Periodization, planning, prediction:

And why the future ain't what it used to be!

John Kiely
UKA Athletic Conditioning Education Lead

The purpose of this article is to re-visit some of the key underpinning beliefs of the traditional periodization model, to examine the evidence and logic supporting these assumptions, and finally on the basis of this discussion to uncover any potential implications for training planning philosophy. Needless to say, it will not be feasible to address every aspect of the debate. Therefore, let's sidestep aspects of periodization that have been covered extensively elsewhere, and instead focus on some novel, and hopefully interesting, ways of considering the planning problem.

To begin..

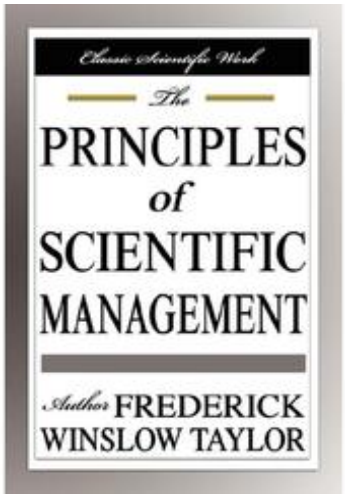
Athletics has been blessed with many knowledgeable, experienced, insightful coaches who have left a lasting planning legacy from which the sport has benefited. Lydiard and Daniels get much of the press in the endurance domain, but there have been others. A Bondarchuk in throws, a Pfaff in sprints, everybody has their personal favourites. Yet it seems we still have a long way to go to figure out how best to construct and manage training plans. There are many unresolved questions. Athletes perform brilliantly using one training structure, yet the next season performance drops even though the training regime remains the same. An athlete has a disrupted training season when nothing goes to plan, yet performs better than ever. Injuries, illness, symptoms of overtraining, continue to plague athlete preparation. While there is no question that these will ever be eradicated, could their
incidence be reduced through more insightful planning methods?

In addition, an interesting observation is that athletics is not alone in having planning problems. Governments, the military, large financial institutions, all put colossal resource in terms of finance and brainpower behind planning initiatives. Yet, the best laid, the most costly, the most thought-through plans, more often than not still end up over-budget and beyond the deadline. Why? What's so difficult? Why can't we get it right every time?

Firstly, back to the start. Where did it all begin?

Frederick Winslow Taylor is not a name often associated with athletic training planning philosophies, yet arguably, his work provided the original basis for much of what was to follow. To recap on some history, Taylor was the industrialist credited with first applying scientific principles to the management of the production industry. Taylor combined the scientific knowledge of the day, his pioneering 'time and motion' studies, and what can best be termed as managements prejudice towards workers ('all we want of them is to obey the orders we give them'), to construct the first great planning paradigm of the modern era.

Taylor firmly believed that there was a 'one best way' to organise, manage, and plan. It was his belief that optimal practices were deterministic in nature, in other words that once optimal practice templates were uncovered that they remain stable and did not change. Hence, once the 'best' plan is formulised all that needs to occur is for this to be repeatedly implemented. Accordingly, Taylor believed in the strict segregation of plan and process. Step 1, gather the relevant information and formulate the plan, step two, execute the plan. End of story!



Henry Ford famously adopted Taylor's planning paradigm, to the extent that this approach was frequently referred to as Fordism. Somewhat more ominously, Taylor's approach was embraced by Lenin and was acknowledged as a formative influence on the 5-year planning template of the Soviet Union. Arguably the most tragically inefficient periodized plan of all time.

So, what's my point?

The purpose of this preamble is essentially to highlight the fact that the original basis for athletic training plans was this historical cultural planning template. So in essence, when the Soviet training theorists sought to construct training planning templates they combined the cultural planning blueprint (as per Taylor and the philosophy of the 5-year plans), with training records, and contemporary scientific knowledge. So for example, the historically influential Matveyev, collated training data from the 40's and 50's, in swimming, running, and

weight-lifting. He then crunched these figures into the industrial planning blueprint, and justified his stance by carefully selecting scientific evidence that seemed to support his position. Accordingly, the original periodized planning concept was essentially the industrial planning template applied to sports training, with all the same strengths, weaknesses, and assumptions.

