The New Principles of Fitness Science
Influence · interaction · reliance

Brian D. Johnston

Although, as the title suggests, these are *new* principles of fitness science – new in the sense that another source that makes reference to these principles do not exist to my knowledge – they are relative to any other facet of existence, and not just fitness. Nonetheless, they are not mentioned in any philosophy text or science text in which one would expect[1]. Perhaps these principles are considered so common sense, I believe, that they have not been discussed or catalogued, and such will be obvious to the reader upon review.

These are the principles of **Influence**, **Interaction**, and **Reliance**, and they state the following (within a narrow context of fitness):

Principle of Influence: Any factor within a fitness prescription will have a direct or indirect effect on all other factors. An example of a direct effect would be the measure of set volume of a workout relative to the intensity of effort, in that the greater the set volume, the more precarious the level of intensity to avoid an overtrained state on an organism. An example of an indirect effect would be a poor night's sleep that then would interfere with the quality of exercise the following day.

Principle of Interaction: All factors within a fitness prescription create a network or matrix that operates as a synergistic whole. When a fitness program is created, we must consider aspects related to exercise, nutrition and sport psychology, and each aspect within those disciplines then must be considered and balanced appropriately for best results.

Principle of Reliance (Dependence): In order for all factors of a fitness prescription to exist and function as a whole, the interaction will result in some factors being influential while other factors become reliant upon that influence. For example, without adequate recovery, the stimulus of exercise will not be beneficial to produce a positive change, such as increased strength or cardiovascular endurance. Physiological change is reliant on the influence and interaction of the stimulus and recovery. Or, without the existence of an exercise set when strength training, intensity of effort cannot exist, and without intensity of effort, the concept of a set cannot exist. Both are reliant upon the influence and interaction of the other.

*** ***

We can expand upon any of these principles and in various ways, from the general to the specific, and in a greater range than is presented above. Doing so will disclose the diversity and relevancy of these principles in fitness and in other disciplines.

Although *the new principles of fitness* can be treated in a very specific manner, such as the *influence* of intensity of effort on exercise volume or frequency, they encompass a broad complexity that is both elegant and perplexing to behold. An exercise program may be intricate in its design and details, yet viewing the effects of a program from a distance can disclose some obvious patterns, including the *reliance/dependency* on *time* and *nonlinearity*. As we age, from past to present to future, the influence of aging and the narrowing of our genetic potentials (and a *reliance* on an appropriate and altering fitness program) become obvious. It also is true that we do not exist in a linear fashion, as can be exemplified by the constantly changing uptake of energy and flow of blood through our veins, whether at rest, modestly active, or undertaking an intense set of barbell squats.

[1] For example, Trefill, James. *The Nature of Science: An A-Z Guide to the Laws & Principles Governing our Universe*. Houghton Mifflin publishing. 2003

An example of linearity is that for every three sets performed, one rest day is required. Therefore, if nine sets are performed, three rest days are required. We know this to be false, that the body involves disproportionate effects as a result of our internal feedback mechanisms to support our nonlinear[2] systems, since the degree of recovery is *dependent* upon many factors, including quality of sleep, nutrition, intensity of effort of those sets, age, the extent of one's adaptation and tolerance to exercise, etc. – feedback elements within the system that can produce some unexpected changes. An example of positive feedback would be the adaptation toward stronger and larger muscles as a consequence of the *influence* of the exercise stimulus. Conversely, negative feedback *influences* a damping effect within the stress-recovery *interaction* continuum, as a higher state of change is hampered because of too much activity or lack of recovery, for example.

The effect of strain on our systems is only one example of complexity that involves *the new principles of fitness*. Because we are in a constant state of flux, from order to chaos among the thousands of chemical and electrical reactions in our bodies (even as you read this article), it is difficult to conclude how we need to exist in order to optimize fitness – both in regard to exercise, but also general well-being and longevity. When dealing with mathematical complexity theory, the concept of 'complexity' of a problem is defined in terms of the number of mathematical operations needed to solve it. This direction is similar in fitness, in that the complexity of developing a fitness program is borne by the complexity of an individual. Consider a healthy 20-year old male who has the motivation to exercise hard and to listen to the advice of his coach, as compared to a 70-year old woman with a heart condition, arthritis in her left foot, a bowel disorder, and minor dementia. The challenges faced by a fitness clinician, and the time to problem solve solutions become exponentially greater as the complexity of the client grows, and indicates the danger of reductionism and peering too closely at one factor/variable in order to simply existence.

