Transitioning from TSC to Feedback Statics

by
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and
Gus Diamantopoulos, Developer of the P.U.S.H machines
[A glossary of technical terms is listed at the end of this treatise.]

Part I—Contributed by Ken Hutchins

Determining Target Load

If you have never used a static device that offers some kind of feedback, the first natural question is: "What should my target load be?" or "What should the target load be for my subject?"

If you have been doing or instructing TimedStaticContraction℠ (TSC) for a while, you already have the tool with which to determine your target load for any exercise applied with a feedback device.

In fact, you may decide that TSC is better than the Feedback Static (FS) for some, perhaps many, subjects. [I have several customers buying my SuperStatics equipment who are so sold on TSC that they believe that FS is just begging for problems in terms of the assumed objective. They would never consider putting feedback capability on my products although I have built it to accommodate load cells and displays. And I greatly appreciate their point.]

Whenever TSC is mentioned, it is a given that the exercise is to be staged. "Staged" means that the exercise is performed in stages or levels or steps. "Staged" does not mean that it is pretended. (This also explains how we are still able to retain the nomenclature of a *set* of an exercise in TSC. In dynamic exercise, it is a set of repetitions; in static, a set of stages.) All of this is laid out in *The Renaissance of Exercise—Volume I* (ROE-I) available from ren-ex.com. It is also explained in *Music and Dance—Critical Factors for Practice and Conditioning.* This article assumes that the reader already has mastered these prerequisites.

The expedient solution to arrive at a target load for performing an exercise FS is:

> Perform the exercise TSC and with the feedback operating. Obtain the subject's force values for stages 1, 2, and 3, preferably with the subject blinded from seeing and knowing the readout.

On the next bout (workout session), discontinue the staging (TSC) and instruct the subject to load to the stage 2 value while using FS for the duration of the bout. Continue progression from this point.

This recommendation to start FS with the value of the second stage is conservative. And for many subjects, this is the ideal approach.

True, the immediately subsequent bout in this exercise might be more effective with a value approximately midway between the second and third value. And there are some situations where the third value is the best place to begin.

Let's closely analyze these wide-ranging recommendations.

Four Novice Presentations

First, consider a novice subject, especially one who has no experience with TSC. This subject has little self-awareness of his body. He has a poor concept of how strong or weak he is. He has not learned to engage his muscle efficiently. He has not become accustomed to physical feelings and how to interpret them. He does not know the feedback equipment, part of which is its sensitivity. And he lacks the skill to use it well. Do not assume that I'm necessarily referring here to a non-athlete.

In his first bout on FS wherein TSC is used to determine a starting target load, the novice may devote a *moderate effort* to the first stage that is way too high. In other words, he may shoot his wad on the first stage, show a less-than- expected increase going to his second stage and then show an unexpected decrease going to and continuing through his third stage.

You, his instructor, must silently consider several possible explanations. The first is that he did exactly as described in the previous paragraph.

The second thing that comes to the mind of a responsible instructor is the possibility of injury (worst case) or an encounter with pain.

At the end of the bout—if the subject has not already terminated the bout early—you must query him as to the possibility of any painful threshold. If the answer is "no" (we will discuss pain reports in a later article), then it is fine to merely ignore this and tag the middle value as a reasonable target load for his second bout occurring several days later. Once you observe his performance with this middle value, you will know more and will decide then whether to maintain, lower, or raise his target load.

A different presentation: The same novice—on a different exercise, perhaps—displays three somewhat evenly spaced values for his first, second, and third stages.

In many cases, the most conservative value to choose is the middle value. Although it is probably too low to choose as a target load for the subsequent bout, being somewhat too low is a good thing. Being a little low will facilitate the subject's mastery of controlling his trace.

Not immediately obvious, a subject is becoming more skilled as he progresses from showing moderate control to demonstrating perfect control with the same target load, and he is also stronger, especially during the first several sessions.

We must admit that skill acquisition in a feedback device (although meaningful at first) is nowhere as profound or as complex or as difficult to assess and account for as that in dynamic exercise.

Nevertheless, skill is definitely a factor even in a feedback static device. We are seeing a mixture of skill improvement as well as strength improvement within the increased numbers of the readout, particularly in the early stages of learning the exercise as performed on a feedback device.

A third novice presentation: This occurred with a new subject with me recently (11/24/2018). I supervised a 22-year-old ballerina in a FS Leg Press for her first bout. Her three stages produced 42: 55: 110. I will set her target load for this exercise at her next bout at 110.

Why so high? Why break my rule to use the second-stage value or to place the target load midway the second- and third-stage values? Is not it risky and unethical to set her target at her maximum strength level?

First, 110 is not her maximum strength. If she can sustain 110 for 30 seconds, it was not maximum.

Second, notice her output on the first stage. It's a pittance to be the output of a young vibrant, athletic, 5' 9" woman. As a ballerina, she runs and jumps and lands around the dance floor.

She merely did not know how to engage the muscles during the Leg Press. My expectation is that during her second workout, she will require a protracted time to load to 110 and then sustain the load for a full two minutes (after I extend the display time). This then will indicate graduation (increase) of target load for this exercise for the third workout.

I could be mistaken about this subject and about her capabilities in this exercise, but this is what experience with these tools often teaches us to expect in this particular scenario. My guess is that she will be using #200 by her sixth workout.

Bear in mind again: This woman is a ballerina. She does not aspire to be a ballerina. She *is* a ballerina—very determined, very disciplined, very focused, and very controlled.

Another scenario: I have a long-term subject (over 20 years with me off and on). She is now 67 and has rods in her back (see photo).

Left: Posterior-anterior view of x-ray of woman with rods across several vertebrae.

Right: Same subject's left lateral view. Weird shadows are from foliage seen through a kitchen window on which the films were placed in absence of a light box.

Static Leg Press is one of the few exercises she can perform. To ask her to perform dynamic Leg Press would be malpractice. (Her husband asked if it would be acceptable for her to ride a bicycle around their neighborhood in order to get some *cardio.* Incensed, I explained to him that if she took a spill, her spine would shatter like a Tinker-Toy model thrown against a wall.)

On her first static Leg Press bout she produced stage levels of 40, 60, and 100. Afterwards, she told me that she hurt during the exercise during the last stage. I immediately asked her if the pain had stopped when she terminated the exercise. Fortunately, it had stopped. This is a critical point to determine if the pain indicated harm.

I then scolded her for producing a force so high that pain ensued. Although I had explained to her not to push beyond a pain threshold—even a mere cusp or faint edge of a sensation that she suspects might become painful—she had wanted to try her best. I made her promise me not to do that again.

On her second bout with static Leg Press, she followed my rules precisely and

managed to sustain 80 pain-free throughout the full two-minute bout. We remained at this level for another workout or two to test her body's reaction, then dared to progress by 2.5 pounds per month for several months. She now regularly performs at 100 although her target is 110. Unrelated knee issues have temporarily stunted and reversed our progress somewhat.

What makes her progress more impressive to appreciate is that her current performances on static Leg Press are always preceded with static hip ADduction and immediately preceded with static hip ABduction for pre-exhaustion purposes (the Leg Press Triad). Note that although I might have reduced her force generation during her first bout doing Leg Press after pre-exhaustion with static AB and AD, their inclusion would then have confused any painful issues so that I would have been unable to distinguish the origin of any irritation.

Often, I must temper my enthusiasm to help a back condition by trying multiple machines/movements involving Rotary Torso, Trunk Extension, Linear Spine Flexion, etc. If I apply one approach and get success, I stop. If I continue to throw my entire proverbial toolbox at the problem and the condition returns within the following three days, I won't know what to blame it on.

Some of the foregoing Part I, though composed by Ken Hutchins, was the result of many discussions between Ken and Gus over the past 10 years.