The issue with this historical legacy is that it was based on very simplistic generalizations on how the world should 'work'. The question is do we still have a 'hangover' from this original planning logic? Are our periodization methods still based upon planning assumptions that do not necessarily fit with contemporary knowledge?

To build the case…

Any discussion is hampered by the fact that there is no longer a universally accepted single definition of 'periodization'. The term was originally coined to describe training programs that took the form of a pre-described sequential chain of linked training periods or blocks. However, commonly nowadays the term is frequently indiscriminately used to describe all possible forms of training planning, regardless of structure.

In an attempt to better contextualize the discussion, we will consider the traditional periodization framework as characterised by the following underpinning assumptions;

- **That there is a 'one best way'**
- **Plan is separate to process; in other words, first you plan, then you execute**
- **Planning is top-down, so coach 'says' and athlete 'does'**
- **The segregation of the program into distinct training blocks is advantageous**
- **There are universal time frames for eliciting, and retaining, specific fitness adaptations**
- **That various fitness attributes are best developed in a sequential hierarchy (for example; strength before power, endurance before speed)**
- **That progress is predictable and follows a set pattern**
- **It is possible to accurately pre-plan future training schemes and loadings**
- **That the empirical description of training loadings is an accurate and adequate means of quantifying training-induced stress and consequent adaptation**
- **That adherence to a pre-planned loading scheme is desirable**

Regardless of your preferred periodized scheme, and give-or-take a split hair or two, this appears a broadly accurate synopsis of the core underpinning beliefs of periodization theory.

Over the course of the past decade or so some inventive, and impressively named, periodization schemes have been proposed such as reverse, block, non-linear, fractal, conjugate sequence, and so on. While there are superficial organizational differences in how training variation is scheduled in these programs, the underlying assumptions of these schemes are still reflected by the general 'rules' described above.

So, why are periodized training schemes most effective?

Firstly, is there any actual evidence that periodized training methods are optimal?

1. Scientific evidence

The term 'the science of periodization' is one that repeatedly crops up in the training literature. There have certainly been many training studies cited as 'proof' that periodization is the optimal method of organising training. However, on closer inspection it is clear that these studies have actually only compared training interventions with no training variation to those with degrees of variation.

Demonstrating that training programmes with high degrees of variation have more benefit than those with no degrees of variation does not necessarily support theories of periodization. Such results only highlight that physical training variation is beneficial but offer no insight into how that variation is best scheduled and organised. Accordingly the citing of such studies as scientific validation of periodization theory is a fundamentally flawed argument.

Furthermore, there have been studies that do not show a beneficial effect from training variation. However, these studies tend to have two design factors in common;

(i) They were completed over a short duration, typically a couple of weeks
(ii) They used subjects who were untrained, and had an initial low level of fitness, for example inactive elderly groups

Therefore, a reasonable working assumption may be that the need for variation is dependent on both the training status of the subject group and the time-scale. However, for competitive athletic groups it seems safe to conclude that ensuring training variation is a necessary component of effective planning.

To re-iterate the key messages on review of the literature; there is

evidence that training variation is a critical design feature. Moreover, although there are plenty of theories proposing how this variation is best applied, there is little or no supporting evidence to help us differentiate the effective from the ineffective variation schemes.

2. Observation

Anecdotal 'evidence' can be powerfully persuasive, but also dangerously misleading. Pointing at a great athlete who succeeded using training plan 'X', is essentially meaningless. Could they have performed more impressively with a different plan? What about others who followed the same plan yet failed? Arguing the worth of any training plan based on that plans 'survivors' doesn't move us forward. While examining how former champions trained is always both interesting and educational, it becomes culturally damaging when these methods are interpreted as being the 'best' and are consequently held up as idealised planning templates for others to follow.