The difference between these the disciplines of mathematics and fitness is that mathematics is appropriate to determine the behavior of simple processes, such as movement of objects in a frictionless environment, but of little value when describing complex, nonlinear relationships of exercise stimulus and adaptation because of the constant changes experienced. This being true, a very bright student of mathematics once presented me with a series of equations he was developing to determine a person's ideal exercise program, including volume, frequency, recovery days, nutrition, and loads. When asked how he factored variances in motivation, cell regeneration in the body, and a poor night's sleep, for example, he had no response – was bright when dealing with numbers and exercise linearity, but not to realize the limitations of applying those abstractions to a concrete and living being in constant flux. It is apparent that we require the study of simple systems to teach and learn, but such systems are exceptions to reality, whereas we need to focus more on complexity and the synergistic effects of how networks and systems operate.

The best we can do is to problem solve solutions to a situation, to look for the best and least viable alternatives to produce the greatest response. In effect, we look to apply the least to achieve the most or, at any rate, that *should* be the objective of an impartial fitness clinician. But even then, the dynamics of a client can change so quickly, whether speaking of the person's psychology or physiological reactions that new solutions need to be developed constantly to address new and developing problems. Nonetheless, this does not involve mathematics, except for the written prescription of what is to be done, but the conceptual direction of how, when, what, and why it is to be done after observing the organism as a whole.

[2] The nonlinearity and uniqueness that is part of every individual has not stopped the fitness industry from spewing one exercise method or program after another, as to denote a universal approach for all, but 'linearity' is how many people think. Hence, some people will find it difficult to integrate the *new principles of fitness*.

Of related importance, it is impractical and pointless to perform an exhaustive scrutiny of every aspect within the solution, since, as stated, reductionism will lead to an exercise in futility. Yes, we need to determine the elements of a fitness program, such as tension time, loads, and frequency, but the overall *influences* and *interaction* of those factors must be considered as a whole and in a broad context. Nor are the 'best' alternatives best all the time. If we consider the value of very intense exercise, to produce optimum changes in muscle strength and hypertrophy, few of us could tolerate, mentally or physically, pushing our limits to the edge every time.

With peaks must come valleys, and an optimum fitness strategy must account for fluctuations in training to meet the fluctuations in our responses in order to *influence* long-term progress and sustenance of a fitness lifestyle. Sometimes we need to take a step back in order to take two steps forward. The required peaks and valleys are *influenced* by the continual uncertainty that exists in the real world, thus making the ability to predict what the conditions or results will be challenging to deduce. This is true since even the slightest uncertainty, such as the fine line between over-reaching and over-training, amplifies exponentially as time passes. Yet, even with such uncertainty there remains a sense of order – we can predict to some extent what is happening and what will happen based on observable patterns of *reliance*, *influence* and *interaction* – and that is why it is called *deterministic chaos*; things appear chaotic, but the body maintains a sense of order throughout the fluctuating changes as it moves from disorder to a self-organized stability.

*** ***

The principles of *influence*, *interaction* and *reliance* can be directed specifically, and still maintain its general elegance. For example, the prominent Italian economist, Vilfredo Pareto, is known for the 80/20 Rule (a name derived by others and not Pareto himself), whereby he noticed when gardening that 80 percent of his peas were produced by only 20 percent of the peapods. He then made a similar connection in economics and saw that 80 percent of Italy's land was owned by only 20 percent of the population. Eventually Pareto's 80/20 Rule became a law of management, whereby 80 percent of profits are produced by only 20 percent of employees, or that 80 percent of sales are made by 20 percent of a business' customer base. This rule has been observed in other areas of life, such as 80 percent of crimes being committed by 20 percent of the criminals, and it should come as no surprise that 80 percent of results in exercise come from 20 percent of workouts.