Part II—Contributed by Gus Diamantopoulos

Winging it

With a novice subject it is often tempting to merely guess the target load in FS and to dispense with the TSC protocol described in Part I. I have been guilty of this at times and I'm sure that many instructors have been *winging it* in much the same way.

But with the breadth of feedback systems in my facility, and more recently in my development of the P.U.S.H. machines, I have learned that guessing is a haphazard approach that may even interfere with optimal progression. (See photos.)

You might sometimes guess target load correctly, and this can be satisfying. But if you guess a target that is too low you may waste a number of sessions before a subject experiences appropriately demanding workouts.

This can have far-reaching implications if that subject learns to work with insufficient effort. This is akin to selecting too low a weight load in dynamic exercise. By the time the weights are appropriate, you've lost many weeks and worse, the subject now has a recalcitrant attitude to inroading.

By contrast, if you guess at a target that is too high, you're asking for trouble with

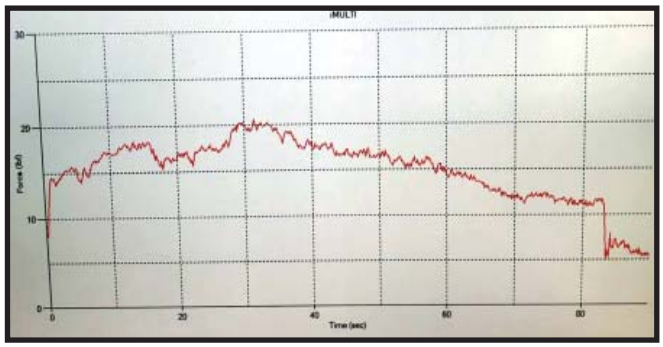
P.U.S.H. machines by Gus Diamantopoulos.
These truly portable static exercise machines provide digital feedback to both user and instructor. They require no additional floor space and when not in use merely hang on the wall as they are recharging.

Upper Left: The iADAB is a 2-fer in providing exercise for both hip ADduction and ABduction. It can be applied as illustrated or while seated on the RenEx or SuperSlow Leg Press machines to perform buttocks pre-exhaustion for leg press exercise without the need of wasting precious time transitioning the subject between major machines.

Upper Right: The iLR is the ideal way to perform a lateral abduction (lateral raise) exercise for the shoulders.

Left: The iPec can be applied with the shoulders either internally or externally (shown) rotated. Similar to using the iADAB immediately preceding leg press, the iPec is most effectively used for pre-exhausting the chest musculature immediately preceding chest press by seating the subject in a chest press device, thus eliminating the need to move between major machines.

all sorts of discrepancies and a tendency for the subject to display outroading behaviors that are very difficult to correct.



A very weak subject's initial attempt at performing TSC for FS posterior neck. Her stages are not distinctly graduated. Also, her third stage is lower that the first two stages indicating that she exerted too much effort on those first two stages. With experience, she will acquire the skill to manage this much better.

More on Stages

TSC requires the subject to produce three distinct stages of effort. In practice, after a subject has been inculcated in FS, the trace of a well-performed set of these stages is relatively flat (until a high enough intensity presents inroading below the target).

In contrast, when a novice is first introduced to TSC and asked to perform an exercise, it is common to see a force trace that grows stepwise in concert with his effort level. That is, each stage of effort is displayed as a distinct stage of force output.

It is from these force-measured stages that an instructor will select the middle value to determine the future target load.

On very rare occasions, however, you may encounter a *natural;* someone who produces a relatively flat *and* stable force trace from the first deciding TSC set, despite having no visual feedback to benchmark his TSC efforts.

A unicorn: The novice who may be an expert. Consider the recent case of a novice subject who was introduced to TSC and FS exercise for his upper body exercises because of a shoulder injury. [Note that compound row is expectedly the most unoffending shoulder exercise for anyone, especially a subject with shoulder issues.]

On his first attempt at TSC compound row he produced a nearly flat trace at about 90 lbs of force. Moreover, his ramp to 90 lbs was nearly perfect at 10 seconds.

Realize that this subject had never done TSC or static exercise before and yet he

The RenEx iMulti used for static compound row exercise.

demonstrated a trace that subsumed the three stages of effort (a blending of force and effort). In stage 1 he appropriately attained his *moderate effort* which was 90 lbs of force.

Initially, I thought this was too much force for the first stage and I worried that his force output would decrease precipitously, but I was wrong because in stage 2 he was clearly able to sustain that force level.

At 60 seconds, stage 3, I incited him to gradually pull *as hard as you dare*. And even though he was working very hard, his trace remained at about 90 lbs.

Remember, this subject had no visual feedback to reference for his force output. He was merely following my TSC instructions.

I was incredulous that such a performance could occur from a subject's very first attempt at TSC. Having said this, I am not surprised that I've not seen the likes of

this since. Perhaps one day there will be another…

Different But Same

The real objective of an exercise is to momentarily fatigue the musculature to inroad it as safely, quickly, efficiently, and deeply as possible for the purpose of stimulating the muscular growth mechanism with the least amount of weight (dynamic) in the least amount of time.

In many ways, TSC exercise is the apotheosis of the real objective because it completely obviates the quantitative aspect of load. With TSC, we cannot know the magnitude of load. There is no objective measurement of it, and there is no repetition or pattern of movement to complete like in dynamic exercise. The only known external variable is *time.*

We might consider TSC exercise, therefore, to be internally mediated. An instructor can referee discrepancies and may be able to detect malingering to some small extent, but no instructor or subject can reliably estimate force values in TSC. And although it is not necessary to know these values when it comes to meaningful work relative to the real objective, it becomes challenging to scale progress over time which can impede motivation—and possibly compliance—to a long-term strength exercise program. [It's redundant to state, "strength exercise." A strengthening program is the only real form of exercise.]

[One important benefit of TSC is the ability to precisely manage the slightest presence (or suspicion) of pain. How to teach TSC to novices (and the necessary graphics for teaching this) so that a pain threshold is safely dodged is presented in *Music and Dance—Critical Factors of Practice and Conditioning* by Ken Hutchins.]

This is why we have created Feedback Statics (FS). We acknowledge that we are—by our nature—achievement-oriented as a species. And exercise is by no means exempt from our predilection for measurement and quantification. FS exercise facilitates the ability of the subject and the instructor to not only perform static exercise with precision, but to also enhance our ability to make incremental progressions over time, to effectively explore the treatment of injuries and debilities below pain thresholds, and to promote higher levels of mastery of any given exercise.

I tell my clients that their static workouts are a blend of high-tech and low-tech. It’s novel and helpful to have force measurement feedback, but it is not necessary. In fact, most advanced subjects develop a unique pattern of attention to the feedback displays.

The speedometer in an automobile is an accurate indicator of your vehicle's speed. And it is important to be aware of your speed. But if you stare entirely at the speedometer while driving you are guaranteed to crash. While driving, your primary concern is the road and where you are going.

Similarly in FS, the feedback system is a tool to effectively achieve the target load. But your primary concern is the loading of your musculature and its progressive fatigue.

A subject who is performing well in FS is applying a TSC mindset within an FS environment. Such a subject is more concerned with progressive effort and engagement of the target musculature rather than keeping a flat trace or merely staring at the numbers. Used in this way, FS can help to enhance our achievement of the real objective.

Important Concepts For This Section:

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Feedback Statics 101

Consider a RenEx iMulti machine with its integrated feedback system. The computer screen displays a graph. On its Y-axis is Force and on its X-axis is Time.

Time is the independent variable.

Force is one of our dependent variables. It is the variable that we can measure and the key variable that a subject can manipulate in his performance of any exercise.

Force is the result of your pushing or pulling (tension or compression) upon the machine parts resulting from the interaction between the subject and the machine.