OK, so there's no hard evidence, but it still makes sense, right?

Doesn't it make sense to consider the problem, plan in detail, make a firm decision on the best course of action, and then have the grit and determination to follow through on the prescribed course of action?

Sure, it makes sense, to a point. Assertiveness, courage, and the stubbornness to grind out sessions are all attributes that are rightly admired and critical to achieving optimal athletic potential. However, these same human qualities, if erroneously applied have a very obvious downside. Consistent training errors inevitably lead to negative outcomes; injury, illness, and the various manifestations of psycho-physiological stress mismanagement such as overtraining syndrome, staleness, and burnout. Courage and perseverance, blindly applied can be as much a curse as a blessing.

This leads us to a fundamental question relating to our training planning culture, a question that has very rarely been explored to any degree of detail.

Is it possible to accurately advance plan future training?

Part of the legacy of the traditional planning model is the unspoken underpinning assumption that it is possible to adequately estimate, in advance, the condition of the athlete at some future juncture. After all, if you can't accurately predict where the athletes 'fitness' will be, then how can you possibly forecast the training scheme and loading variables that will be appropriate? How confident are we that this can be forecast, and to what degree of accuracy?

To explore this critical issue let's look at it from two very different

angles. Firstly, from a biological, and secondly from a psychological perspective:

1. Biological perspective

Is it likely that there is a 'one best way' to organise training? Is a training scheme that worked for one athlete likely to work for the next athlete? Will training schemes that worked for an individual athlete in the past, work for that same athlete in the future?

Consider the underlying biological variables that will dictate the training response to any given session, or sequence of sessions. Essentially these can be broken down as follows;

- Genetic inheritance
- Transient states of biological functioning
- Habituation to similar stress exposures, i.e. training history
- Psychological variables
- Environmental factors

All these variables have repeatedly been shown to have a significant impact on training response. What has not always been appreciated is the magnitude of these effects.

Let's take a brief look at a couple of examples..

Firstly, consider the findings of the HERITAGE Family Study, a linked series of over 120 studies investigating the role of genetic inheritance in responses to exercise. The results of these studies have important implications for understanding human variation across the physiological attributes.

For example, training induced changes to VO_2max were established to vary widely among a large group of subjects in response to identical training parameters. In this study high, medium, and low responders existed among all age groups, both sexes, among blacks and whites, and at all levels of initial fitness. In relation to VO_2max adjusted for age, sex, body mass and body composition, genetic factors explained about 40% of the variation. The average increase in VO_2max was 19%. However the range of responses was truly surprising, 5% of the subjects demonstrated little or no change in aerobic capacity, and about 5% had increases of 40 to $\rightarrow$50%. Furthermore, there was no relationship between the initial level of VO_2max and the changes to VO_2max after training. In other words, it appears that one set of genes influenced initial fitness and another set of genes influenced the response to training.[1]

So, this example considering only one small aspect of overall fitness, exemplifies the wide spectrum of possible training responses that can occur when a group of individuals partake in identical training programs.

Obviously, these findings need to be taken with a pinch of salt as subjects were not elite athletes. However, they were human! The key learning point is that as a

species our responses to imposed stressors vary tremendously. Not only in relation to the magnitude of our response to any given form of training, but also with regard to the timescales of retention of varying fitness attributes. Just as we all have differing strengths and weaknesses; we will all also be sensitive to differing training triggers and risk factors.

So, the next obvious question is; although sedentary people will vary in training response, elite sportspeople probably won't vary as much because they are all likely to be high responders, right?

Consider the following..