The 80/20 split is not unyielding, and in some instances it may be 78/32 or something of a similar ratio, but the point is that a majority of something comes from a minority of something else, and exercise is no different. The majority of results come from a chosen few workouts because results occur most when something changes in a protocol, to keep the body on the edge of chaos and to adapt accordingly. But once the body becomes accustomed to the training, further progress slows and is difficult to achieve since the body is adapting or has adapted to the stimulus. Hence, the Principle of *Reliance* dictates that we *depend* on a minority of workouts to produce a majority of results, and brief overview of one's training history will indicate this clearly. Not all workouts are created equal or have an equal *influence* on progress.

The 80/20 Rule was relayed to make reference to what is known as a "power law." Most of us are familiar with the bell curve concept in that most quantities in nature are considered "average," whereas the remaining quantities deviate from average, and when graphed the quantities take on the shape/curve of a bell. For example, if we considered how much the 'experienced' male population between ages 18 and 25 could bench press, we would find that most might be able to press 225 pounds, whereas a few might press upward of 300 and others only 175. In effect, there would be a peak in the middle of the values with fewer and fewer representations that deviate from the norm. In our bench press example, the odd person could bench press over 500 pounds, whereas a few relatively weak individuals may struggle with 100 pounds.

However, how we respond to exercise is non-linear, and that is where "power laws" emerge. A power law follows a different type of distribution, in that it does not have a peak, but a continuously decreasing curve that suggests many small events coexist with very few large events. The income distributions and crime observations mentioned previous follow a power law, and so, too, does exercise progress insofar that the muscular system evolves into a critical state characterized by a long period of static behavior that is interrupted by intermittent bursts of activity – so long as that activity is *influential* as to cause change. In effect, small changes and gains do occur with regular exercise, but it is only when something unusual occurs with exercise (unusually different and sufficient to generate an abnormal stimulus and response), such as changing an exercise program to something dissimilar and equally or more challenging, do we notice big changes.

I have observed this in my training, whereby I gained three-quarters of an inch on my thighs from only five workouts, as a result of a different and unusual training method (and level of overall demands) that I never encountered before, although I trained as hard previously. I experienced a quarter-inch gain in my calves from two workouts – again, because of a very unusual and uniquely demanding protocol. Certainly such dramatic changes are possible only in those muscles with the greatest potential for growth (perhaps 80 percent of large-scale gains are made from 20 percent of one's muscles?), but such is possible if exercise is applied appropriately and strategically, a topic beyond the scope of this article. In any event, power laws do indicate that a few large events carry most of the action, and so we need to look and plan for large events in our training, and not maintain a consistent direction that leads to mediocrity if optimization is the objective.

Also, the results of occurrences *influenced* by power laws do not happen by chance; they often signal a transition from disorder to order – that *edge of chaos*. Consider the order-to-disorder-to-order sequence at the critical point as water turns to steam, or a metal becomes a liquid. These transitions are not random, and although complex they are self-organized (i.e., a self-organized critical state) with a particular behavior to change and adapt with the assistance of feedback systems that ensure a well-defined structure. The structure is so well-defined that when a liquid becomes a gas there is no way to distinguish perceptually between gaseous and liquid regions – only a single state of matter is present. At that critical point, every molecule has an equal *influence* on all the others.

The concept of the self-organizing system is not new, to which any living thing that does not stay in equilibrium can attest. In effect, the self-organization refers to the ability to restructure into a higher order of organization, as demonstrated by a pan of water that is brought to a boil – from still water to a higher organization (and a specific pattern) of bouncing molecules. From such systems we can see different things happening, yet each 'thing' continues to maintain its identity, to exhibit the quality of autonomy, while integrating within its community as a whole – again, such as bubbles mixing through the vortexes of water currents when water comes to a boil.