However, force is merely the external objective variable. The truly important dependent variable, as we have already asserted, is effort. Effort is internal, subjective, and invisible.

For our purposes, effort is the vehicle of exercise intensity. *The percentage of momentary effort exerted* is how we define *exercise intensity* (also definable as *inroad/time).*

Effort is an expression of will. It is determination. But on an FS computer display or force gauge, effort does not really exist.

Above- and Below- Target Inroading (ATI and BTI) The key to transitioning from TSC to FS exercise is to acknowledge that force (load) and effort become inverse over time, and that fatiguing of the body begins to occur immediately upon loading.

This is to say that *inroading* begins immediately upon loading.

If you gradually ramp to 100 lbs of force in about 10 seconds and continue to steadily produce around 100 lbs of force for the next 50 seconds (a blending of stages 1 and 2), your effort is greater to sustain that force at 60 seconds than it is at 30 seconds. Although this is obviously true, it is very easy to confuse force measurement with effort while exercising.

Your effort is progressively increasing from the outset of any exercise because you are fatiguing with each passing second. A maintenance of the target load (100 lbs) is only a maintenance of the external variable.

If beyond 60 seconds you are unable to sustain 100 lbs and force begins to decrease, assuming you're pushing *as hard as you dare* at stage 3, your effort must be increasing commensurate to your dwindling force capacity. You are now experiencing *Below-Target Inroading* (BTI).

At 70 seconds you may only be able to produce 85 lbs. Then at 80 seconds you're down to 70 lbs. By 90 seconds you might only be able to produce 65 lbs of force. This would be an approximate 35% BTI, a substantial level of inroading.

We generally like BTI values to be between 25% and 40%, though advanced subjects can experience 50% (BTI). Any more than 50% and likely the target force is too high and with BTI happening too soon (and too precipitously), which may introduce orthopedic risks as well as numerous performance discrepancies.

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... effort is the vehicle of exercise intensity.

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Force is one of our dependent variables....

... inroad begins immediately upon loading.

... it is very easy to confuse force measurement with effort...

Standardizing Force Generation

With FS, we have the unique capacity to instruct a subject to generate force with consistently graded values. We generally prefer to build force (ramp) to the target load in about 10 seconds, without spiking and overshooting.

This can be a bit of a moving target and, in some cases, a longer ramping may be necessary for injured subjects or to manage pain, but for the most part, aim for 10 seconds.

Realize that in FS exercise, the target load is never the maximum force output that you can produce. If you use TSC to determine target load, you can quickly (within a few sessions) get a novice to perform reasonably well and to engage the target musculature in FS.

Within such a scheme, the target load will be high enough to produce appropriate demands on the body within 90 seconds and without being dangerous. A ramping to this magnitude is in concert with the *moderate effort* scheme of stage 1 in TSC. Therefore, a 10-second ramping is well within the confines of safety as it provides ample time for the subject to register any potential approaching pain threshold and to react to it by lessening effort.

Recently, I did an informal survey clocking a day's worth of clients on FS and found that the longest ramping was 18 seconds and the shortest was about 7 seconds. Ramping of 3 seconds or less may constitute what we term *spiking*. And spiking is usually combined with *overshooting*.

A spike is a sharp (or abrupt) generation of force. The more vertical the trace on the graph, the more sudden the force buildup.

Overshooting is the inadvertent exceeding of the target load. Most often a subject will spike at the beginning of a set and then overshoot before returning to the target a second later.

A case of spiking. I have a long-time client who has learned to manage many of her orthopedic issues with proper exercise. Nearly her entire workout program is performed statically. However, despite her protocol literacy, she still has trouble with spiking and overshooting at the start of an exercise. This subject is notoriously jittery and performs all sorts of antics prior to most of her sets.

When she did TSC in the past (before the availability of FS), I knew that she was spiking, but without feedback there was no way to know this for certain. With the feedback system I can much better assess and correct her discrepancies.

In a recent set on the iLCLE machine (static Leg Curl/Leg Extension), in the performance of knee extension exercise, I instructed her to begin gradually and to ramp to her target load of 125 lbs. Instead, she swung her lower legs abruptly

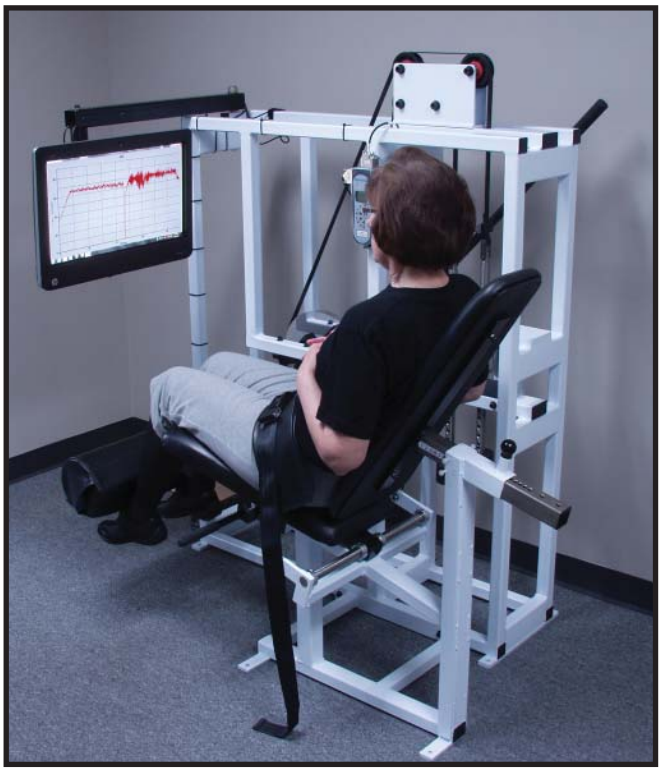
against the movement arm which caused a spike to almost 175 lbs. Then (while holding her breath) she lurched forward and back in the seat and bucked her head back and forth, erratically. Her force plummeted to 80 lbs followed by another spike to 150 lbs and finally back to around 135 lbs but with violent tremors in her legs and resonant juddering in the movement arm.

[Just imagine how difficult (actually impossible) this exercise—or any exercise—would be for this subject to safely attempt in a dynamic mode!]

This effect can be seen commonly in subjects with poor neurological conditioning but can often be corrected with proper instruction.

I reminded her of a *get-set* ritual that includes assuming the correct body posture, being as still as possible before the commencement of the set, staying calm, and breathing.

Becoming physically motionless before starting an exercise is, strangely, difficult for some subjects. Likely a result of anxiety or arousal, such subjects twitch and move about in the seat and express all sorts of nervous behaviors. I can quell many of these antics by merely mentioning them, and it is important to do so as most subjects are completely unaware of their habits.



The RenEx iLCLE being applied to perform static leg extension exercise.

After adopting the get-set, her second attempt showed a trace that was much more stable, her breathing was better, and although she still experienced body tremors (some severe), she was able to avoid head-bucking and lurching in the seat. Most importantly, she was able to avoid spiking and overshooting.

[Note that this subject routinely reports feeling opposing muscle groups during exercise. Some examples are hamstrings during leg extension, latissimi during chest press, and triceps during compound row. However, when her discrepancies are properly managed as described above in the static leg extension exercise, she actually feels her frontal thighs engaging.]

False Ceilings

A key challenge for many novices is learning how to accept the seemingly discouraging effects of BTI.

Most subjects like to see a flat trace in their FS exercises (ATI). But when a subject first experiences BTI, they are not as enthusiastic about it as I am. Most subjects are dispirited when their trace slopes down to display a 20% BTI, even though this is exactly what they should be doing.