A recent investigation, conducted with professional New Zealand rugby players, established that different weight-training sessions resulted in significantly varied hormonal responses amongst a seemingly homogenous group of individuals. In a related study, the hormonal responses of players to four distinct weight-training protocols were determined. Players were then alternatively trained for three weeks using the protocol that elicited either their maximum or their minimum testosterone responses; they then crossed over to the opposing protocol for a subsequent three weeks. All the players demonstrated significant gains in strength measures when they trained using the protocol that elicited their maximum testosterone response. In contrast, when the players performed the protocol that resulted in their minimum testosterone response, either no change or a significant decline, in tested strength measures resulted.[2, 3] A logical conclusion might be to suggest that if all players had performed the same standard session, then some would have benefited substantially. However, others, whilst performing the exact same training, would have made little or no gains.

So what?

The significance of the above is essentially two-fold;

1. Individual athletes will respond differently, to one another, to identical training sessions
2. Identical training sessions performed by an individual will always elicit a different training response, for that athlete, depending on the state of underlying transient biological parameters

What's the relevance to athletics?

The reason for including the above research is purely to highlight the fact that individuals respond in an individually specific way to particular training sessions, just as they will to specific diets, specific disease risk factors etc. It is the interaction between genetic inheritance, aspects of environment and lifestyle, psychological factors, previous

training histories, and imposed training stress that will dictate the eventual adaptational response. So there are no 'one size fits all' exercises, sessions, or planning structures, even when dealing with groups of similarly conditioned elite athletes.

2. Judgement & foresight

Human performance in judgement and predictive tasks has been extensively investigated within both behavioural and social psychology domains. Although the relevance of this research has not yet percolated into coaching cultures, there are potentially powerful insights to be gleaned by those willing to consider the implications.

How is this relevant to training planning?

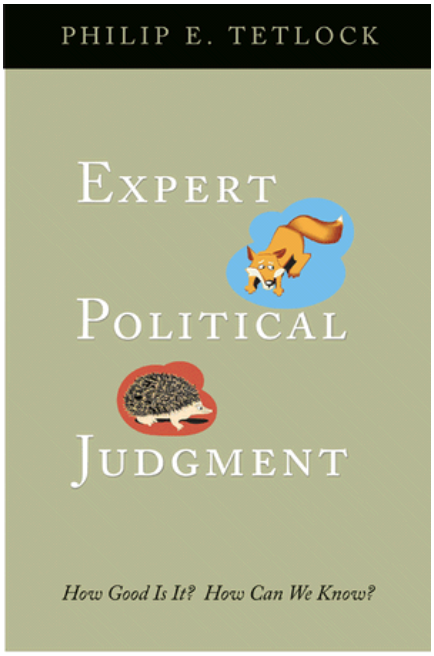
A particular area of interest is concerned with testing the ability of 'experts' at predicting future system states. Consider the 20-year study run by Philip Tetlock of UC Berkley. This was a particularly well-designed large-scale study, involving 284 professional experts who made their livelihood from commentary and prediction of political and socio-economic trends. All of these experts were given regular lists of questions and asked to predict future system outcomes. All experts had access to extensive information, had extensive experience (average of 12 years in their specialised areas), had high levels of relevant education, and were considered leaders in their respective fields. Yet, when the results of the many thousands of predictions were collated, it became blatantly obvious that their ability to predict was universally poor. No single expert came remotely close to being consistently right. In fact only in certain cases was expert prediction better that what the researchers termed 'dart throwing chimps'. In other words randomly generated guesses.[4] see text box 1

So what?

There are very definite parallels between the two arenas. The main similarity is that both the political-economic system and the athlete-training system are examples of complex adaptive systems.

Bear with me for a moment on this..

Complex from the perspective they are comprised of multiple systems that interact in non-linear and unpredictable ways. Adaptive, from the perspective that both systems are capable of spontaneously modifying behaviour in order to accommodate unexpected change or sudden perturbation. So for example, the stock exchange (when functioning normally!) reacts in self-correcting, self-organised, and



unpredictable ways to absorb fluctuations, just as the biological system will spontaneously modify its base level of function in response to training imposed stress.

