challenges the end-user to analyse his own reason for work selection, and its role in the overall program.

Your job is to MAKE those performances predictable, through an organized program and a predictable and repeatable meet preparation.

When discussing different successful training programs, there is no right or wrong. This is a history lesson- not a debate. Any change to a successful program carries with it the risk of introducing undesirable side effects.

Athletes are "plastic" to training input. That is why training is individual and historical. By that I mean, we can exchange ideas based on what has been done but recommendations for change with top athletes carry with them the potential for ruin.

So once you have a talented athlete and you have arrived at a training program that works for that athlete, you simply go back and repeat the process. However, the intensity of the work will continue to go up. Once the quality of performance (training and competition) is clearly increasing, you have to adjust carefully to how the athlete is reacting.

The one and only unalterably specific requirement for improvement in sprint performance is the acquisition of the capacity to hit the specific speed required, and then the extension of the distance over which the required speed can be maintained.

I suggest you look at the reasoning and thought process behind the construction and design of the workouts in track as a guide to help aide you in achieving your athletic goals. It's the plot not the actors.

Now what is specificity for the sprinter? Speed and Speed Endurance. Now how do we maximise the conditions under which we pursue the prime objective?

"I said to myself, He's coming,' Ben related after the race, and I did my best to hold form... Like professional pianists, who simply know where the keys are, the great sprinters are going too fast to dwell on technique, aside from an occasional spot-check on one or two key components - in Ben's case, his hand position." (C.F. SPEED TRAP)

You can't judge from the outside what an athlete feels on the inside. Presenting the best training program and conditions to a group of athletes that you can is all you can do.

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Racing IS sprinting, pure and simple. The key to success in the race is to do what you have already done a thousand times before in practice. The day you decide to do something special is the day you blow it.

Training Component Considerations

The change is directed by the intensification curve. All training must be adjusted to allow intensity to continue rising, and, eventually, the program must be modified. This is, however, slightly more complex than it appears at first. This is an important point. There comes a time when you have to decide what elements must be limited in order for others to continue to move forward. The first thing that must be limited is the expansion of overall training volume, second comes the individual high intensity training elements, with a ceiling placed on those deemed sufficient, to allow any possible continued advancement of the remaining elements.

Think of differentials between the main requirement and other support activities. The support activities must decline relative to the key element (speed in this case) to allow continued intensification, and those closest in demands to the key element must decline relatively more. This is true through the training period and throughout the career.

The closer training elements are to each other, the more directly they compete against each other for the same physical and CNS resources.

This is one of the reasons I wouldn't switch from lifts to plyos for sprinters towards the competitive period, as is often done in classical periodization schemes, even though I'd keep both present, within limits. If you think of the need to taper the volume of speed work, it's easier to see why you'd want to taper other competitive stressors, not just along with, but somewhat in advance of the speed taper, starting with those closest in demand.

I am saying that a slight reduction in competing stressors brings up the main peak of the critical element (speed, in my case) and the taper of elements will begin with those closest to the speed itself.

Nothing's ever simple, as a replacement of Olympic lifts with general lifts, would, of necessity increase the overall number of lifts required in one session to hit the same number of motor units, but, in my scheme the bench press would be dropped last, as it can maintain a strong stimulus close to the meet, involving approx 35% of the MUs, without overly affecting any of the main muscle groups required for the event. I'd also keep these activities going till closer than 10 days out.

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The plateauing of maxes in specific exercises well before reaching Personal/Season Bests might also be explained by the phenomenon I've tried to outline earlier (competition between very closely related activities).

Training Models

There is a certain, finite energy package available for performing at a high level.

An athlete will run within a small percentage of his or her best time a number of times: sometimes it's a better start (explosive strength), sometimes better acceleration (speed), sometimes a better finish (speed endurance). What I try to do is increase the total amount of energy available FOR ALL FOUR KEY PERFORMANCE FACTORS (start, acceleration, maximum velocity, speed endurance).

The training has three major components:

Speed (specific)
Tempo (general)
Strength/weights (general)

All three components are included in the training during most of the year.
So as we can see, general preparation is always present. Therefore, the GPP and SPP would be differentiated primarily by the relative emphasis of each component.

	Early Period	Middle Period	Late period
1>	Tempo Same (Low Intensity Intervals)	Same	
2>	General Fitness Reduced Volume (Core Strength Endurance)	Same	
3>	High Intensity Reduced Volume (Repetitions: 30-50m)	Same+ Speed Endurance (80-120m)	
4>	Short Speed and Acceleration Same	Same	

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5>	Strength and Power Reduced Volume & Resisted Sprints	Same
6>	EMS Same	Same
7>	Peaking Period Short Peaking Period Long (1-3 Days) (10 Days)	Peaking Period Short (3 Days)

Each Period includes all 3 types of training. All training elements are performed throughout the year-only the volumes for each element are changed.

In the GPP, the emphasis is placed on building the tempo volume and weight training. Furthermore, the weights would be of lower relative intensity (8-10 reps). Speed work might not be present at all if the GPP is short (3 wks) or might be introduced in very small volumes toward the end if the GPP is longer.

The SPP would obviously include the introduction or increase of speed work, the tempo volume (now in place) would be maintained, and the weights, while still general in nature, would increase in relative intensity (3-6 reps) and drop in volume (mostly due to less reps per set).

The Competition Phase would see a reduction of tempo and weight training volume, with the speed volume maintained or even increased slightly. So it all comes down to relative priorities among components.

Most traditional models emphasize high volume of low intensity work at the very beginning. By contrast, just introduce the general work in low volumes and build the work capacity, and then once the volume of general training is in place it is maintained while the higher intensity components are introduced.

Model Structure:
1>Accumulation Phase
2>Max Strength--→Short speed
3>Max Strength------→Top speed
4>Maintenance Strength--→Speed endurance

Couple of thoughts on the model:
1: The volume of tempo does not drop until the very end of the comp period, as it is easy to tolerate and enhances recovery.

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2: The volume of speed work does drop through the Maintenance Phase to allow for the recovery necessary for maximum intensification.
3: The volume of lifting drops (and the absolute weight amounts drop slightly as well) during the Maintenance Phase, again to support the intensification of the sprints.
4: The time required for the GPP drops with the development of the athlete, year after year.

Is the relationship between tempo volume and sprint/SE volume linear? In other words, as the volume of speed work goes up does the volume of tempo goes up as well?
Yes. Volume of tempo maxes before volume of speed on way up and volume of speed drops more than volume of tempo in taper phase.

First of all the volumes of speed work and tempo work must be separated. Second, the volumes must rise and then become constant for some time or else the intensification will not be optimal and the peak will be short-lived.

The intensity of speed work can be adjusted by the type and volume of Components within the sessions as well as the speed of execution of the same elements, requiring little volume change to achieve a recovery week.
Also, a given vol. of pure speed work will be more stressful than the same vol. of speed end work and this must be reflected in the sessions.

The overall Volume of speed work does not drop during the initial changeover and, in fact, it may increase slightly at first, even though the individual workout volumes remain the same and the number of sessions per week drops. Why? The ratio between GPP and SPP is constantly moving in the direction of SPP.

The tempo volume drops somewhat for most people during the final taper/competition period in late summer (although not as much as the speed volume), which can run for awhile. As well, the speed of the tempo work tends to drop in the late stages, so some period must be allowed for the smooth re-adaptation to the tempo work.

Sprinting/acceleration is a blending of qualities that are interdependent. In other words the conditions required for optimum performance in one area are set up by work in others (establishment of appropriate muscle tone etc), including optimal TIMING between sessions. If you get too trashed for too long, you loose the optimal tonus for the subsequent session, even if you're fully recovered. Relying totally on variable recoveries makes peaking unpredictable to damn near impossible.

The fatigue levels for high performance sprinting cannot be predictably measured during the session itself (the faster you go, the easier it feels while you're doing it-it's the day(s) after you need to worry about)!

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Avoid a trend of repeated high volume sprint workouts-never try to pound the body into submission only coax it into optimal condition. Undoubtedly there have to be more workouts leading up to the recent sessions that caused so much fatigue. He probably trained at a level beyond his current work capacity for a number of workouts.

If there is general fatigue (i.e. fatigue of the CNS that would affect any high-intensity sporting activity) then it would be seen in any training activity. Certainly sprinting and weightlifting can cause different degrees of CNS fatigue depending on all sorts of factors, but CNS fatigue is CNS fatigue.

I guess you could make the argument that the effect of CNS fatigue would cause different magnitudes of performance decrement for different exercises but it seems to me that you could determine those effects with reasonable accuracy over time.

If we are talking about specific fatigue, as opposed to CNS fatigue, then components that do not effect the same motor units or systems would presumably be safe to train (such as a split routine.)