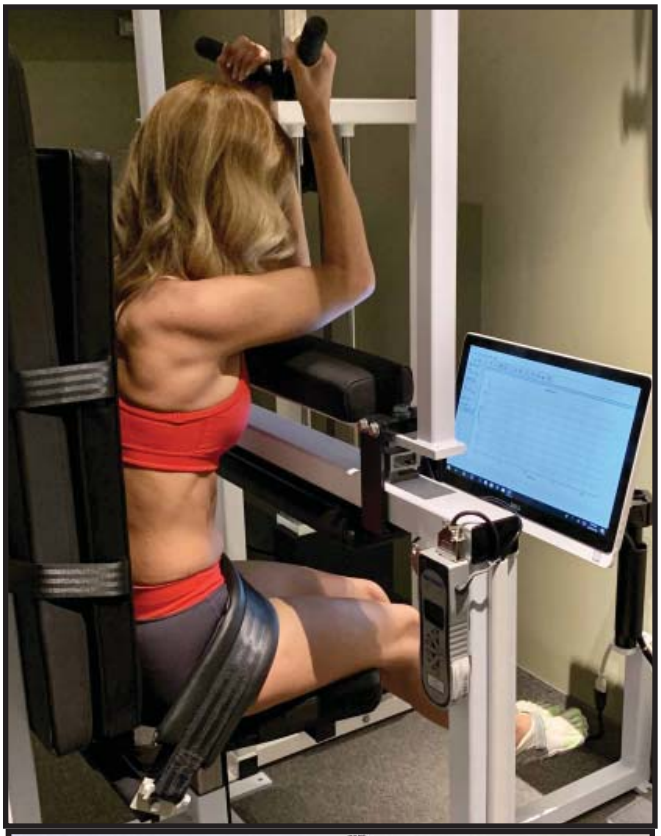
Some subjects will even refuse to strive for a higher target load when it is instructed because they are fearful that they won't be able to sustain the target force even if they do achieve it—a clear indication that they are falling victim to the assumed objective.

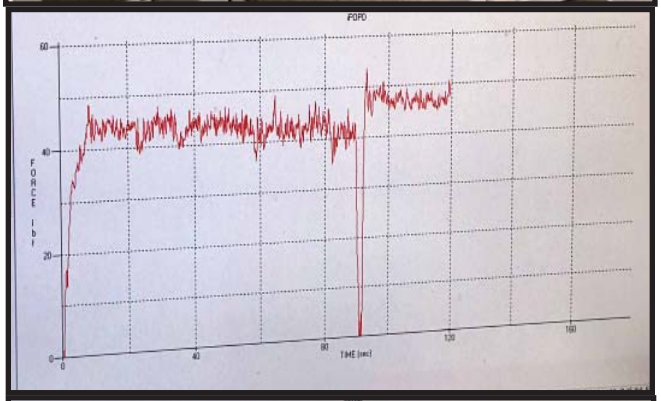
As we discussed earlier, in TSC exercise there is no measurement of force, so the only feeling experienced is the difficulty of continually increasing effort. But with FS exercise, both the instructor and the subject know the exact magnitude of force, and on an analog display, they also know the history of the set.

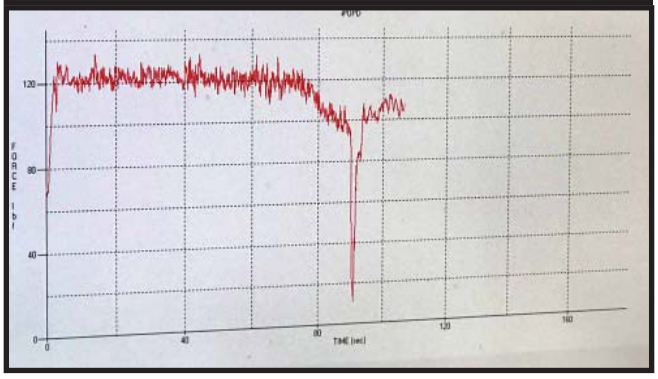
When a subject produces a flat trace for one minute or longer (ATI), it is often necessary (though perhaps not always desirable) to increase the target load. This is the same concept as providing incremental weight in dynamic exercise in a double-progression scheme. When the subject can (properly) perform the number of repetitions at the prescribed upper range of reps for a given exercise, you (the instructor) should increase the weight for the next workout.

In dynamic exercise, a weight increase usually means that the number of repetitions may decrease in the next workout. Ideally, the number of fewer reps will be within the prescribed lower range of repetitions (otherwise the weight increase was too great).

For example, if a subject achieved 8 reps in a given exercise and the prescribed repetition range is 4-8, you might consider adding 2-% more weight. With the increased weight, it is possible that fewer than eight repetitions will be achieved (though at least four are expected).







The RenEx iPOPD.

Top Left: The subject first pre-exhausts the latissimus, chest, and abdominals performing static pullover...

Top Right: ...then immediately transfers to the static pulldown to bring in the hands and arms to drive all the musculatures into deeper inroad.

Middle Right: An intermediate subject ramps into the pullover, spiking somewhat, then overshooting. Note that her overshoot, however, does not exceed her occasional erratic control throughout the course of the exercise. It's acceptable only because her general control to produce a smooth trace is really no better. Assuming she holds her target of 42 (which she arguably did) and if we graduate her (increase the target load to 45), her control will be worse. If we stay the course with the present target load, her demonstration of improved control is subjective demonstration of being stronger.

Her transfer to the pulldown was admirably quick but too fast as it spiked and overshot. We expect more control on pulldown since it is a compound movement (note her smaller amplitude here suggesting better control), therefore the overshoot by this subject should be better controlled, her naturally erratic output considered, of course.

It remains doubtful that, due to the effect of her ventilation, her amplitude for the pulldown can be expected to be much better.

Lower Right: Veteran alpha subject, John Daly, ramps to 120 lbs within 3 seconds (slightly too fast to prevent rebound) on static pullover, sustains for at target approximately 75 seconds, produces nice inroad, then transfers and ramps to static pulldown within approximately 4 seconds with much better control at 105 lbs.

Also note that Ken pushed the start button for pullover slightly after John began loading toward the target as John's ramping begins at 70 lbs. Also note that Ken tares the iPOPD without inclusion of the arms.

Also note: Ken's iPOPD (from which the graphs were obtained) is an early version in which the required pelvic tilt introduces a negative value to the system which is controllably constant and acceptable when applied with the required instruction. Other RenEx iPOPDs (like the one pictured above) are designed to eliminate this variable.

Similarly, in static exercise, when a trace is flat throughout the set (ATI), it is most often necessary to increase the target load for the next workout. Increasing the target load may cause BTI to occur—characterized by progressively lower force output numbers and a downward slope of the trace on the graph.

With respect to increasing target load, instructor discretion applies. Recall that being at ATI does not mean that the workout was not productive. It is not always necessary or desirable to achieve BTI. There is value and benefit (particularly to special populations and to beginners) with static sets that only produce ATI. Although the analog trace does not show the inroading that occurs before you become unable to hold target, you can be sure that inroading was ongoing above the target.

"I can't reach it." I have a novice subject who started FS exercise in October 2018. One of her greatest difficulties has been the iPOPD (static Pullover and Pulldown) (see photos). In particular, she has always been challenged by the static pullover. The dorsal muscles used in the pullover are not easily engaged or felt by many women (and also some men). The necessary pelvic tilt is also a skill that requires practice.

On the static pullover load-determining test set, her three stages produced 20 lbs: 30 lbs: high-30 lbs. So, I started her FS pullover at 30 lbs.

Six weeks later, she attained targets of 45 lbs (iPO) and 55 lbs (iPD) with flat traces (ATI) for both—no force loss. This was the second time that she achieved a flat trace that was also steady (narrow amplitude) for both sets.

At her subsequent session I planned to up her target load to 50 lbs. However, she complained that 50 lbs was too much and insisted that she could not reach the new target.
I explained to her that she likely meant that she might not be able to sustain 50 lbs for all 3 stages but that she could absolutely *achieve* 50 lbs, if only for a short spell.