Chaotic properties are a fundamental component of such systems behaviour. Most of you will have heard of chaos theory and the butterfly metaphor. However, chaotic systems are not truly chaotic, and the butterfly metaphor is not very good at explaining how such systems work. Much of the time, chaotic systems remain relatively stable and are capable of absorbing stresses and traumas without disruption. However, if the system is sufficiently delicately poised, small, seemingly innocuous occurrences may undergo amplification as they propagate throughout the system, eventually being manifest as major events that have large-scale consequences.

So one small, apparently unimportant, occurrence in some isolated stock values results in a knock-on effect that rapidly escalates to financial pandemonium. An athlete chooses to ignore a low-level early warning sign, say a slightly irritated hamstring, decides to follow the session as outlined in the program and finish their reps.. And bang! Season threatening injury. Why? What caused it?

A confluence of small minute factors conspiring to suddenly, and unexpectedly, initiate a catastrophic event.

And that is a key point. Chaotic systems can react unexpectedly to a single low-level event, or a series of interacting low-level occurrences. This biological sensitivity to small events makes accurate forward planning impossible. The chaotic, highly sensitive, nature of the biological system will ensure that the progress of physical fitness will not be an orderly, uniformly incremental, and predictable process. The adaptive responses to any given training 'inputs' will not result in readily predictable fitness 'outputs'.

Accordingly, this FACT subtly alters how we should perceive the training plan. The traditional planning model typically presents sweeping generalizations in relation to the 'best' approach in terms of structure, sequential order, phase duration, and so on.

However, logic, based on evidence, points us in a subtly different direction.

Now, obviously, nobody can construct training plans that can account for all minute potentialities. However now that we are aware of the scope of the problem are there some key alterations that can be made to planning practice that can help to reduce the likelihood of training errors?

Some thoughts..

- Optimal training plans should be sensitive and responsive. Sensitive to emerging low-level threats, and also to unexpected training opportunities. Responsive so that coach and athlete can react to threats and opportunities by seamlessly changing the forecast plan without disrupting the overall shape of the program.
- Prescribing training purely in numerical terms (sets, reps, loads etc) is insufficiently accurate.
- In order to enable seamless on-going modulation of the program, future training should be only broadly defined when advance planning. However, when delivering sessions prescribe training meticulously using cross-referenced training parameters. Especially during 'high gain/high risk' sessions. See text box 2
- Include 'what if' options in session prescriptions. For example, "If technical quality &/or 'feel' or pain symptoms deteriorate to 'X' level, then adjust by taking the following action", (for e.g. increase rest interval, terminate session etc).
- Avoid decision-making arrogance bred by the 'expert problem', i.e. over-confidence based on previous success.
- Be wary of generalized 'rules'
- Do not expect athletes to adapt along what are considered to be conventional norms.
- Develop athlete decision-making judgement through relevant guidance and education.
- Optimise communications and feedback systems with athletes.
- Record and review training data, analyse the trends, learn the lessons, and adapt accordingly

And, finally..

Mike Tyson was once quoted as saying, "everyone has a plan, until they get punched in the face", and that's actually a very perceptive comment. Humans plan on the basis of optimistic; 'hoped for', outcomes, and our brains are not well disposed to dealing with forecasting in uncertain environments. When reality

intervenes in unexpected ways rendering the plan no longer viable, we habitually over-commit to adhering to the plan. In essence, trying to dig our way out of a hole.

Formulating restrictive plans on the basis of generalised 'rules', and attempting to adhere to such plans, will ultimately lead to training errors and inefficiencies. Our only defense against an uncooperative complex reality is to be aware of our planning and predictive limitations. Accordingly the planning task should be one of constructing and managing a sensitive and responsive training system that accommodates on-going change, while all the time irrepressibly homing in on the competitive goals of the athlete.