For example, if I go out and trash my CNS by sprinting one day, then the next day head to the gym, it is unlikely that I will be able to achieve optimal performance in lifting. If I do (because of potentiation effects or whatever) and then proceed to trash my CNS more, eventually it will show up (in all of my training activities) and I would then autoregulate down. Of course this is all very reactive instead of proactive. Perhaps by the time I regulate down, it is too late…

Maybe I can come up with an example:
You may have an excellent sprinter with excellent lifts BUT you may also have an excellent sprinter with good to average lifts. The recovery demands of the excellent sprint sessions will be much greater than the needs of the lifts (in either case, but more with the lower lifts), so the recovery cycles may be all over the map, ending up, on one occasion, with lifts on the same day as the sprints, and, on another, an alternate day, etc.

In other words, the "art' in the coaching is in the compromise. How much can you advance each of the components so that each of their recoveries is complementary to every other, allowing for an organized advancement of the whole- and the timing of the ultimate peaking goals?

As it is unlikely, in this holistic setting, that you will maximize the advancement rate of ANY one component (beyond speed, of course!), it is not surprising that any number of maximization schemes may offer faster results for a single component in the short term.

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I point out the PROBLEM of how the weights and speed may create different recoveries.
The ORDER of my workout, with lifts right after speed, and the frequency of lifts in the schedule, is part of my SOLUTION to that problem, when demands are highest in the program (you can see on the GPP DVD that this isn't always the case).

Also, though my programs attempt to be proactive, this simply isn't possible all the time, especially at the highest level, so you must be prepared to be reactive as well.

While I don't like unsubstantiated claims and attacks on other programs, I DO like the discussion of demands and recoveries. There simply cannot be enough of it! But, while we discuss these points, let's not forget about the role and timing of work in the potentiation and preparation for subsequent work. Experience will allow for the customization of formulaic systems.

There really shouldn't be any drop off in the SE, as the number and break are selected to prevent that (hopefully). The weight session will be self regulating to a large degree, as the performance in the SE may reduce, or even trash your ability to lift after, BUT (and this point has been made in the forum review) work done anywhere in the high CNS output area affects outcome everywhere, so a higher than expected output in the runs compensates for a lower than expected or missed weight session so the ultimate outcome of the weight plan should not be affected.

A personal best level, full volume speed workout for the highest level athletes must be separated by 10 days. So a session occurring 4 days later at the same intensity would occur before the compensation curve has reached even baseline, let alone super compensation. Likewise, waiting even 4 days to repeat the speed session would result in entering the workout with inadequate tone to generate the elastic response needed. This is where an understanding of the application of sub-maximal work (95th to 99th percentile of performance by time) is required. Working at 100% for an adjusted volume just won't work.

1: Drop off levels would be a disaster for SE runs. If your athlete didn't pull a muscle in the next session, it'd happen in the one after that.
2: At the highest performance levels super compensation will move from 2 to 10 days, with the movement from slightly sub-max to maximal performance, so, if, by some fluke, the athlete didn't pull up, he'd go steadily downhill after the first PB.
3: Each aspect trained at maximum, creates a consequence for every other aspect, which must be considered in a Vertical Integration program.
4: Most strength programs max out in a short time whereas sprint programs must handle over 40 weeks of development.

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When you've had a particularly demanding session elsewhere, you may well be better off to skip the weights- and, if you're correct about the quality of the session proceeding the dropped weight session, progress should not be diminished at all.

CNS Distribution in Training

Say one were to take one sprint per day over 5 days:
Day 1- one sprint
Day 2- one sprint
Day 3- one sprint
Day 4- one sprint
Day 5- one sprint
Total- 5 sprints

VS.

An every other day approach
Day 1- 2 sprints
Day 2-
Day 3- 2 sprints
Day 4-
Day 5- 1 sprint
Total- 5 sprints

VS.

Day 1- 3 sprints
Day 2- off
Day 3- tempo
Day 4- 2 sprints
Day 5- off
Total- 5 sprints

On paper the volume is the same but IMO the degree of neural fatigue induced would be different and I don't think scenario #1 would really be as effective as it looks on paper.

I equate turning on the nervous system maximally in an advanced athlete similar to turning on the lights in a major league ballpark... Whether you leave the lights on for 30 seconds or 2 hours most of the energy is spent getting the lights on - and regardless the city's gonna send you a big ass bill that might take a while to pay back (fully recover).

Doing all 5 sprints on the same day would be recovered from over such a long period, and so gradually, that you would likely get no super compensation-

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especially for a world-class athlete.
Option 1 offers no real "wave loading", only constant exposure.

In option 2, the waves are close together for such similar work (speed work usually occurs only twice per week, separated by a Speed Endurance session). Additionally, the final session of 1 x 100 would likely be of limited stimulatory value.

In this order, however it might be more useful if done in 2, 1, 2 order through the week, rather than 2, 2, 1.

Option 3 is probably the best distribution of the 5 sprints, taking advantage of the "wave effect" to stimulate super compensation.

A top performer can generate much greater CNS fatigue than a beginner.

Basic Programming

Keep all your workouts above 95% or below 65%. The in between stuff is unfruitful. Instead of moving down in Volume, start high in intensity, and move up in Volume as you grow accustomed. Start with 1 x 300m @ 95%. Then, increase volume and maintain intensity.

Keep your weights to speed days only, and use Tempo days as strictly recovery days. Keep out of the weight room on these days (unless you are doing abs).

Day1 - starts, speed, Upper Body Weights (best to do more general lifts to target more/larger areas).
day2 - Tempo
day3 - special endurance, lower body weights
day4 - Tempo
day5 - starts, speed endurance, long jump/triple jump technique (at high intensity and include as overall daily volume), Upper Body Weights
day6 - Tempo
day7-chill and relax.

There is no real workload prescribed, mostly just workout type and frequency. As far as timing from one day to another, it is good for general monitoring, but you can't really compare a speed endurance day with a pure speed day. Even comparing Monday to Monday is not the best way to monitor your athletes. There are too many variables like weather, stress, wind, how the athlete has been eating, sleeping, etc.

Chris T. in his Black Book makes the comment that strength improvement is not linear, as in you won't improve every time you do bench or squats (even on a proper program). It is the same with speed.

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Sample program…

Monday:
Speed: 2x3x20-30m accelerations (at least 4 min rest between reps).
Med ball (3-5kg): squat push toss x 6-8, back toss x 6-8 (at least 1 min rest between throws), think of them more like the shot put than a conditioning (endurance) drill.
Weights: squat or deadlift 2-3(s)x8-10(r); press movement 2-3x8-10; pulling movement 2-3x-8-10.
Core: 100 reps (variety of low intensity exercises)

Tuesday:
Tempo: 8-12x100m (easy, this means fast jog); do 10-20 sit ups between each run and use the runs as the recovery between the sit-ups
Core: 200 reps

Wednesday:
Special endurance: 2x150-300m; 20-25 min recovery. During the recovery (maybe every 7-8 mins) she can do some light tempo runs (e.g.: 2), this is simply to keep her warm during the break.
Weights: similar to Monday if she's up to it.
Core: similar to Monday.

Thursday:
Similar to Tuesday

Friday:
Similar to Monday

After several weeks, longer sprints (50-60m) can be added to the speed workouts on Mon and Fri. This is a good starting point. Don't overcomplicate things

---

There is a 2 week training effect to any change in training protocol.

Remember, many successful programs are arranged to follow a weekly pattern:

1: Speed
Speed Endurance
Off
Speed
Speed Endurance

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Off
Off.

Tempo sessions could be inserted on one or two off days.

The intensity of the speed work is higher than that of speed endurance so the effect of doing the SE first would be to lessen the capacity to do quality speed the next day.
I suppose you might set up a scheme like this if the speed on the subsequent day was short starts only, but I'd still rather do it the other way around.

There are some other in-season options following a Sat comp and before another Sat comp:

2: Mon- SE
Tues- tempo
Wed Speed
Thurs- tempo or off
Fri- few starts, sub max only.

3: Mon- tempo
Tues SE
Wed tempo
Thurs- Speed
Fri- off.

As meets in this period often consist of numerous runs, option 2 looks better.

At the end of the season, there is the possibility of option 3.
Sat competition serves the complete function for Speed Endurance, leaving Tues and Thurs as pure speed days- usually sub-max.

One thought would be to reverse the normal order, and lift with LOW numbers of reps and sets daily:

- upper body AM + speed PM
- lower body AM + tempo PM

With this sort of set up, the plyos would need to play a more extensive role and would have to be after the speed sessions).

I think this structure can probably be applied successfully to a variety of distances, with the relative volumes of each component being varied according to the demands of the competition distance.

For example, a 100/200m sprinter might utilize a 2:1 work ratio of speed: special endurance, with special endurance ranging from 80-300m, and a tempo volume of 2000m per session.

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A 400 runner might use a similar speed:SE ratio, or maybe progress from a 2:1 ratio to a 1:2 ratio as the year progresses, with SE ranging from 150-450m, and a tempo volume of 3000m per session.

Continuing in this vein, an 800m runner might use a 1:2 speed:SE ratio, with longer average speed work (50-80m), SE ranging from 300-600m, and tempo volume of 4000m/session.