Basic cell physiology is an example of a complex, self-organizing organism that is a network (a modular organization that multi-tasks) governed by power laws, whereby cells enter a stage of disorder at the moment of regeneration, which event occurs sporadically and not continually, and then quickly regains a sense of order. But even when in that seemingly critical state of disorder – of change – there remains a sense of order or a required process of specific steps that are followed each and every time.

Muscle cell regeneration certainly experiences such a critical point, as do muscular gains. And the extent of *interaction* is *dependent* upon the *influence* of the exercise environment. This much is known, as exercise experts concede that progressive overload is vital to induce further structural change in muscle. However, the extent and rapidity to which we are able to adapt to our environments often is given little concern. Cell regeneration involves coordination, to keep the organism alive and constantly on the edge of order and disorder. The stimulus of exercise is no different in that a mathematical consistency is obvious in how we respond to exercise and that we require chaos from exercise in order to induce a higher level of order.

In this regard exercise adaptation becomes part of the self-organization of the human body, and requires a higher order of agitation to disrupt that self-organization. But it is "strangeness" of an exercise program that induces the greatest agitation or chaos to one's homeostasis, and simply introducing exercise and increasing loads initially work rather well, until we adapt to regular overload practices, particularly as we approach a genetic limit in muscular size and strength. At that point, the *influence* of progressive overload becomes far less significant or unlikely to place muscles in a state of significant chaos – significant enough to induce further (or optimal) progress as opposed to merely maintaining the current state of self-organization. A higher level of self-organization means a higher level of adaptation and resilience to change. This is true since, in any area of chaotic study, once a system has obtained a strong sense of order, it is relatively difficult to disturb… or, at least it is when attempting to *influence* a higher critical state for potential change.

Consider the neurological adaptation that takes place with exercise – a mechanism that hinders or restricts muscular growth (since greater functional ability without the increase of muscle is a preferred condition of the human body). Like other networks, the nervous system adds "nodes" to its memory bank and we become progressively more proficient at our activities, whether riding a bicycle, playing a musical instrument, or squatting a barbell. The muscular system, too, adds nodes in the way of muscle cells or greater sarcoplasmic volume, for example, although the degree of chaos must be far greater and unusual to override the *influence* of and *dependency* upon the nervous system's *interactive* hardwiring command toward adaptation. Continual repetition of the same events, with little or no 'strangeness' results in system optimization, viz., a stabilized system not *influenced* to change. The *interaction* of stimulus and response becomes so tightly regulated and efficient that the system becomes over-organized and inflexible to modification. It is within these patterns of improvement, maintenance or loss of function that we are able to determine and predict emergent behaviors of our muscular systems – but only if we pay attention to the coordinated *influential* and *reliant interactions* that exist around us.

Let us consider further the network complexity of the nervous and muscular systems. The main hub of the wheel in the nervous system is the brain. It can function even if we were to remove a few nodes, as in the case with a paraplegic or other nervous disorders. The other nodes are not affected. However, remove too many nodes, above the 'critical error threshold' and the system breaks down, as with MS or Parkinson's prior to death. In a similar way, the body works as a complete network system, with functioning *reliant* upon the stressors experienced. If we think of our recovery abilities as nodes within the network, it can be understood how removal of too many nodes will *influence* general well-being, insofar as our systems breaking down (a general failure) as a result of overtraining. What that limit is, is *reliant* upon each person's *critical threshold limit*, a weak link within the chain determined by the properties of the system or network, which also is true of our abilities to develop strength, muscle hypertrophy or muscular endurance[3]. Continual strain that cannot be managed, and which exceeds a threshold limit will result in a *cascading failure,* a dynamic property of any complex system that can precipitate death when carried to the extreme.