We started with a Yogi Berra quote, so here's one to finish; "I knew I was going to take the wrong train, so I left early". Plans will very rarely follow the predicted course, be prepared, and allow space for change.

Text Box 1:

Just how good is human predictive ability?

Interestingly, the experts who fared worst in their predictions were the very ones who had the most confidence in their forecasting abilities! This group felt that by benefit of their experience and expertise that they 'knew' how things worked, that they had figured out the pattern, and it would appear that this over-confidence made them increasingly vulnerable to decision-making error.

It is a natural human tendency to observe the world around us and to try pick out patterns in our attempt to understand. When knowledge is scant, we interpret on the basis of limited evidence and build theories around this truncated snapshot. Consequently, when we employ these simplified representations of reality to make predictions of the future, we are rarely right. For example, optimists have been demonstrated to grossly underestimate the time required to complete projects, surprisingly so too have pessimists, just not by quite as much. This problem is amplified by the all-too-human instinct to over-estimate how good we actually are at predictive tasks. We all tend to think that our personal experience and our unique insights have granted us a special ability to make accurate judgements. Unfortunately, fifty years of research ranging from the classic work of Paul Meehl in the 1950's, to contemporary evidence, such as the 20-year Tetlock study, have consistently demonstrated that our confidence is ill-founded.[5] There's not a lot we can do to counteract human nature, except be aware of its tendencies. Forewarned is forearmed!

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Who is Yogi Berra?

Lawrence Peter "Yogi" Berra (born May 12, 1925) is a former Major League Baseball player and manager. He played almost his entire career for the New York Yankees and was elected to the baseball Hall of Fame in 1972. Berra was one of only four players to be named the Most Valuable Player of the American League three times and one of only six managers to lead both American and National League teams to the World Series. Berra is also well known for his witticisms, known as Yogiisms. Such as...

As a general comment on baseball: "90% of the game is half mental"

On why he no longer went to Ruggeri's, a St. Louis restaurant: "Nobody goes there anymore. It's too crowded."

In July 1973, when Berra's Mets trailed the Chicago Cubs by 9½ games; the Mets rallied to win the division title on the penultimate day of the season."It ain't over till it's over."

When giving directions to his New Jersey home, which is accessible by two routes: "When you come to a fork in the road, take it."

Berra explained that this quote originated when he witnessed Mickey Mantle and Roger Maris repeatedly hit back to back home runs in the Yankees' seasons in the early 1960s. "It's déjà vu all over again".

"You can observe a lot by watching."

"Always go to other people's funerals, otherwise they won't go to yours."

Responding to a question about remarks attributed to him that he did not think were his: "I really didn't say everything I said!"

Text Box 2

Is numerical prescription of training sufficiently accurate?

In a previous survey, investigators examined the relationship between training prescribed by 123 coaches and the self-reported training of their best runners. The results illustrated that the association between the coach's prescription and the actual training performed by the runners were generally poor. This was attributed to inefficient communications between coach and athlete. The athletes did adhere to the coach's prescriptions with regard to run volumes. However, the desired intensities described by the coaches, and performed by the athletes, were different.[6] Similar findings have been documented in both swimmers and triathletes. This is further supported by practical experience when runners prescribed training has been compared to actual training conducted using systems such as accelerometer foot-pods, GPS, and old-fashioned detailed diarising.

The triangulation of variables will aid the coach and athlete in more accurately defining training parameters, therefore helping to eradicate some of the pitfalls inherent when describing training loadings in solely empirical, uni-dimensional terms.

Examples of triangulation of training prescription;

For the desired training adaptation; this is how much work you need to do; this is how the work should feel; this is the necessary quality;

	Training parameter	**How to quantify**
Volume	Recommended range of sets & reps	Numerical prescription
Subjective feel	How efforts should feel during execution	Athlete rating (e.g. 1-10)
Quality of effort	Expected technical quality OR speed OR distance thrown/jumped	Coach rating (e.g. 1-10) Timing system Measurement