The Problem with "Exercise Science"

by

Mark Rippetoe

I talk to lots of kids who are interested in becoming strength coaches. I get e-mail about this every week, and we talk about it with people who attend our seminars every month. Most are in school for an "Exercise Science" degree, at either the graduate or Masters level. I have two important observations:

1. The university-level programs are so uniformly bad that everyone who comes prepared to pass our barbell training and coaching course has done the preparation themselves, with no help whatsoever from their coursework at school. As far as I know, there are so few college-level programs that actually equip their graduates to function beyond the commercial gym pinsetter-level that I cannot tell you the name of a single school that does the job adequately.
2. These people come to our Starting Strength seminar, and the most frequent comment from them is something to the effect that "I learned more in your 25-hour course than I learned in the past 4 years of my Exercise Science program at (name any university). Thank you THIS much (stretches arms wide and hugs me)."

I understand that people don't go to college to learn how to lift weights. I know that Brooks and Fahey must be read and understood, that some approach to understanding cardiopulmonary topics must be taught, and that testing and measurements are sometimes important if quantification is necessary for the Physical Therapists.

But I also know that any college-level program that calls itself "Exercise Science" or "Biomechanics" or "Exercise Physiology" or any other trendy permutation of PE should at least prepare the student to function in a situation where the coursework can be applied in a real-world scenario, *beyond* what would be expected of a self-taught trainer in a gym, and that this is the expectation of the student who enrolls there. Most of these people graduate from the typical PE program quite literally unequipped to show a client the most basic weight room exercises and, more importantly, completely unable to put this client on an effectively-designed program that improves physical capacity over the longer term. The ones who *can* have learned how on their own.

Barbell training is the most basic and effective method for improving strength and conditioning, the basis of athletic performance. But it is not taught in university PE programs. Perhaps this is mere personal bias – perhaps you think that aerobics class, ellipticals, and some leg extensions constitute an effective exercise prescription by a Degreed Professional. Or that cutting-edge "functional" training on balance boards and swiss balls using 3-pound dumbbells produce high-level athletic performance.

They don't. Strength improves the performance of both casual exercisers and athletes, and though this may be a personal bias I have acquired through 38 years of experience, it has proven itself to be absolutely, undeniably true. The best way to get strong is to squat, press, deadlift, and bench press more weight than you were doing before. Taking his squat from 135 to 315 makes a personal training client happier than anything else you can do for him in the gym. Taking her squat from zero to 85 makes a 55-year-old lady feel more alive than she has been since she was a kid. And taking a high school athlete's squat from 185 to 455 may make the difference between a scholarship opportunity and a job at Burger King.

Leg extensions, yoga, Pilates, balance boards, glorified lunges, and ipsilateral/contralateral dancing with light dumbbells are merely assistance exercises, no matter what you call them. They cannot make the difference between a scholarship opportunity and a job anywhere.

For a person who is not already strong, an improvement in strength makes the most difference in physical capacity, and that the best way to get stronger is through the use of barbell training. But this is not taught – and in fact is often discouraged – in the huge, gigantically vast majority of universities who offer a PE degree. This is a tragedy, an embarrassment, and a theft of money and time all rolled into one big fat self-satisfied tenured peer-reviewed asshole of a situation.

I make this observation to you without any intent to advertise our products, although they are quite a bit better than anything else on the fitness education market. My point is that we are a small company – a *very* small company – and we manage to get the job done. How is it possible that a multibillion dollar university running a multimillion dollar PE department cannot do – in the 4 years of a typical undergraduate program, and even in the additional 2 to 3 years of post-graduate work – what our tiny company can do in the space of time it takes an interested student with some personal experience in strength training to prepare for and attend a weekend seminar? *This stuff just isn't that hard*. But it is important, and it's not being taught competently, if it's taught at all.

Research by Researchers Who Are Not Experts

And neither is anything else, apparently. A modern university education is most often an expensive waste of money. Universities compete for students. They do so by developing a reputation students are attracted by, and by offering degree programs they think students will want to pursue, whether they are useful or not, marketable or not, or even legitimate in an academic sense. They host sometimes-successful sports teams, they spend money on beautiful campuses, and they cultivate an academic reputation by hiring faculty who publish in peer-reviewed journals. They seldom cultivate an academic reputation by hiring competent *teachers* – people who know how to communicate the material to college students, regardless of their publishing history.

I remember the adverse effects of this policy when I was trying to pass Calc I. The majority of the math professors were simply not capable of explaining differential calculus to freshmen and sophomores, because they had no idea why you didn't already understand it. It took a while, but I finally got through the course, being afterward accused of minoring in Calc I.

In an "Exercise Science" department, the opposite scenario is often present; it is common to find the entire faculty composed of people who have either a background in aerobic activities or some sport like tennis, soccer, badminton, or handball. Their lack of experience in strength training adversely affects that portion of the students who are interested in a strength and conditioning career after graduation.