Length of mesocycles:
It depends on the time available, working backwards from the date when top performance is required. I use triple periodization for a whole year plan but, I suppose, the real question is what the shortest time frame is before you switch to a double period? I think it depends, to a large extent, on the type of athlete you're dealing with. The more explosive the training is, the shorter the training cycles can become.

In the beginning, you might need to spend 8 weeks or more in the GPP during phase 1, 4 to 5 weeks during phase 2, and 3 weeks during phase 3, for a total of up to 16 weeks out of the training year. Assuming a training year of 48 weeks, that leaves a maximum of 32 weeks for speed work (66% of training time). Later, GPP might be reduced to 3 weeks in phase 1, 1 or 2 weeks in phase 2, and 1 week in phase 3, for a total of 6 weeks, leaving a maximum of 42 weeks for speed (88% of the training time).

Spring GPP:
Everything is shortened in the second GPP because of the relatively short indoor season- typically 2 or 3 weeks. When you include a short break (3 to 5 days, depending on the level), the period becomes too short to loose the qualities you developed in the SPP, so you can be VERY FLEXIBLE, and, if your athlete seems particularly tired, you can start pretty much from the beginning of the last GPP, or anywhere in between.

Intermediate Speeds

Always separate the work into high and low intensities. 90% of best time is intermediate speed.
Don't loose site of the objective- which is manifested by Speed, Speed End, and Special End work.

I briefly experimented with some intermediate speed work in the spring of 1980 but was disappointed with the results. It caused interference with the quality of special endurance runs and caused too much volume on the track, as intermediate runs were too fast to be done on the grass.

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I quickly reverted to a strict separation of speeds, using ever shortening breaks as the means to keep the training challenge going.

Why run intermediate speeds unless you are unloading the CNS but still working a lactate system?
I wouldn't use intermediate speeds, I'd adjust the SE distances and increase the low intensity tempo volume from approx 2000 to 3000meters.
If you do go into the intermediate speed area, make sure it's in place of a speed session, not a tempo session!

When you're ready to peak, the 95th percentile is easy yet still in the high intensity category.

If intensive tempo replaces a speed session, it lowers the CNS demand overall for the week, while replacing extensive tempo with intensive tempo and leaving the speed sessions in place will raise it, allowing insufficient recovery for the subsequent speed session. If this additional demand is maintained, speed work will suffer.

Short to Long and Long to Short

A program can run from long to short or from short to long, depending on the athlete's strengths.

The weekly layout could be pretty fundamental but volumes of work are totally individual. Additionally, training starts with general fitness and moves towards power (to the left) over time. in other words, you can gain whole seconds in the 200 (and by extension a large reduction in the deceleration section of the 100) while, initially you can gain only tenths in the first 30m.
That said, you can still work on perfecting technique through reps over short distances. So, even with the same general layout, you can ensure that you are optimally fresh for the 200s (only 2 to start, with complete recovery)

Once competition starts, you use the meets for special endurance and keep the runs in training slightly sub-max. (I think you started to do that but you were already in trouble with tight and poorly recovered muscles, due to a prolonged high intensity overload). During the injury recovery, intensity must be reduced to allow the CNS to recover.

It is possible to go in two different directions in the seasonal plan. From short to longer distances or from long to shorter distances.

I prefer the first option as shorter acceleration bursts can easily coincide with the extensive weight- lifting program we use in phase one. Also, speed endurance is specific to the speed of execution only.

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For example, even the most intensive 300meter runs cannot be carried out at a speed that will have any impact on the speed needed in the closing stages of the 100meters. The top speed needs to be developed first and then endurance can be developed at that exact speed.

To a considerable extent, it's based on training age and body type. Explosive, stronger athletes tend to do well with a short to long approach while lankier athletes with less CNS tolerance tend to do better with a long to short approach.

That's just the direction towards max speed, as you can't go fast right away in the program.

→Think of long-to-short and short-to-long as acting along a speed curve, moving up then down again. So you could work on accels out to 20 and then use accel to 20 + maintain, generating enough speed to break the world record in the 600m, then 30m accel + maintain to break the WR in the 400m, 40 + maintain for the 200m, accel as far a possible, up to 60m for the 100 WR.

So you can see you can work on Speed and SE at the same time with either approach. The diff is that with L to S you work on accels only out to the distance you'll use for the SE at any given time, while with the S to L approach, the accels are worked on beyond the distance you use for SE (for example accels out to 40m, but 30m + maintain for serial reps over 60m) Thus speed is developed ahead of SE.

First, speed endurance is eventually done, but it is done after the required speed level is in place (perfected in alactic conditions). Thus, the speed endurance is superior in quality to that which could have been done earlier.

Second, an adequate volume of alactic sprints, when done over an adequate period of the season will enhance alactic capacity by as much as .5 sec (from 7.5 to 8.0 sec) a huge amount when you consider that as performance goes up, the 100 time comes down- all of the time shaved off is in the lactic anaerobic portion of the race.

Not much variation in volume is required. The adaptations should be primarily related to intensity.
Think in terms of averages. If you want to average 500m per speed session, what sort of volume would you have to hit on your highest days to compensate for the low days? How could you advance both intensity and volume to such a degree?

With athletes age 16 and below, special endurance distances should be restricted to 150m and below, with the main conditioning emphasis on general fitness. Later, the emphasis changes to a ratio of about 50/50 between a-lactic

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and lactic speed work. In the final development stages for top athletes the emphasis shifts more and more towards a-lactic speed.

As special endurance distances for athletes under 16 should be kept to no more than 150 meters, I'd switch the special end to 100+50.

I think there's a lot of confusion about the nature of short to long work. While the early EMPHASIS is on the acceleration, this need not define the DISTANCE you run. For example, the emphasis is on a 30m acceleration, so, if you want to do a series of 60m repeats, you accelerate to 30 and then maintain that given speed to the end without change (i.e. 30+30). As well as running exactly the distance you're concentrating on, you can progress your speed through the 60s in a training block, by moving up the acceleration distance- 20+40, 30+30, 40+20, etc.

You can emphasize acceleration and work some endurance at the same time by accelerating up to the distance you're ready for and maintaining for the planned distance. If you do the reps at the exact distance you accelerate to, it's likely that endurance will predominate, but, obviously, you can work acceleration to 30 or 40m and work longer with a shorter acceleration (20m + maintain for example). The variables are pretty much limitless.

In both programs, acceleration and speed end are developed from the beginning and acceleration distances are used to control the speed of execution.
With the long-to-short approach, the main emphasis is on longer runs, so accel vols start off a bit lower and tend to be concentrated on accel distances needed for the speed required, ie 20m accel is adequate for any level of 600m run required (20m accel + maintain).

With the short-to-long approach, the initial accel vols are higher and tend to run slightly longer than required for the speed end runs at any given time, ie accels out to 30m simultaneous to speed end runs of 60m, performed as 20m accel + 40 maintain.

Due to the balancing act between strength and endurance, in a short to long scheme, the biggest strength gains will be achievable in phase one (of a triple phase plan), while the biggest strength gains in a long to short program can be obtained in phase two. Also, the overall seasonal strength gain potential will be higher in a short to long program

Think of the number of training elements in your event. As you only accelerate for 30m, Speed endurance related elements are not involved, so you have less Components to rotate in training. To prevent plateauing in training you'll have to rotate your training elements more often.

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The higher velocity components tend to have a higher carry over to the lower velocity components than the other way around.

Depending on the athlete, you can go from long to short OR short to long. If you go from long to short, the special endurance elements can start sooner because the speed required is lower for longer runs. BUT, if you go from short to long, you must maximize speed earlier and add speed endurance after speed is in place. This means that speed end will start later in the program.

Additionally, the time required to maximize speed depends on where the athlete is starting from. If the athlete is close to the speed level required for his event, it may not take so much time to achieve it. For others, it may take longer.

Planning for the Season

A good thing to remember when planning, if you get tired reading it, imagine what you are going to feel like doing it.
If you get bored reading it, your body is going to get bored doing it.

Work backwards from how long you want to be at your best. Shade the zone where you want to be flying. Shade the zone where you want to be a strong man. They can't be the same zone.

Be honest where you are now are you really fit enough? You aren't going to be able to get fit in the two zones above so you better do it now.

Planning Priorities:
First is the overall direction of the training blocks, with the expected improvement by training cycle.
Second is the weekly structure, which will provide the structure to tolerate the training loads.
Third, the means by which advancement can be continued without a premature plateau.

Work backwards from the date you must be ready, use a 10day taper, then look on the fixtures list for five appropriate races, then plan back from there. Remember, in the competition period, the races are your special endurance.

The 100meters usually takes 5 to 6. The 200meters takes 4 to 5 and the 400meters takes about 3 depending on the preparation method. I would ensure that your max strength phase is finished fairly early so that you are in your maintenance phase during your attempts to qualify.