I reminded her about the real objective and I further elucidated on BTI:

> Aim for 50 lbs for just the first stage: 30 seconds. It will be hard, but I think you can get there.
>
> If you begin to fatigue to the degree that BTI is beginning to occur at stage 2, that's okay. Increase your effort to try to stay on 50 lbs. Maybe you can sustain your output through stage 2 and maybe you can't.
>
> When you actually can no longer sustain 50 lbs and force begins to ooze downward, that's when you'll be experiencing below-target inroading (BTI), and I want you to turn up your effort. The key is to not give up. Rather than letting the force drop abruptly, try to push so that force only drops at a trickle. Perhaps you descend to the high 40s, then a few seconds later to the mid 40s,

then a few seconds later to the low 40s, and so on. Control the rate at which your force dwindles.

Continue to breathe and don't suddenly back off or give up.

If BTI happens, think of your diminishing force as a *slow leak* rather than a *blow-out.*

Keep pushing until time runs out.

... think of your diminishing force as a slow leak rather than a blow-out.

When she finally performed her static pullover set, she not only achieved 50 lbs but managed to sustain it for 75 seconds—half way through stage 3. By 90 seconds she was down to about 40 lbs of force; a 25% BTI and her first experience with inroading below target on the static pullover.

[Note that a BTI of 25% is an overall inroading value of nearly 50%. We cannot quantify this, of course, but it is worthwhile to understand that the totality of inroading is greater than the measurable BTI value.]

When it was over, I couldn't tell if she was proud, frustrated or both. Regardless, I was keen to seize the moment and try to anchor in her mind that this performance was not only the best that she had done thus far in the program, but that it also must be what she always strives for when she exercises.

Summary

All three subject experiences that I have reported are not unusual. They are fairly representative of what legitimate exercise instructors strive to convey to their clients daily. This is regardless of whether exercise is conducted in the dynamic or static realm.

Another Example from Ken

On November 11, 2018, I had a similar experience as Gus.

D is a client that I instructed at the Lincoln Fitness Center in the early 1990s. She recently resumed working with me this past September after a hiatus of about 28 years.

D has been progressing admirably well—including getting a grasp on all the new philosophy in my latest book. She is especially motivated since she is a singer trying to maintain a modicum of stage presence.

During her first workout (9/15/2018), she performed leg press FS, as it was staged as in TSC. Her initial values were 80 lbs/ 90 lbs/ 130 lbs for 30 seconds, 30 seconds, and 60 seconds respectively. This first leg press bout was casually (not rushed: no meaningful pre-exhaustion of the buttocks before leg press) preceded by TSC hip ABduction for pre-exhaustion immediately after TSC hip ADduction.

During the ensuing weeks, D became more proficient at performing these three exercises—The Leg Press Triad—as well as more efficient at transitioning between them. In other words, the pre-exhaustion effect became more profoundly intrusive upon her leg press performance.

On November 30, I compelled D to cross that chasm between ATI and BTI. During her preceding workout, I had recognized D being very challenged to complete the leg press at 200 lbs for the full two-minute TUL. I knew that raising her leg press target would be where D was likely to figuratively c*ome unraveled.* And how subjects deal with this new experience can be quite varied.

D ramped confidently to 212 lbs and sustained it flatly for 40 seconds. But then she abruptly quit.

> Ken: Are you hurt?
>
> D: No, but my thighs are really burning.
>
> Ken: Then continue the exercise. Try to get back to your target, and don't let off as I will guide you through to the end by telling you how to think about the thigh burning.

D ramped back up to 212 lbs, then quickly sloped back down to 140 lbs.

> Ken: Did you decrease 70 lbs because you feel pain other than the expected thigh burn?
>
> D: No, but I can't push any longer.
>
> Ken: Yes, you can push, perhaps not strongly enough to maintain the target, but you can push... You can push all day.
>
> Remember that "... but I can't push any longer" does not fall into your five-word vocabulary.
>
> If you are feeling pain, cease the exercise. If not, continue to push.
>
> I know that your thighs burn. Think to push with your buttocks.
>
> Where we want to go with this exercise is beyond the thigh burning. Your buttocks are doing not just most of the work here, but almost all the work.

You will eventually learn to feel them over the thigh burn.

D: I just can't do it.

Ken: Your words are that you "can't do it" when what you *can't do* is not what I'm asking you to do.

I'm merely asking you to push.

I'm not asking you to hold 212 lbs. I'm asking you to try to attain and to hold 212 lbs.

You are quitting only because you cannot *hold* 212 lbs.

You demonstrated that you can hold at least 140 lbs after you could no longer sustain 212 lbs. 140 lbs is not zero.

Therefore you can still push. And this means you *are* DOING IT as you protest that you are not able.

Stop the exercise, catch your breath, and we will talk.

D remained calm and cooperative, although she was perplexed, dazed, and struggling to understand my seemingly conflicted statements. [She is extremely

A RenEx Leg Press Machine incorporating four load cells, junction box, force meter, computer, monitor and analog interpolation software. We will soon post a piece highlighting its applications and advantages.

intelligent and is motivated to save her bone density through muscular strengthening. She is also technically astute with a myriad of medical testing equipment.]

I repeated all the foregoing. I knew that removing D from the instinctual milieu of the exercise would enable her intellect to take hold of it completely.

I then explained the differences between the assumed and real objectives as they are revealed in *ROE-I.* D grasped these arguments immediately and could appreciate that they are as fundamental to exercise as is the study of phonics is to learning to read and write.

On my white board, I drew the inroad graph from *Music and Dance.* (I give all my clients and prospective clients a copy of this book to serve as a primer as well as a reference for just such a moment as this with D.)

After reminding her that the graph was in her copy of the book, I showed her that once she has inroaded down to the target, she has attained classic failure (MMF: momentary muscular failure). This is that depth of inroad that corresponds to when she can no longer lift the weight selected in a dynamic exercise. And as Arthur Jones instructed us:

> Once you reach a point of fatigue—when using 100 lbs in an exercise—that you cannot continue moving the weight, this does not tell you how strong you are. It tells you how strong *you no longer are.*
>
> You might be able to produce 99 lbs, but you must produce slightly over 100 pounds to move the weight, 99 lbs won't do it. But note that neither is 99 lbs zero!
>
> However, your body's nervous system will lie to you and convince you that 99 lbs IS zero and that your body is incapable of generating force when, in fact, you still are.

Then D complained that she had never before performed an exercise wherein she could no longer feel that her legs were responding to her will to push. This is a somewhat common experience with people new to exercise and new to deeply inroading. During leg press she could not feel that her legs were doing anything.

We have such effective techniques with FS that sometimes we are actually inroading past the momentary competence of the skeletal muscles and seemingly into the sensory nervous system... at least to the degree that muscular feedback is fuzzy.

... once she has inroaded down to the target, she has attained classic failure (MMF: momentary muscular failure). This is that depth of inroad that corresponds to when you can no longer lift the weight selected in a dynamic exercise.

By insisting that subjects like D resolve *to think* and *to believe* that they are mentally connecting to their buttocks—no matter what the sensory nervous system is lying to its owner about—then the graphics display actually becomes part of the subjects' sensory feedback system.
Since inroading below target is never deeper than approximately 50% of target, the force produced by the subject is never zero. As the body torque/weight of the limb is tared prior to an exercise in many cases, the force of muscular contraction can be viewed even when the subject's nervous feedback is muted.

D returned for her subsequent workout on 12/4/2018. Before commencing the workout she wanted to review all the discussion from the previous workout. She was still mystified that she had taken an exercise so deeply that she could not sense that her legs were effectively pushing—although her frontal thighs were intensely burning.