As with any system, such as an avalanche, minor failures in recovery ability can go unnoticed for a long time. Eventually, those smaller failures produce a cascade effect and *influence* a far more disruptive consequence. For this reason we *rely* upon our biorhythms and responses to exercise, such as sleep patterns, eating habits, body composition, psychological state and exercise performance in order to determine the potential for minor failures that can lead to a major complication. Hence, we need to think of the overall picture, both training and lifestyle, to ascertain a program's productivity and an appropriate *interaction* of the parts that constitute the whole. The body is a complex network of billions of cells, and the more complex the system, the greater the extent of its multi-tasking, as evidenced through our organs, immune systems, nervous systems, etc. And the greater the strain on the body, via exercise or by other means, the more intense the multi-tasking will be in order to combat and adapt to strain.

[3] Once we begin to reach an upper limit in genetic potential, further strain to improve is treated as chaos and the body rebels rather than adapting by way of improvement.

The cascade effect does not seem to work in reverse when attempting to enhance physical conditioning. A little bit of exercise often does very little to *influence* progress, and one event is not distinguished from other like events as a result. On the other hand, the cascading effect of one's recovery system (i.e., the network that involves relaxation, sleep, nutrition, and management of life's stressors) to combat the strain of 'typical' exercise (typical in that it does not cross the critical threshold limit to induce an increase in function) does have a contrary influence. In this regard, too much activity that is unable to *influence* positive change still can result in negative consequences, such as an overtrained state because of moderately intense exercise performed for too long or too often.

For networks that act as a transportation system, such as the heart in the circulatory system, a local failure (occlusion of a vein) will *influence* the heart's operation, and shift responsibility to other nodes within the network. The result in this example is harder work borne by other blood vessels, and possibly the proliferation of new blood vessels, as sometimes can occur from mild heart attacks and any associated damage and inactive part of the heart, thus producing a new *interaction* within the system. Hence, first there is chaos and then there is order. If the system cannot tolerate its new environment, such as an excessively high heart rate from too much strain, then the cascading failure can continue toward another heart attack and possibly death.

An interesting point is that although the body works as a whole, as a network, it involves hierarchical modularity, in that it allows parts of the system to change or evolve separately. A common example is the developed pectorals and arms of teenage boys who strength train by doing little else than bench presses and biceps curls, and while not *influencing* the hypertrophy of other muscles. Similarly, long distance runners can *influence* greatly their cardiovascular systems, but will not (positively) *influence* muscle mass. As a broader example, the body will attempt to maintain functioning of the organs at the expense of the other tissues, such as the catabolism of skeletal muscle (no matter the intensity of exercise) if insufficient nutrients are consumed to allow for proper recovery and energy replenishment.

When speaking of a critical point (of change), we need to stop thinking of each aspect of a program separately. The cliché "the sum is greater than the parts" is very true, and the elements of an exercise program are not equal to the complexity of the program as a whole or the *influence* it has on our systems. Likewise, the truth of a statement is determined only by studying its meaning and its context to what is being referred, rather than contemplating each word of a statement separately. Hence, we cannot comprehend the effects of an exercise program by breaking it down into individual parts and then analyzing them as if they were *independent* of each other. Although reductionism can teach us a lot, and help us develop an ideal exercise program, we often obtain different answers to problems once we try to put the pieces of the puzzle back together.

This should be evident if we consider that our muscles can respond differently and to different extents while implementing the same program. Change is *reliant* on the program as a whole, and a person's lifestyle as a whole, in regard to managing stress levels, proper nutrition, and adequate rest. Everything we do, and the manner in which we do it affects us as a whole. It is not enough that we describe what has happened, but to understand the mechanism that shape how our bodies evolve as a result of exercise. If we want to understand exercise we have to understand the concept of a 'network.'

The problem is the coordination of all factors in our lives that serve to stimulate or support an *influential* change that can place our muscles in significant disorder, and then to allow those muscles to revert to a higher level of order. 'Groundbreaking' workouts such as these do not come often, and requires creativity, strategy and unusual intensity of effort, all of which few people possess and which is why few people develop above average physiques in hypertrophy and strength. Nonetheless, it is the complex systems that are always near the edge of chaos that will evolve or change, and conditions for life at optimal occurs when apparently random behavior or stimuli coexists with more regular dynamics – the 80/20 Rule. Exercise needs to be treated and applied in this manner, as well.