A 10 day taper probably serves a male sprinter best at a level of 10.20 or faster, otherwise 5 to 7 days might suffice. However the 10 day taper always applies to competitions before important meets. If your athlete should unfortunately be

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injured, with 10 days left, he might well recover. With less than 10 days left' he won't.

Every individual component in a training program is separate and has its own cycle. Everything is interdependent, of course, and all things combine into a whole. But your recovery from, and your adjustment and adaptation to every single component is specific.

That's why I stack the individual components in layers, so that I can see how they relate to each other.

For each athlete every components introduced separately: there's never simultaneous introduction of different components: they're always staggered.

There's constant overlapping: as one component is being increased, the next is being reduced.

I would start with tempo AND general weights to start as you want to spread the work over as many muscle groups as possible when getting fit. The (intensive or better: extensive!) tempo would move towards more intensive split runs and then evolve into special endurance during the SPP.

GPP		SPP1		SPP2
Tempo	--→	Tempo	--→	Tempo
Weights		Speed		Speed
(Speed)		Weights		Weights
		SE Split Reps		Special Endurance

If you constantly monitor your performance throughout the training period, you will know if there's a problem long before you run across a study to confirm your suspicions. This is one of the reasons why speed work must be present during most of the year and why multi-phase annual planning works best.

A drop in performance in the other training elements for more than a brief period is a sure sign of overload.

A tempo base must be developed (runs at 75% of best time or slower) but if you progress in speed all year through the middle speed zone you will only have a short time for specific speed work and the annual total speed volume (95% up) would be completely inadequate. As well, training at middle intensity is too slow to be of any specific benefit yet is too high to recover from easily and middle intensity work competes with other high intensity training elements for CNS reserves.

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The 95th percentile for high intensity work applies to runs at the distance prescribed (95th percentile for 300m athlete with a best of 31.0= 32.6 or faster. This would be in the race pace range for a 400m runner of this quality. The high intensity threshold changes with ability throughout the season as absolute performance capacity improves. No-one expects an athlete to run 32.6 for the first special endurance workout of the season unless other SE qualities have been perfected before-hand.

In the first meso-cycle, we concentrate the acceleration work on distances up to 30meters as the most intense acceleration takes place within this distance. The speed increase beyond this point is much more gradual.
We start speed work within a month of the start of fall training, but the speed is sub-maximal (95th percentile),over short distances, which reduces stresses by keeping the speed down and limiting the range of motion required for the strides. These speed sessions can often be done in spikes on a smooth grass surface for at least 4 weeks.

So long as the tempo work is maintained throughout the training year you should be fine. Many swim coaches hate my training cycles. They claimed that my swimmers "open up way too fast."... or "They will have nothing to taper off of" My athletes had the best % improvement with a moderate volume.

I think that speed mechanics should be practiced all year. You won't be all out at the start but the more you do something the better you'll get. I feel it also allows the coach to gently refine in a very hands off way. i.e. you can introduce the tiniest cues and watch how they progress rather than trying to rush things.

As the athlete gets faster, the difference in effort between 95% and 100% becomes more dramatic and easier to discriminate.

For example, the difference in energy output between a 10.00 and a 10.50 is much easier to feel than the difference between 11.00 and 11.55. That's why you need to time all speed work. (This doesn't mean you have to tell the athlete all times, but it allows you to know what load is being carried out). Telling the athlete to relax will often lead to a faster time. This shouldn't harm the taper plan- as long as you shut things down right away! Of course, instituting the adjustment between 95% and 100% throughout the entire training plan should mean that the athlete knows how to control things long before the taper starts.

The important lesson is: don't try to make up for the lost training, it's gone. You'll probably have to scale back a little and build up again.

I think that sudden gradient changes in volume/intensity curves are a lot of athletes' undoing.

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I think sometimes we need to be honest and maybe take a step back. This is often so hard to do for coach and athlete as its human nature to want to make up for lost time.

Such a paradox really… patience being the means to running fast.

Vertical Integration

Instead of any mesos being strictly for the development of a given capacity, threads (vertical integration) of these capacities are featured throughout the mesos and macros only in varying volumes and sometimes intensities. Some of all of what's important is done throughout.

All elements are present all the time but the emphasis can shift slightly as requirements and opportunity present.

You can also rotate the EMPHASIS of the work without changing the format OR the volume progression.

For that matter:
Week One: Emphasis on Short speed and speed change work (cone drills) on speed days, with split-runs for the speed end.
Week Two: You could transition to slightly longer speed without the cone drills, which would reduce the CNS stress, even within the same volume. This would allow greater reserves for emphasis on straight Speed End work.

This is why different aspects of work must be included in each high intensity session, which, in turn, means that no one element can be stressed to the max resulting in the exclusion of other elements (unless it is on the track, where the performance is not predetermined by weight or jump numbers and is, therefore, not completely predictable.)

Try lowering the volume but keep the plyos in. Even 10 can be stimulatory yet easy to handle.

One variation on the intensity scheme is to use strength endurance on one of the speed days as the principle component. An example of that would be 3x80m of running A's at walking speed forward, with full recovery between.

The argument (over the magnitude of contribution of different types of work) matters only in as much as it determines the amount of additional work done, not whether the additional intensification of a training component is of value in advancing overall performance.

Session Plan

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Always do the highest priority work first after the warm-up. That way, if something has to be dropped due to fatigue etc it will be something of less consequence.

Speed sessions could follow this order:
1. Warm-up
2. Relaxed starts/Blocks
3. “Flying” Sprints
4. Longer Sprints
5. Power Sprints /Blocks

Your rest between these fly's needs to be increased since you will be going through these at max. velocity. The rest also has to be increased due to the extra work needed to perform the 20m or so build-ups prior to the max. velocity work.

Accelerations are PART of the warm-up but count towards total speed volume.

Periodization

You would only have 3 opportunities for high intensity in a week if you allow for 48hr recoveries.

Some people try to short-circuit recoveries by doing a Speed, Speed Endurance, Tempo, Speed, Speed End, Tempo plan. The problem is that intensification can continue for a shorter time before a recovery week must be taken- usually 2/1 vs. the 3/1 plan which is normal for EOD speed programs.

Let's do some math…
Given the 2 speed + 1 speed end with a 3 week high 1 wk reduced approach, a 16 week training cycle will include 24 high int. speed sessions and 12 high int. speed end sessions. (2:1 AL:LA Ratio)
The 2 speed plus 2 speed end on a 2 week high int. and 1 week reduced int. will yield 20 speed and 20 speed end sessions. (1:1 AL:LA Ratio).

The implications are that system one yields more speed sessions- and at a higher quality per individual session due to longer recovery between sessions, while system two yields more speed end at the cost of lowering the quality and quantity of pure speed work.

At the highest levels of performance in the 100 meters, the period beyond the alactic/anaerobic threshold becomes shorter and shorter- so which approach will ultimately yield the greatest gains and which will yield fewer injuries?

Would the second option have more advantages for a 200m sprinter?
I still think the same rules apply for the 200m's. In the advanced athlete, you don’t want to compromise recovery from the high CNS demands.

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First of all, let's look at the 3-1 week mesocycle…

1: In EVERY scheme of ANY length, the final intensification will carry the highest risk. If you try to get around this with a 2-1 intensification, you still carry a risk in week 2. Why? Because, in order to meet your objectives in the time available, you must intensify more rapidly because you have approx 1/3 less high intensity weeks per period/season. The skill is in the appropriate selection of workload for the scheme that suits your weekly training set-up.
2: It is always possible to adjust your mesocycle approach within a period- moving from 3/1 to 2/1 in the later stages, or varying by period- i.e., in a triple periodized plan, 3/1 in the first and second period, and 2/1 in the third.
3: The weekly schedule will dictate a suitable approach. For example, a two high intensity day week would certainly dictate a 3/1 approach: a three high intensity day week could go either way, while a four high intensity day week (speed, speed end, tempo, speed, speed end, tempo, off) would almost certainly require a 2/1 set-up.
Adjust your high intensity components to suit the conflicting demands relative to each other, whether by day, week, or mesocycle.

You don't need to change the workout to intensify over three weeks. It's simply a matter of improving through continued exposure (times improve).

3/1 vs. 2/1 recovery scheme…

A four week training cycle would be too long in terms of the body's natural rhythm. I think the only real options are two or three. If you do go with a 2/1 scheme, you must use EMS for 1 of those two weeks, not both, otherwise the loading progression cannot be stepped adequately. As for the fatigue that requires the 2/1 scheme, I'd prefer the spread the high intensity training elements you're doing now over 3 weeks. This way you're reducing the weekly volume and density, yet you're overall loading won't really be reduced because:
1: The "down time" is reduced to 25% from the 33% you propose.
2: You're less likely to get injured, reducing training losses further.
3: The spreading out of the high intensity components should allow intensification to proceed more effectively.