In addition to what was discussed during the preceding session I added:

> Your body does not know or care if you attain and/ or hold 212 lbs or any other number. Your body only respects your attempt, not your accomplishment. And you are allowing yourself to become emotionally upset about something that no one else—including your own body—cares about.
>
> When you observe the inroading falling beneath the target, this is success.
>
> And the faster it falls the greater your indicative effort to elevate it to the target.
>
> This is the essence of *intensity* and Arthur Jones' second definition of *intensity: inroad/ time.*
>
> This is the *real objective.* Staying on target is the *assumed objective.*

I wrote a note on the back of the workout chart and told D about the note, but did not tell her what it said.

When D commenced the leg press, she ramped confidently to 212 lbs and held it perfectly for the full two minutes. Her entire workout was much improved.

Then I showed her the note. It revealed that I had predicted that she would graduate from the 212 lbs during that workout.

What's more, D performed the leg press for a full two minutes with 225 lbs on 12/6/2018, thus graduating again. She perfectly succeeded for the full two minutes with 237 lbs on 12/14, then with 250 lbs on 12/18, then with 262 lbs on 12/24, then

with 275 lbs on 12/28, then with 287 lbs on 1/1/2019, then with 287 lbs again on 1/4/2019 (I wanted to see her obtain slightly more flatness in her trace.) As of this writing on 1/9/2019, she is scheduled to perform FS leg press this afternoon with 300 lbs—100 lbs more than what she believed she could sustain a little over five weeks before—50% more than she believed she could perform.

Statics, especially feedback statics, greatly simplify, but do not guarantee, our technological conveyance. SuperSlow technology greatly improved this from our Jonesian beginnings, and FS is another leap toward assuring understanding between instructor and subject.

Glossary

Following are the terms special to our use in TSC and FS exercise. Some of them are generic terms or phrases common to physics and physiology as well as general language. These are denoted as G.

Others are coined by persons in our field to specify particular concepts in our field. Their origins, if known or believed, are denoted by KH for Ken Hutchins, GD for Gus Diamantopoulos, RS for Rob Serraino, AJ for Arthur Jones, ED for Ellington Darden, DM for Doug McGuff, U for unknown, BH for Brenda Hutchins.

Where G words or phrases have a special application or interpretation they are noted with G followed by the person of special adaptation.

almost all—G-KH—somewhere between 90 and 99 percent. Compare to most. When you state that, "most of the exercises in my workout routine are static exercises," when only 5% of the exercises are dynamic, you should have stated, "almost all of the exercises..."

amplitude—G—the total distance between the peak and the valley of an analog trace; the distance between the highest and lowest number of a pendular swing (oscillation) of data points.

analog—G—a trace or plot of values that leaves a history of those connected values as a straight, curved or jagged line. Note that all analog traces begin with interpolated signals from a load cell, perhaps to a junction box (in the case of multiple load cells), then converted to a string of digital numbers by a force meter, then sent to a computer program whose software interpolates the digital values to a line on a visual graph.

above-target inroad (ATI)—KH—inroading, as viewed on an analog graph or with data points on a purely digital force meter, that occurs before the subject's trace descends below the target load. ATI is one of two factors that are invisible to the load cell(s), to the force meter, to the digital-to-analog software, and therefore to the viewer of the projecting monitor.

Note that *above-target inroad* does not refer to the achievement of a force value that is merely above the instructed target load. It is the inroading that occurs from the beginning of the initial ramp and up to the onset of BTI (see below).

"at target"—a phrase sometimes used in conjunction with a statement of performance like in: "... the subject performed 62 seconds at target." This indicates that the subject sustained the target load for 62 seconds.

below-target inroad (BTI)—KH—inroading, as viewed with a trace on an analog graph or with data points on a purely-digital force meter that occurs after the subject can no longer maintain the target load.

bout—G-KH—a distinct exposure to a meaningful time under load (exercise).

Example of usage: If the subject performs leg press exercise in only one (Routine A) of two different exercise routines that alternate as Routine A---Routine B---Routine A >>, the instructor might say, "You are using the same target load as in your past three bouts." This is a much more convenient way to state, "You are using the same target load in leg press as when you performed leg press in the last three routines in which you performed leg press."

In the case that the subject performs the same routine in every workout, the use of *bout* is not as important as the *last three bouts* is the same as the *last three workouts.*

data points—G—numbers representing distinct force values observed in static exercise performed on feedback equipment.

data set—G—a grouping of distinct values (numbers), especially those three numbers representing the force values observed in the three stages of TSC.

digital—G—describes a feedback device that provides only data points with no analog capability to provide a curve of the performance history. Of course, an analog device obtains its source information from a digital source before interpolating it to analog curves and history.

dynamic—G—an exercise wherein gross movement of the body or body part(s) occurs.

dyskinesia—G—disordered, involuntary movement.

fatigue, fatiguing—G-KH—specifically applied to the momentary weakening or inroading during a bout of a given exercise.

force, force output, force measurement—G—*Force* is difficult if not

impossible to define, but we can see and use its effects. Muscles produce force, and that is all they do.

Force is a specialized term that we use to denote this production by the muscles. We do not use other terms for force—*pressure, weight, intensity*—that are applied in other particular applications.

Force can be measured in various units, but the most common metric unit is the newton (N). In standard inch units, pounds are the unit force, despite their ubiquity as units of weight. One pound is equal to 4.448 newtons. Force is often conflated with torque (which is force that tends to cause rotation). Where newtons and pounds are units of force, newton-meters and pound-feet are units of torque.

frequency—G—how often an exercise (bout) or a routine or a workout is performed by a subject. We speak of the frequency of a bout or the frequency of a routine or the frequency of a workout (which might differ with routines).

feedback statics (FS)—KH—static exercise performed with either digital or analog observation of the subject's performance. This observation can be by either the subject, the instructor, third parties, or all of the above.

graph—G—the plot of a subject's performance of a static exercise. Normally, this plot has a trace between multiple data points related to the time transpiring during the bout.

high-intensity training (HIT)—ED—true exercise, activity that produces meaningful inroad with brief workout routines of a minimum of muscle isolation movements with extended rest of several days between workouts.

intensity—AJ—The Nautilus-era definition is *the degree of momentary effort.* This definition, although still relevant, might be better suited to describe the overall intensity of an entire workout.

Intensity is not to be confused with *force.* In fact, in a controlled exercise setting, the higher the intensity of muscular contraction, the lower the force may be.

It is confusing that *intensity* is sometimes and archaically used to mean *force.* This misusage is not within the context of proper exercise discussion.

The MedX-era definition of *intensity* is *inroad/ time.* The Nautilus-era definition still applies (although subjective and invisible on a graph), but the MedX-era definition specifically applies to the intensity of a bout of one exercise.

inroad/inroading—ED—momentary fatigue in a bout of a given exercise effecting a declining force (strength) capability of the subject.

It is easy to assume through our and others' writings that we are stating that inroad is the exercise stimulus. This is not what we mean.

Inroad is the exercise process (We often refer to it as the *real objective.* The *purpose* of the exercise is the stimulus.) or means to *get* to the stimulus, but that exact

stimulus—although there may be several competing ideas for what it is, has yet to be identified. And if we identify it, it may have little to no bearing on the process to obtain it, i.e., the inroad.

isometric—G—adjective describing a static exercise wherein the subject exerts against an immovable object. *Traditionally,* this is performed with a maximum effort for a bout length of 5-15 seconds. This traditional approach is extremely high-force, it has limited inroading efficiency, it is fraught with excessively uncontrollable outroading issues, and is therefore dangerous. The Renaissance Exercise approaches to static exercise—i.e. TimedStaticContraction and SuperStatics—*isometric* in a loosely general sense, but are performed with the implementation of guidelines to rectify the traditional issues.

Jonesian—G—of or related to the exercise philosophy and exercise equipment (Nautilus) by Arthur Jones.

judder, juddering—G—machine vibration and/ or resonance caused by the muscle tremors and/or dyskinesia of the exercise subject's body.

most—G-KH—somewhere between 50% and 99%. This is an overused descriptor that often leaves incorrect impressions. If we state that most people exercise, some readers will assume that the number is close to 100% while some other readers will assume it's only slightly more than 50/ 50. Political pundits often use the phrases *landslide* or *vast majority* to indicate a constituency voting on an issue that is 60%-70% since voting outcomes are rarely won with much more than 50% majorities. Be wary of using or reading these descriptors.

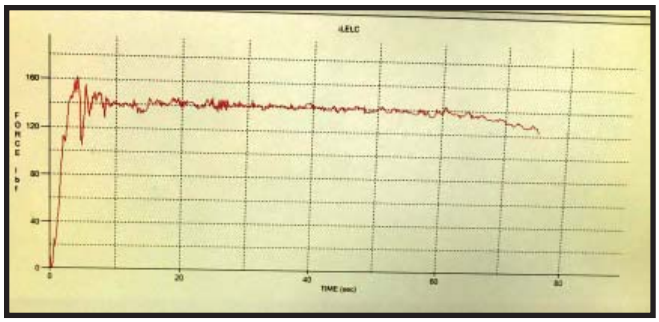
outroading—RS—the opposite of inroading. The opposite of isolation. This is a remarkably useful term as it encompasses a mouthful of discrepancies—Valsalva, gritting, grimacing, gripping (the three Gs) and a host of out-of-control behaviors as thrashing, yelling, screaming, grunting, slamming weights, embracements of the assumed objective, etc.—that are difficult to discuss as a collection. For years at Nautilus, we had to run down the entire litany every time it came up in a sentence. Now—once the term is defined to the listener—we can use one word in subsequent discourse.

over-correcting reflex, (OR)—KH and GD—excessive downward swing of a trace caused by overshoot caused by too-fast ramping.

overshoot, overshooting—G-GD—ramping beyond the target load. How we couch this idea naturally assumes that overshooting applies exclusively to FS. But reckless ramping occurs in dynamics as well as in TSC.

In dynamics, it results in ballistic behavior.

With TSC, it manifests with the subject exceeding stage levels. Of course, such



Blatant Overshooting: Subject ramps too quickly to 140 lbs during static leg extension exercise causing overshooting by 20 lbs, then exhibiting over-correcting reflex to 107 lbs (a 53-lb swing: 38% of target swing), then overshooting again by 15 lbs, then reflexing again to 132 lbs before providing a relatively flat trace. This is a veteran subject possessing poor focus although her flat trace implies somewhat average motor control. She needs to be more careful, to use a longer ramp time.

exceeding is usually invisible. It is not entirely *invisible* when it produces injury or unique sounds in the exercise equipment.

Compare to *spike, spiking.* Overshooting and spiking are usually related as spiking often causes overshooting, but the two terms are not synonymous. It is possible to spike while not overshooting, and it is possible to overshoot while not spiking.

P.U.S.H. (Personal User-feedback Static Hardware)—BH-KH-GD—trade name for the portable static devices by Gus Diamantopoulos.

ramp or ramping (also de-ramp or de-ramping)—KH—going from zero effort and force to the target effort (TSC) or to the target force (FS). Ramping also refers to going between stages of effort—as in going from stage 1 to stage 2 or from stage 2 to stage 3—during TSC.

De-ramping—the reduction of force and effort that terminates the bout. Note that de-ramping is not inroading. It is not the force loss displayed when BTI occurs. Force decrement during inroading is unintended and concomitant to increased or continued effort.

[Note: While inroading occurs as soon as ramping commences, no further inroading occurs during de-ramping (in most cases). Also Note: The previous note states something entirely different than the statement in the previous paragraph that "... de-ramping is not inroading."]

routine—G—a collection of exercises and their sequence performed in a workout.

spike, spiking—G-GD—a sudden application of force. It is evident by the verticality of the trace in FS. Of course, verticality is dependent upon time lapse and the force obtained. To explain, a ramping of 400 lbs in five seconds shows much greater verticality than ramping to 100 lbs in the same time.

Compare to *overshoot, overshooting.* Overshooting and spiking are usually related as spiking often causes overshooting. But it is possible to spike while not overshooting and it is possible to overshoot without spiking.

stages (staged)—G—discreet levels of effort in a TSC exercise bout.

static—G—something still, exhibiting no gross movement.

static hold—U—refers to a *loose* variation of pure statics whereby the subject is presented with a *live* and *loaded* movement arm with the challenge of holding it in place for a predetermined TUL. The static-hold mode offers better loading and control than dynamic mode, but still unnecessarily incites outroading behaviors that compromise the real objective.

statics—G—exercises wherein no gross movement occurs of the body or of the targeted body part. Traditional isometrics as well as TSC, FS, and SuperStatics are all version of statics in exercise realm. *Statics*—in formal engineering parlance—refers to the study and analysis of forces as they are structured within the tolerances of various fixed engineering designs. All engineering schools place heavy emphasis on mastery of this subject. Major application of the equation *force x distance = force x distance* is made.

SuperStatics^{SM}—KH—Ken's new pending service mark to distinguish the precision with what we practice and promote at SeriousExercise from the haphazard statics performed throughout the fitness and physical therapy communities.

This is Ken's marketing term to distinguish our technical verbiage, practices, philosophy, etc., from the scattered and undisciplined thinking, beliefs, and practices that are widespread regarding exercise, with particular emphasis on static mode.

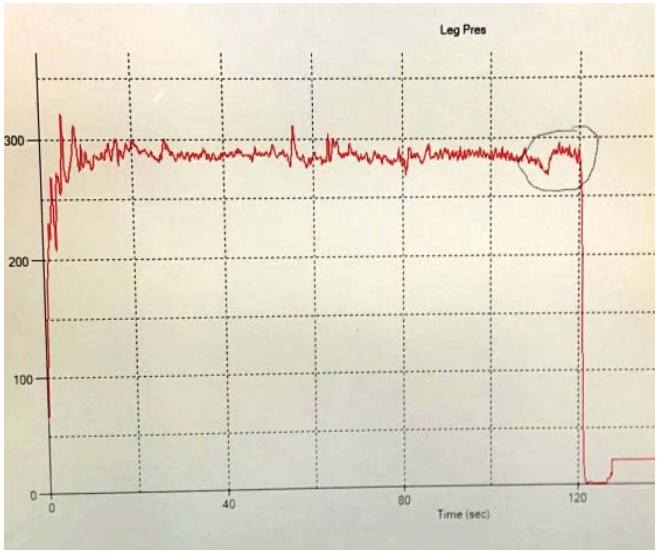
surge-sync—KH—a discrepancy marked by continuous off/ oning, often rhythmically synced with ventilation. Since it rarely involves Valsalva (but can), it is distinguished from *Valsalva sync.*

tare, taring—G—In a static exercise machine, the procedure of excluding non-net the weight (force) of the movement arm. Taring subtracts the weight of the associated limbs from the load sensor(s) and gauge.

In a similar manner, when following a large tractor-trailer note the stenciled message that reads something like:

Gross 100,000 lbs
Tare 56,000 lbs

This tells the authorities at the weigh stations that the trailer weighs 56,000 lbs



From Ken: After finally obtaining some good control of her trace and sustaining it on leg press exercise, I asked this subject to attempt to raise her output to 300 lbs for the last 10-12 seconds (circled part of the trace). She immediately began to moan and to lose force. I managed to coax her to open up her breathing and, thus enable her trace to rise to a level slightly above her foregoing trace.