Running the 400m

She ran special end for 2 reps, 2x/week at the beginning (long and short) but moved to shorter only for 2 reps, and, finally short for one rep towards the end of the season. Additionally, I kept her out of 400m races for most of the later season, running 200s, and competing in 400s only in the most important meets.

Normally in the pre-comp period, it isn't too stressful for a 400m runner to do two sessions, as the second session of 2x 500 or 600m isn't as demanding on the CNS as shorter work might be- even though it's plenty tough.

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With young girls, there are two things to keep in mind:
First, once general fitness is in place, they respond best to improvements in Speed End (8 to 15 sec), as opposed to longer Special End (15 to 45 sec, which should be used very sparingly).
Second: In line with the earlier concept, 400m competitions should be used very sparingly, with the majority of improvement coming from comps in the 100 and 200m.

Also, two issues with women:
1: Intensive tempo x 300 in 50sec (approx) with 90 to 120sec rest.
What is the effect? Similar or not?
2: Women can never develop the strength of men so must always rely on more speed and resultant speed reserve.

Both points are very clear. The 1st is quite relative, since we had good success with this type of session during the winter. A noted effect was a heightened ability to finish well during the critical stage of their long sprint races subsequent to these work bouts.
However, this was made easier for them since alactic sprint sessions were never compromised. Hence, the 2nd point is raised with regard to speed reserve.
Most of our tempo work is duration oriented.

If you want to run a fast 400... sooner or later you'll have to come to the conclusion that high performances will have to be achieved in your Special Endurance sessions. Just dividing by 4 and multiplying by 3 will tell you that much. Now how is that going to happen?
I've had girls running in the 50 points- and below, and they ran 300's in the mid 35s. Tempo 300s were much more likely to have been done in the 48s or slower, with short breaks.

My point is to train smarter, not harder. If you want to improve the 200, then Sp End 1 and 2 must be at a very high performance level- volume doesn't matter (this is not a best of ten contest).

For example, she runs up to 8 x 100m under 11sec ht with 5 to 7 min breaks in practise. Adjusting to electric on times without a gun, you're looking at performances of around 11.30 to 11.40e. Although impressive as a proof of work capacity, this does nothing to impact max speed or specific speed end at her level. One means of making an analysis would be to look at early comp results vs. late comp results. If there is a big difference, then the speed might come from racing itself, but if results are good from the beginning of the comp period, another explanation must be present. This requires knowing the ratio of training to competition and, not only race times, but section breakdowns as well.

400 meter Special Endurance must start early in training (although the longer SE runs shouldn't affect acceleration work,as the speed necessary isn't that high. In

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this case the highest speed work will have to come a little later.) Special Endurance work for the sprints can start a little later, perhaps by as much as 3 to 4 weeks, depending on the structure of the program and the development stage of the athlete. The ratio of speed to speed endurance volumes runs between 2 and 3 to 1.

The 400 to 800m runs are NOT Special Endurance as they cannot, under any circumstance, be performed at a high speed.

The main work area for 400 improvement lies in special endurance i.e. 2 to 3x 300 to 350 with complete recovery once/week.

SE sessions often occur for the 400m wed- with 300s and Sat with 500 or 600s. In the pre comp period the no of SE runs per session usually drops to one.

There are several ways to view the 400m, depending on level and aptitude.
If strength predominates over speed, it must be emphasized (or vice-versa).

A typical strength set up:
Mon: Speed
Wed: Speed End to SE1 (2x300m, full recovery)
Fri: Speed
Sat: SE2 and Strength End on Sat. (2x600m, full recovery and 2 to 3 reps of running As over distances of up to 120m)

Sat's workout is possible after Fri speed because it has a reduced CNS demand, even though the work is incredibly hard!

I presume that one tempo session is dropped (from 3 to 2 per week) to make way for spec end 2 session but with such a set-up, how would you modify weights sessions to allow for this extra track session (particularly on Friday with spec end 2 the next day)?
You would move the weights to Sat and, yes, one tempo session is gone- at least throughout the main prep period.

First: You are already developing lactic tolerance in SE work. You're also right that you must have work on both sides of the 400m either through split runs or single runs (like a 500 or 600).

There is no direct correlation without knowing the state of endurance on the other side. If someone is a strong performer at 600m, then the 300m times won't need to be as fast to get a good 400m result.

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General Conditioning

Whatever method is used, you must develop general conditioning first (get the 5 seconds available in the 200m before worrying about the .3 available in the first 30m) This is what I mean by the "Right to Left" shift of training throughout a career, BUT the means to general conditioning may not be related to the selection of Special Endurance distances. in fact a 15 year old should not be running SE beyond 150m, yet he can work on General conditioning without a problem, and an athlete emphasizing shorter runs may be far fitter than an athlete using longer SE.

The selection of approach should have more to do with individual aptitude.

General fitness and special endurance are not the same things.
I qualify the SE limit for those under 16- not for all. General fitness, including extensive tempo, fitness exercises like med ball, sit ups, pull-ups, etc. I'd avoid intensive tempo.

What this does illustrate is that, once general fitness is in place to reduce the big losses over the final portion of the 100m, gains will increasingly be found by a shift to the 'left' in training- the alactic area. Once you're totally fit and have taken advantage of all the time that's easy to get- that's where the gains will increasingly come from.

How do you know when an athlete can't gain anything else from fitness? Is it based on the athlete's PB, special endurance runs, training age?
When the deceleration pattern at the end improves. Beginners might decelerate by 25 to 30% but top guys only up to 3%. So, when the deceleration is pretty good, the main difference will be alactic.

Another way to look at it is by time. When an athlete is running 10.50 for example, he still has deceleration to contend with but he also must focus a lot on alactic work. An athlete running 10.10 would spend the majority of his emphasis on alactic work.

Both gen. fitness and Special End would have to be part of the process by the time results got to 10.50, and, no, general fitness cannot be replaced by SE as GF should be there first.

Once you're into the specific training you have to adjust the best you can to address deficiencies as you go, but, if the season's pretty much over, you might as well go back and take care of the GF issues.

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Special Endurance in the Season Plan

I wouldn't do any Special Endurance in the GPP but that period doesn't last long for developed athletes and SE can start quite early.

SE can be added as soon as enough speed is in place. This occurs at different times. For example 300meter SE speed is already in place when the athlete can accelerate at full effort to 30meters but 80 to 120meter SE peed is only in place when all speed qualities are in place.

You can include it early. Remember that during the acceleration phase, top speed may be limited but there is plenty of speed available for the longer SE runs. For example, if you can accelerate for 20m and maintain it you can run a world class 500.

If you think of overall speed volumes, you half to start early to get an adequate volume. For example, Ben totalled over 60,000 meters of speed work annually, yet he seldom ran over 500- 600 meters in any one session (3x500x40wks=60,000). Although sufficient speed must be in place before quality speed endurance can be carried out, that sufficiency varies with the SE. Once accel to 30meters is in place, there's enough speed available for a world record at distances of 300 meters or greater, but you need speed perfected all the way to max (60meters) to expect optimal SE between 80 and 150 meters.

Speed endurance work can be done over shorter rep distances if required. i.e. 4x(4x60) with short breaks between the reps with 7 to 10 min or longer between the sets. The 65 to 35 ratio refers to the training volume of tempo and speed- not the ratio between lactic and alactic speed work.

As for the weekly set-up, it depends on whether the plan is from short to long or long to short.
As most plans go from long to short, you'd probably start with 2 SE sessions per week, with 1 speed and 1 Strength Endurance session (running A's for a longer distance/time) as follows:

M- SE (i.e. 2x300m)
T - Tempo
W- Speed
Th- Tempo
F- SE (i.e. 2x600m)
Sat- Strength End (80, 100m running As at walking pace forward).
Short to long programs have so many more variables that you'd have to give a very specific example to come up with a plan.

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The intensity of the speed work is higher than that of speed endurance so the effect of doing the SE first would be to lessen the capacity to do quality speed the next day. I suppose you might set up a scheme like this if the "speed" on the subsequent day was short starts only, but I'd still rather do it the other way around.

There are some other in-season options following a Sat comp and before another Sat comp:

1:
Mon- SE
Tues- tempo
Wed- Speed
Thurs- tempo or off
Fri- few starts, sub max only.

2:
Mon- tempo
Tues- SE
Wed- tempo
Thurs- Speed
Fri- off.

As meets in this period often consist of numerous runs, option 2 looks better.

At the end of the season, there is the possibility of option 3.
Sat competition serves the complete function for Speed Endurance, leaving Tues and Thurs as pure speed days- usually sub-max.

Obviously, you can't come back the next week with SE on Mon after a Sun meet. You have to determine the recovery needed. If the SE must move as far as Wed then you'd do only one rep. If you got closer still to the big meets, then the meets ARE the SE (or, if an appropriate event is not available, an SE run follows the competition(s) that you do have).

In any case what type of recovery would we be looking for in the GPP?
Would 5-6min be correct if the run was done at 80-85%?
5 to 6 min would be an OK recovery for the GPP runs at 80 to 85% of best time and they can be set up as split-runs, but I wouldn't want to spend more than a few weeks at that pace before moving into the Special Endurance runs, as unfavourable fibre changes might result from a prolonged exposure.
Long bounds and hills can certainly be incorporated into a good program.

Would you place the long bounds in the high intensity category, and therefore include them on speed days?

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Yes, for the long bounds, as it becomes a "height vs. breadth" issue of CNS stress. Shorter bounds could be done on the tempo days as the overall height x breadth CNS exposure is much lower.

Long bounds would more likely be used in phase 2 and/or 3 in a short to long program. As max speed and speed end is emphasized at this point, there would be a limit to the numbers. Higher numbers of shorter bounds could be used in phase 1. You could do shorter bounds during the GPP as part of acceleration development. I would think that bounds would only be used in intensive tempo as part of a short to long program. An example of this type of work- several reps of (80m bound directly into 200m tempo directly into 50m running As.

In a triple periodization plan, SE could be 60m with breaks between reps moving from 4.5 to 10min or more as the SPP progresses. Rep numbers will be highly individual and variable.

Height and Breadth of Speed Simulation and Plateauing

CNS stress has two dimensions- height AND breadth (duration/distance) and sprinting tends to have more breadth than lifting, and should require more recovery for a given intensity level.

On the other hand, even maximal speed sprinting may consist of a coordinated series of slightly sub-maximal actions, so direct comparisons are extremely difficult.
The only safe ground I could ever find was to keep the speed component as the principle consideration and therefore all other components secondary, adjusted according to the effect on the speed component.

This brings up another can of worms that I don't think we've really addressed much. That is, the introduction of speed to the program during a volumization period, particularly with a short to long program.

Questions:
1: How do you decide on the speed to be used in the beginning?
2: If the vol. is to be fairly high (240m of short accels + 4 x [4 x 60] for a total vol. of 1200m in a session, as it might be with a mid-level sprinter with a good background but not quite world-class performances), the speed level possible to handle the volume might be less of an indicator of CNS fatigue. Would you then start off with weights as your principle CNS fatigue indicator?
If so, when would you switch to speed as the principle indicator- later in the GPP or at the beginning of the SPP?

Volume is high, but not extremely so, especially at a controlled pace, such as 25+maintain or 30+maintain. As it must be sub-max, then the question is- what do you monitor and when do you shift the emphasis?

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Once you build up to a volume max then a simple example might look something like this, over a number of weeks.
accels + 4 x [4 x 60]
accels + 3 x [4 x 60]
accels + 2 x [4 x 60]
etc. with increasing velocities, obtained by progressively longer accels and breaks between runs and sets.

A more advanced sprinter, with better developed speed might build as follows:
accels + 3 x [4 x 60]
accels + 3 x [3 x 60]
accels + 2 x [3 x 60]

The speed component must always be varied, not only by the nature of the work, but by the intensity. Variability is not only designed in, it is used reactively as well.

At the highest levels, the intensity is key, with 100% efforts being used sparingly. There is a huge amount of room between the 95th and 100th percentile of performance.

The more components there are in training, the less often each one needs to be varied. So someone who is only lifting weights and maybe doing a few shorts sprints will have to vary these more often than someone who is doing short sprint work, special endurance, med ball throws, weights and plyos.

It's not necessary to vary the intensity as much over such a short distance as it is:
A: Where speed is higher (longer acceleration),
B: Where speed change is involved (in and outs, etc.)
C: Where Speed Endurance between 80 and 150m is involved.

There's a big difference in the CNS stress generated by high performance in the 80 to 150m range vs farther out.

This brings up the topic of 'height (i.e. flying 20s) and breadth (i.e. 150s or 200s)' of speed stimulation and variability while still moving the total demand forward .

Speed Set up:
Monday: tempo
Tuesday: speed(~300m total (30-60m), 5-8 min between reps); lifting
Wednesday: tempo
Thursday: speed endurance(2x150-300m, 20min rest); lifting
Friday: tempo
Saturday: speed (~300m total (50-80m), 5-10min between reps); lifting

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Stimulation comes in different forms:
Short speed - higher CNS stimuli/lower overall muscle stimuli.
Longer SE - higher muscle stimuli and lower CNS stimuli.

As recovery at the highest levels of performance can vary hugely, this gives great flexibility in assigning what, at first glance, might seem similar work.

Example:

Problem…
All high intensity sprinting requires 48 hrs recovery BUT very high CNS stimulation from session 1 with a probable complete CNS recovery time of 6 days.

Solution…
Session 1: "Flying 20s"
Session 2: Tempo
Session 3: Long SE= 2 x 200m (this is the opposite of session 1 with high muscular demands and moderately low CNS demands.)
Session 4: OFF
Session 5:5 x 120s at 95%. (This sub max loading provides the capacity to handle a relatively high volume of speed work while still allowing the CNS to bounce back from session 1.)
Session 6: Tempo
Session 7: 80, 100, 120, 150 max effort. (The CNS and muscular systems are now fully capable of handling this demand.)

This is purely an example chosen at random and individual loads and recoveries will vary widely. This just shows the flexibility you have to adjust.

Generally, 12 weeks is a maximum for advancing speed during a period of training gains, as speed will continue to move up after the 12 week period during the maintenance phase, due to the effects of lowered work loads and increased recovery.

This will continue up to the point just before training losses outweigh freshness gains.

Of course, everything is contingent on the rate of improvement/intensification.

1) level of performance is an important consideration (higher the standard longer the recovery)
2) CNS recovery will usually happen in 48 hours, extremely high CNS demand takes longer (e.g. flying 20s due to the higher CNS demand of speed change work)

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3) The timing of introduction of SE coincides with the extending out of sprint distances. Shorter acceleration distances (less speed and resultant less CNS stress) may only require a 48 hour recovery, allowing 3 speed sessions in phase I.
4) Impact of other training elements on both CNS and muscular recovery? (Weights, Plyos, Med Ball etc.)

So would 5 x 120m @ 95% be the CNS equivalent of 2 x 100m 1 x 150m @ 100% ?
Not at all, as the intensity is lower. This is the point of having variability of intensity within the HI range. This would allow you to get in the muscular work between the most CNS taxing workouts.

Can 300s help the sprints?
Sure for some- others may use a shorter range of SE runs. As a general observation, the people with the highest speed tolerance may choose SE reps over shorter distances, and those with a slightly lower speed tolerance may use 300s (lower CNS stress for a given speed volume [compare 2 x 300m to 5 x 120m in terms of intensity] and more differentiation of speed sessions, thus varying demands). As for recovery 300s and 400s at the pace described, I see no benefit, in terms of recovery, or on the finish of the 100m

I would flip the Special End to Wed and put the Speed End on Fri. This way , the fastest work is Mon, second fastest Fri and third fastest wed, allowing for a better spread of the work demand.

If you've analysed the program on a demand basis, you should be OK.
One further clarification:

Think of CNS and Muscular work like a sine wave.
As the amplitude gets higher, the baseline points get farther apart. As there is performance progression throughout the training cycle, CNS amplitude- and therefore its recovery-(distance baseline to baseline) will get farther apart for a given speed workout, as time goes by, even though the muscular demand will, by design, stay relatively constant.

Does that mean as you improve (performance wise) you have to be even more cognizant of heavy CNS stress and take extra precautions for recovery even though muscularly you might feel fine?
Re Recovery:
Yes, CNS and muscular recovery begin to diverge as performance rises.

Do CNS waves have the same ratios in training, meaning the amplitude and wave length are always fixed but can grow based on CNS depth? So a Speed Endurance session will have a shorter height but the wave length would be of course shorter so the athlete could rebound faster?

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CNS amplitude has a direct correlation to level of impact. For the height this seems to make sense, but the wave length?

I'd use mostly "flying 20s" with relaxed run-ins of varying lengths to determine the execution speed- all with complete recovery. The narrow "breadth" of the work allows the "height" to be accessed more often.

Not all top speed drills have to be practiced at top speed at all times- though it is important to "max out" sometimes.

Neural patterning only requires ONE episode. The point I'm trying to make is that the use of "flying 20s" is, by definition, almost always SUB-MAX, due to the difficulty in getting PBs in this narrow area, and because it works as a learning tool by lowering the breadth of exposure rather than raising the height.

Think in terms of the height and breadth of speed-related qualities, and how they inter-relate. Examples on this continuum might be:
Flying 20 at 12.1mps for up to 1.66sec.
150 from stand at 14.65 or approx 11.0 to 11.1mps for up to approx 10sec of the run
300 meters from stand at 31.0 or approx 10mps for approx 28sec.

In any flying run, you must consider the top speed achieved and the average achieved during the run.
In longer flying runs the average must be lower than it could have been in a flying 20m, therefore likely no better than race pace. It would be better to work above pace- or, at least, at pace with ease more often (ie more reps).