This experience became instructive for the subject. The analog history of what she did incorrectly, its consequence of reduced output, and its corrective measure was manifest. Without feedback statics this kind and degree of correction and education for the subject is almost always impossible. Dynamic exercise can never offer this!

empty and that its maximum combined weight of both contents and trailer is 100,000 lbs.

If you weigh out a quantity of food (beans, cereal, grain, etc.), you must place the food in a container, but you are not interested in the weight of the container. Therefore, you first place the container—empty—on the scale and adjust the scale's readout to *zero.* This operation is *taring the container.*

Then you add the food to the container and reweigh the container with the food in it. Since the container has been tared, the scale will read the weight of only the food.

When the exercise subject places his feet on the RenEx foot plate, the meter will read the weight of his legs PLUS the force he exerts on the foot plate. Therefore, to know the force produced by the legs, the weight (sometimes *bodytorque)* of his legs must be tared before the exercise commences and with the subject perfectly placed and relaxed.

Specific taring procedures are required for specific machines.

target load, target force, target—GD—usually read on a force meter or monitor as a value to maintain during an exercise.

time under load (TUL)—DM—the duration a subject's targeted muscle group is subjected to an above-rested effort of performing the exercise beginning with and including the ramp time but excluding the de-ramp time.

time at target (TAT)—KH—the subject's targeted muscle group begins to inroad as soon as the subject begins to ramp toward the target. TAT is the duration successfully maintained at the target, excluding ramp time.

For various reasons, some subjects require an inordinate amount of time to ramp. If a subject takes 40 seconds to ramp to the target and then sustains the target for the entire remainder of the TUL (TUL = 90 seconds; Set = 90 seconds), this presents an inherent problem.

As normal ramping is 5-10 seconds with a subject successfully sustaining the target for the full TUL, the TAT is 80 seconds. For the subject who ramps for 40 seconds, the TAT is only 50 seconds. These subjects, therefore, cannot be equally considered for graduation.

trace—G—the line created by analog software that connects the plots of data points emanating from a subject's force performance.

TimedStaticContraction℠, (TSC)—KH—a protocol for static exercise wherein a subject loads the musculature against an immovable object through distinct stages of effort over a given duration. Ken has a pending service mark for this.

un-contract, un-contracting—ED—the act of lengthening—but not relaxing—a muscle under meaningful load as experienced in negative-only exercise.

Valsalva—G—action characterized by abdominal back pressure against a closed airway. Although the closed airway is usually at the glottal level, this closed airway could also be by a musical instrument or something like a balloon. An effect of Valsalva is reduced cardiac output due to reduced venous return. Also, venous blood pressure may rise greatly and momentarily (depending on the extent of the Valsalva), but only on the venous side (right side) of the circulatory system.

In and of itself, Valsalva is not dangerous, but it is to be avoided in exercise as it is a factor of de-isolating the subject's muscular engagement. What's more, Valsalva is usually the first in a cascade of behaviors termed *outroading behaviors.*

The other outroading behaviors do raise blood pressure on the arterial (left) side of the circulatory systems and do pose threats to safety during exercise.

The Valsalva maneuver, or simply Valsalva, is named after the 17th century Italian anatomist Antonio Valsalva, who first used the technique to study the

human ear. In proper exercise, we may consider Valsalva and breath-holding to be interchangeable terms, although cessation of breathing is possible without Valsalva.

weakening—G-KH—generalized loss of strength. Not used in conjunction with the momentary fatigue of inroad. Compare to *fatigue* and *fatiguing.*

[Thanks much to Lou Gardner for editing this. Also, thanks to Brenda Hutchins for proofing. All of it was also reviewed and edited by both Ken Hutchins and Gus Diamantopoulos. Thanks so much again to Anastasia Koretskaya, Brenda Hutchins, and to John Daly for their posing and data contributions.]

[Note: All contents of this treatise are material for test questions on the new SuperSlow Statics Certification.]

Warning: *Never Suddenly Collapse Your Effort!*

by Ken Hutchins

For the West Point Project in 1975, Nautilus founder and owner, Arthur Jones, instructed his nephew, Scott LeGear, to build about eight strength-testing machines. At a glance, their overall color (the standard Barbados Blue with black Naugahyde upholstery) and shape gave the impression of a regular Nautilus exercise machine. Closer inspection revealed that they each provided crooks in place of their weight stacks where conventional strain gauges could be hooked in line with the force of the subject's effort.

In the late 1970s and the early 1980s I saw these measuring devices in the massive junk pile at Nautilus. In fact, it was my responsibility and decision to send them to the scrap yard per the regime that bought Nautilus directly from Arthur in 1986.

If you consider the many thousands of dollars invested by Arthur to build these measuring devices—merely to haul them up to West Point to test a score of subjects before, and then again, after the experiment there—and then haul them back to Lake Helen, Florida and have them put in the junk pile for ten years, you appreciate only one level of Arthur's energy and effort. But when you then learn, as I did later in 1978, that it was all for naught, because the strain gauges—although obtained from a reputable lab—could not be calibrated, then you appreciate a great and disappointing waste. But all Arthur's efforts in this regard DID produce one bit of valuable information:

Never Suddenly Collapse Your Effort!

During each test on these crude devices, each West Point subject was carefully instructed to gradually build (We now say, "ramp.") into a maximum effort. This was done because Arthur's staff was well versed on the dangers of any explosive, sudden application of force. But still, several of the subjects did get hurt while performing these tests. The common injury was a pulled (strained) hamstrings muscle.

What no one could predict was that the injuries all occurred—not during the feared and carefully managed application of force—but during the de-application of force... the let-off, the relaxation immediately after the maximum-effort test. We could never explain this danger. We could only acknowledge it. As Arthur repeatedly stated in those days, "We don't understand gravity, but we do know not to go walking off tall buildings."

In the early 1980s, I injured a hamstrings performing a test on an infimetric computerized Nautilus prototype. I was shocked that I was injured as I knew not to suddenly release my effort. Arthur noticed me limping the following day, and after I told him how I became injured, he launched into the West Point experience. Quickly sensing that I already knew the story and had, indeed, applied great care with the entire procedure, he seemed momentarily dumbfounded.

Silently, I decided static testing could never be made safe, especially if I was injured—and I being well aware of the dangers and safety procedures—how could I expect anyone else to perform such testing safely? Note that this was several years before the founding of MedX.

And although we do not perform or recommend testing to be performed with our static equipment and approaches, and although the muscle is to be deliberately deeply fatigued—hence, no longer able to render its maximum and most dangerous force—before terminating an exercise, it still deserves warning to slowly *un-contract* the muscle. Don't merely *collapse the energy field,* so to speak.

I borrow this last phraseology from my early experience with ignition systems in small and large internal combustion engines. Note that the typical lawn mower does not have an on board battery; however, a large voltage is sent to its spark plug with each rotation of the flywheel. Where does this voltage arise from?

A magnet resides in the flywheel that closely passes a coil with each rotation. By disturbing the magnetic field, a current is induced in the coil and sent to the spark plug.

Before the advent of electronic ignitions in the 1970s, a larger engine—such as that in an automobile—sent a much larger voltage to its spark plugs. It obtained a relatively small voltage from its onboard battery to send through the primary windings of its coil. This current created a magnetic field around this primary winding that collapsed each time the mechanical points opened, thus sending a huge voltage down the secondary windings that were wrapped around the primary windings. The current induced in the secondary windings went instantly to the spark plugs.

I'm not saying that the collapsing magnetic field surrounding the primary winding of a coil is the same as that in a muscle. I merely see similarity with the abruptness of the collapse and the corresponding force that accompanies it.

So, no matter what we eventually learn about the nature of a sudden collapse of effort, instruct all subjects to slowly decrease their effort. De-ramping should take about as long as ramping, perhaps slightly longer.