In any speed session, you must stop if you start losing form whether you reach your planned number or not. The number will always depend on the velocity of execution and the level you're training at (the higher your speed, the lower the number)

At SUB-Max speed, you might handle 2 sets of 4 x flying 20s, but at max (supra-max really!) you're probably going to have to stop by 4 reps. Any such workout requires complete recovery between reps and must only be done when your feeling completely fresh.

Runs up to 30m aren't differentiated 95 to 100% for CNS reasons very often as the "breadth" isn't great and the "height" is limited by the velocity you can reach by that distance.

One of the places I've made a "killing" with sprinters is in looking at sprinters early fall (initial) fly tests and deciding where to go. It's not so much the time that they run (although that is a very important element also), but *how* they ran it.

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What were the 10m splits like. Were they even? Was there a big jump or decrease somewhere? What was the stride length/frequency relation like in their fastest segments? When did it occur (1st 10m, 2nd 10m, last 10m). What were the ground and air times like during each 10m?

I would prefer to use a "flying 20" which is the practical limit over which top speed can be maintained. What distance are you using for the run-in to the "flying 30"? Obviously, this will influence the results in the various 10m segments (a short run-in will guarantee segment 3 is fastest, while a long run-in will guarantee a drop-off in segment 3). Also the level of the athlete will influence the results even using the same run-in. These runs do give you an opportunity to view an athlete's limits and technique more often than by more traditional means.

The farther to the left on the strength curve you go, the faster the gains- and the faster the losses, BUT the conditions for improvement in the area must be present. Also, how can you define Speed Endurance as optimal if speed is inadequate, as all SE is dependant on the speed of execution?
This is a complex question that has been presented without much comment before.
1: The duration of stimulus must be counted as well as the intensity (height vs. breadth). Greater range equals longer stimulus.
2: As tendon and bone strength are only increased after stimulation by muscle load, why wouldn't gradual strengthening be advisable? Young- and, sometimes, not so young, athletes can fall victim to avulsion fractures (tendon breaking bone away from its "moorings". Extreme stimulus over a short range should be reserved for the fully developed athlete.
3: Weights are far from the only stimulus that affects the muscle/tendon/bone complex.

Remember also that, with sprinters, there is a lot of muscle endurance involved, so the "pyramid" will have a very wide base compared to the top- compared to a weightlifter or thrower. All top sprinters will find that their strength pyramid is shallow because of the qualities of strength endurance that must be present for success at the highest level.

Can SE make you faster when introduced early?
The answer is probably yes and no. SE does have an effect on the density of muscle and cross-linking, similar to that produced by maximal efforts in lifting or short speed, though achieved via another, complementary mechanism. In terms of perfecting execution patterns, the small number of reps possible and the physical state in the late stages of the runs, makes SE a poor primary learning opportunity. I think, for most people, SE is most complementary when introduced after most of the speed and almost all of the technique is already in place.

What is the complementary mechanism?
There are probably several mechanisms at work.

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First is the enhancement of overall fibre recruitment by another means, (serially vs all-at-once as in max weights, or, to a slightly lesser extent, pure speed) which can be advanced even after the primary means have reached a plateau.
Second is the increased density (cross-linking) which causes a given amount of heat, generated by work, to be contained in a smaller volume, which, along with increased micro-capillarization from tempo, concentrates more heat within muscle fibres. Greater heat and proximity of fluid around the MM neurons lowers electrical resistance allowing the Intermediate Fibres to take on FT characteristics.

Can plyos/explosive med-ball be used to keep a strength stimulus present and avoid the qualities going towards endurance? Also, if you feel a sprinter's mass is hurting his performance (max velocity phase), how would you go about fixing it?
Yes, the plyos and med ball can replace the weights. Body size will probably re-adapt to the new training in time.
Be careful of radical solutions- which might be worse than the problem! Train effectively a watch the changes over a reasonable period of time.

It's true that post session stretching can shorten recovery times by 4 hrs, but this shouldn't change the dynamic with the CNS- only with the muscular recovery.
While 48hrs is the standard recovery period between speed sessions, there must be some leeway to allow somewhat shorter spreads when using split sessions and the smaller volume within each session will alter the height x width (intensity x volume) impact of each segment.
Because speed work is usually most effective a minimum of 5 hrs after rising, the order of high intensity elements may have to vary and that may alter the selection of pre-speed work lifts.

Intensity

A 100% performance doesn't equal 100% contraction. It equals the best possible interplay of muscles that the athlete can achieve.

That ideal interplay will generate the best times all along the way, though in the learning process, it may be necessary to give up some time at the start to get into the ideal rythem for the rest of the run.

Remember that you can adjust intensity within categories, for example, high intensity runs from 95% to 100% of best time and there's a BIG difference in performances within this category.

95 to 99% speed IS sub-max. Max is 100%.

The level of the athlete will determine the CNS demand of 100% sprinting. A beginner will be achieving PBs all the time, so 100% performances are a regular

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occurrence, but at the world record level, obviously PBs are rare and the vast amount of speed work will be sub-max.

I would be careful of the concept of “trying” to run at 100%. If you run smooth, things will often sort themselves out, if the technique is good.

What do we mean by 100%? Do we mean 100% effort, or are we going by time? If by time, then the trick is to train so that when we do speed work, that it is 100%+.
The percentage consideration is time-related only- not effort.

Sprinting/acceleration is a blending of qualities that are interdependent. In other words the conditions required for optimum performance in one area are set up by work in others (establishment of appropriate muscle tone etc), including optimal TIMING between sessions. If you get too trashed for too long, you loose the optimal tonus for the subsequent session, even if you're fully recovered.

The fatigue levels for high performance sprinting cannot be predictably measured during the session itself (the faster you go, the easier it feels while you're doing it- it's the day(s) after you need to worry about)!

I can go at 100% effort every practice, but my times won't necessarily be where they should be.
Furthermore we have to consider what other factors there are in measuring our intensity such as 100% over 100 meters or 100% over 70 meters.

So maybe choosing what type of sprint you run is a way to not go a 100% all the time.
Maybe flying sprints are a 100% because you run faster in them then any other sprint, and accelerations are in the 95%-100% range and special endurance is in the 92%-95%.
Maybe the intensity is defined by what type of sprint.

When an athlete would run a PB at practice you would move on to the next part of the workout.
Depends on the distance and how strong the performance is. A PB in the 600 at an intermediate level doesn't call for a break- but a PB at or close to world record level over 120m does. It is also dependant on the size of the PB.

If the workout is 3 x 200 and your PB is 21.00 and you run 20.86 (=101%) in the 1st 200 for example, you would stop there and skip the other two?
Depends on how demanding I thought it was, but, most likely, I'd carry on with the other reps at a sub-max pace (21.2= 98% to 21.5=97% for example: + 0.4->0.6)

You need to use your judgement.

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It may be a little difficult to define the gradations between 95 and 99%, though you can adjust quite finely. For example, in sprinting, you can dial up the muscular demand yet maintain a lower CNS load by running into the wind and reverse this by going with it for the same running time.
I might start with 95 to 96- or even 97% in your "capacity" category, with 98 to 99% in the higher risk category. Certainly proactive planning can create a peak exactly where you want it. World Records and personal bests by my athletes were almost always set in the most important meets of their season.

Speed improvement occurs within a much narrower intensity range than strength and endurance development. For example, improvements in maximal strength occur mostly within the 80-100% intensity range, and maybe even lower. By contrast, speed improvement really only occurs at intensities over 95% (that's objective performance, not perceived effort). Anything below that intensity will cause fatigue and may improve endurance, but it won't increase maximum speed, unless you're a rank beginner.

Unfortunately, most coaches' "speed" workouts take place in the no man's land intensity zone between 75% and 95%.

Therefore, proper speed workouts need to be at least 95% or faster of best performance.
It doesn't take much fatigue to drop you below the 95% mark, at which point you're just making yourself tired, which is how most athletes and coaches judge their training.

Be careful not to go in the wrong direction. You'd be best to do more reps slower to build fitness first- but, certainly you DON'T go from SE with full recovery to "SE" with partial recovery when the meets have already started. In other words your SE will be getting slower instead of faster- as it must if you want to improve!

In order to maintain the necessary intensity levels, there must be complete recovery between runs. For 30m sprints I suggest at least 3-5 min. It's not the muscles that need to recover, it's the nervous system, which takes about 7 times longer to recover.

The fatigue created by a speed workout at the requisite intensity levels will also require several days of recovery.

If you perform sprints without enough rest between runs or between workouts, those sprints will not be fast enough to improve your speed. What you will improve is your ability to repeat a lower speed.

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You can always start and finish at the same pace, regardless of the rest period, if the pace is slow enough. It all depends on the objective of the training session. But if you want to improve performance, fast SE is the name of the game.

The reality is that the body's ability to tolerate sprinting at the necessary intensity levels is VERY limited.

For high-level sprinters, after a short series of spectacular workouts, the recovery cycle might be 7-10 days, during which they wouldn't go above 95% intensity. A consistent volume of tempo training and massage is maintained during this 7-10 day period.

On the other hand when the athlete has had a workout consisting of 95% intensity runs reinforcing "smooth running" he/she can go in the weight room and really "blow them up".

The faster you get the less often you can have a PB in training- or Comp for that matter. This means that you must use a judicious mix of max and sub-max work, so that max and supra-max speeds can be achieved at key times in the program.

Don't throw in the kitchen sink with every HI workout. You'll get there in the long run with a careful distribution of the work. Keep your eye on the advancement of the individual HI components. Are they moving forward as they should?

Volume

"Less is More". Less volume (less fatigue) allows for more intensity, which produces more speed.

Create a pyramid with the time available and go up (increase volumes) for the first half and down into the meets after that.

Any training between sprint workouts must be below 75% of best performance in order to avoid additional nervous system fatigue that will interfere with recovery from the sprints. I would recommend more than 48 hours for most people, except for high level athletes who have developed their work capacity over several years of training at high intensities. Therefore, for most, this means about two speed workouts a week.

There is no ideal volume- only specific solutions for individuals. Ideal volume depends on:
1: Nature of program- short-to-long or long-to-short.
2: Number of training years- more can be gained initially by developing general fitness first, and, as the beginner reaches his (lower) top speed sooner in the race, he will spend more race time in the speed endurance area.

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3: Time of year- the vol. of accel work must be balanced against required vols. for speed and speed endurance.
4: Individual tolerance for high intensity work (less tolerance requires more work in the endurance portion of the equation)

There is a definite limit to the amount that is appropriate, and that limit is reached exponentially sooner by those with the greatest capacity for power development (another term for natural talent).

The principle guideline must be your own capacity. Don't forget, there is a HUGE difference in the CNS demand in runs as they rise in intensity above the 95th percentile. 24 runs at 95% might be very do-able, but 24 runs at 98% would have serious consequences- even if the workout could be completed. (Mennea ran his max runs in 6.1 and the vol. runs in 6.4 to 6.5- so extrapolating to 100m this equals the 94th to 95th percentile for volume work.)

Can the sprints be divided up into multiple sessions on the same day?
Yes, certainly, if you have the time. The whole day's output is counted as the stress. The only tricky part is the time differential between the last speed session of the day and the first speed session of the next speed day- you'll have less than 48 hours, but there's usually a bit of leeway in the formula, though you may need to play around with the timing. If a 3x/day setup doesn't allow enough time for you, a 3x/day set up with the first session being light tempo/warm-up and the 2nd and 3rd sessions speed should work out. With a 2x/week speed format, either set up could be accommodated.

If you are preparing for the rounds in major competitions you should do 3x1, 4x1 or 5x1 distances that you will run (example, if you run 100m you could do 4x1 100m max. intensity with rest between reps 12-15 min. or 4x1 110m rest is the same)!
I know for a fact that former east-German athletes used to do this prior to major competition (Tomas Schoenlebe 5x1 400m all reps between 45.00-45.50 and rest was 20-30min ,this he did before WC in Rome and he won). Of course, to do this you have to be well prepared.

The Taper

A reduction in volume and an increase in intensity increases the stress on the CNS and lowers the possibility of performances.

The taper consists of a slight reduction of intensity on the speed work and a reduced speed vol by session and by week. The slower work has no real cost to the CNS and needn't be reduced much, if at all.

Why can't speed and special endurance co-exist 14 weeks away from a championships? Surely a 2/1 or up to 3.5/1 volume ratio of speed to speed

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endurance is ok till the last 10 days. The special end runs can be reduced from 2 to 1 per session over the last couple of sessions.

It is advisable to progress to a maximum volume of speed work during a training phase and maintain it until shortly before the taper in order to prevent a prolonged gap between capacity and load from narrowing the peak too much.

Remember, for every taper period, the numbers must rise elsewhere to average out.

What is the implication on a short to long program and a long to short program? Which method will have more CNS stress during the late stages and why?
All unloading schemes must consider the duration and level of training/fitness to determine how much unloading can take place without a sacrifice in fitness.

Generally, the lower the performance level, the shorter the required taper period.

The loss of training effect is in direct relationship with the amount of training time. If you were to shut down every fourth week of the mesocycle, you would severely limit your annual progress.

The amount of drop on the fourth week operates linearly (if not exponentially) over time, year after year, and as you advance through the training cycle (it takes a very slight drop after mesocycle one, but significantly more after mesocycle five).

Likewise, as the need for recovery rises, so does the capacity to take it, but the ability to shut down totally would not occur more than once or twice per year and only for the most advanced athletes.

14 2xPB CNS: Very High
13 Tempo
12 Race CNS: High
11 Rest
10: Speed 400m CNS: High
9 Tempo
8 Speed 400m CNS: High
7 Tempo
6 Race CNS: High
5 Rest
4 Speed 300m CNS: High
3 Tempo
2 Speed 2x120 CNS: Med-High
1 Rest

10 Days “Emergency” Taper model

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Coming out of bad Comp and poor physical state:
8: Rest
7: Rest
6: Tempo 10x100 Micro stretch
5: Tempo 10x100 2 x 3 Explosive Power Clean @ 60% Micro stretch
4: 4x30m, 1x60m, 1x80m Ice Bath
3: Tempo 10x100 (very easy), Salts Bath
2: 4x30m @ 95%, 3x3 Bench Press @ 80% Contrast Shower
1: Warm up
0: RACE (2x100m)

This is what I would do. I think it's better to leave training as late as possible so that you can get over the cold, whilst keeping in mind tonus and CNS requirements for your race.

12 Days Taper Model
12:Friday: speed/weights
11:Saturday-tempo
10:Sunday-sp/weight
9: Monday-tempo
8: Tuesday-spec endur
7: wed-tempo
6: Thursday-sp/weight
5: Friday-tempo
4: Saturday-massage/off
3: Sunday-sp/weight
2: Monday-OFF
1: Tuesday-off/starts over 20mx3
0: wed-COMP

In East Germany, sprinters ran their last full-speed work-outs 10 days before their meets---an unheard-of gap in the West.
There were more surprises. During that last maximum workout, Hille's women sprinters performed about as much speed work as mine did, but at an even higher intensity---in some cases at world-record paces. Hille's athletes would run:

4x 30-metre starts +7'RI
15-minute break
1x 80-metre sprint
20-minute break
1x 100-metre sprint
25-minute break
1x 120-metre sprint
35-minute break
1x 150-metre sprint.

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These were extraordinary rest periods- my own sprinters had never paused longer than 15 minutes between speed runs at those distances, and most coaches allowed for rests of five minutes or less.

These extended recoveries, along with the East Germans' incomparable massage, physiotherapy, and other support, allowed their sprinters to go at their absolute maximum on that 10th day before the meet. The work was of such high quality that a sprinter's central nervous system---first drained by the intense speed, then recharged by the ten-day taper period---would rebound like a pogo stick on the day of the competition.
(To use the technical term, the sprinter would 'super-compensate' to an even higher peak than the last maximum work-out.)

In between---usually on the eighth, sixth, fourth, and second days preceding the meet---Hille's sprinters would perform a single speed drill, either 80 or 120 metres, at 95 percent of maximum intensity. In these work-outs they were simply keeping their muscles tuned, without deepening fatigue.

For the 10 day period before the most important competition (for high level athletes) runs beyond 30m are restricted to the sub max category - as the training objectives have already been met, and are now merely being maintained with as little effort as possible to allow the organism to rebound to super compensate for the "Big Day".

What about the idea of more runs 2 days out, i.e. 4 x 30m block starts and one short, sub max run, with the day off before the meet? That way he won't be flat.

About the 10 day taper.
If you do it too often, you loose the qualities you built up.

This approach is the most effective for those at the highest level and the most high intensity training background. This is because training effect can be maintained/advanced from this procedure only by the successful administration of a very high intensity stimulus at the end of the taper.

One possible scheme is:

Fri: (today) easy tempo, 2 sets of 10 x 100m at a very easy pace on grass
Sat: Sun- off.
Mon: relay exchange practice (4 passes, 20m run-up to and out of zone only),
Starts= 4 x 10, 4 x 30 from blocks (for hurdles: 4 x 1h, 4 x 3h from blocks)
Sp= 1x120, 1x150 VERY SMOOTH with full recovery.
Tues: Tempo 10 x 100m very easy on grass, sit-ups, stretching, etc.
Wed: very easy relay work to concentrate on marks (outgoing runner judges the mark to ensure leaving at the right point, incoming runner DOES NOT

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catch the outgoing runner to make the pass, therefore the work is very easy (3 in and 3 out)

Thurs: 4 x 30m block starts (or 4 x 3h from blocks)
Fri: off
Sat: competition

I like to see some stimulation closer to the meet, but not always the day before.

The time you can maintain the required stimulus usually depends on the athlete's level- the higher the longer. Also, it depends on the vol. and intensity of the previous training- again, the more the longer.

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