First, a faculty with no experience in strength training has no idea about how to write a curriculum to teach it. They quite literally *don't know* what they don't know. They were quite likely hired for their publishing credentials, not their strength training chops. Or it might be their first job in a university setting. So when the coursework for a degree is designed, the department chair is at the mercy of his lack of experience, and that of the rest of the faculty. The majority of the time, students in these programs graduate with no hands-on "lab" experience in administering effective strength training protocols directed by the faculty or the GA staff. Unless the student happens to be a lifter himself already, he will graduate without the ability to administer a strength training program, because it has not been part of the curriculum.

Second, a faculty who must publish but who lack any practical experience in strength training should stick to topics other than strength training. Often they don't. Such a situation gives rise to volumes of utterly stupid, pointless research that nonetheless receives approval from review committees made up of the same people (most of whom actually know each other), and which subsequently becomes ensconced in the hallowed halls of The Literature. I read these journals every month for years, thinking the whole time that these geniuses were merely working above my head in ways I was unequipped to understand. That was not always the case.

For example:

1. **No difference in 1RM strength and muscle activation during the barbell chest press on a stable and unstable surface.** The Journal of Strength and Conditioning Research. 2008 Jan;22(1):88-94.

From the abstract: *The results show that there was no difference in 1RM strength or muscle activity for the stable and unstable surfaces.* There were 13 subjects, and the heaviest weight used was 253 pounds (I think – the only record of the data in the paper is a graph).

In addition, there was no difference in elbow range-of-motion between the two surfaces. Fascinating. The ROM in a bench press is controlled by the distance between the chest and the bar at lockout, so the grip width would be the determining factor in the ROM, not the type of surface you're on. They might as well have also observed that the sun did not change its approximate position during each set.

Taken together, these results indicate that there is no reduction in 1RM strength or any differences in muscle EMG activity for the barbell chest press exercise on an unstable exercise ball when compared to a stable flat surface. Now, I have a lot of respect for the nads of a guy who would lay down on a rubber ball and bench press 253, but do these guys really feel comfortable here drawing a conclusion about the bench press, given the fact that the raw record is over 700, and that their study had a population of 10 men and 3 women? Did they consider the fact that a 253 1RM isn't all that good (unless it was one of the women – nah, probably not), and that things change rapidly when the weight actually gets heavy? ***Seriously – do they know that 253 isn't heavy?***

2. **A biomechanical comparison of back and front squats in healthy trained individuals.** The Journal of Strength and Conditioning Research. 2009 Jan;23(1):284-92. From the abstract: *The back squat resulted in significantly higher compressive forces and knee extensor moments than the front squat.* Might the fact that they used heavier weights for the back squat (really, read the paper) have something to do with this?

From the paper: *Subjects lifted nearly 90% of their body mass during the back squat (61.8 +/- 18.6 kg) and almost 70% of their body mass (48.5 +/- 14.1 kg) during the front squat.* It is interesting that the word "significant" was used to describe compressive forces applied to a lifter that had *"met our stringent requirement of at least one year of experience in both lifts used a minimum of one time per week each in their regular weight training programs."* when those forces amounted to less than the bodyweight of the test subjects. A pattern emerges...

Shear forces at the knee were small in magnitude, posteriorly directed, and did not vary between the squat variations. You have all seen a front squat, right? And you have all seen a back squat. One of the obvious differences between them is that the back must be much more vertical in a front squat, or the bar will fall off the shoulders. This means that the knees will be much more forward in a front squat where enough weight is used to make not dropping the bar a factor. So the knee angle will be more closed. And a closed knee angle, among other things, shortens the hamstrings and loads the quads. And a shortened, looser hamstring cannot protect the knee effectively by countering the anterior force applied by the quads. Yet these guys conclude that the shear forces at the knee ***did not vary*** between the two squat styles. ***Do they know that heavy front squats and heavy squats are performed with different knee angles?*** There is no attempt to quantify either technique beyond a couple of pictures that actually show the subject posed with apparently identical knee angles in the bottom position of both front and back squats.

Although bar position did not influence muscle activity, muscle activation during the ascending phase was significantly greater than during the descending phase. Bar position did not influence muscle activity? So a fairly horizontal low-bar back squat and an upright front squat have the same effect on hamstring recruitment. The only person who might believe this is a person who has never performed either movement with post-novice weight.

The front squat was as effective as the back squat in terms of overall muscle recruitment, with significantly less compressive forces and extensor moments. In addition to our previous observation about the bar position and muscle activation, how is it possible that lower forces and moments are as effective for muscle recruitment as higher forces, muscles being what they are/doing what they do? Compression on the system is a function of the load, and the heavier the load the stronger you must be to lift it. The moment forces at the knees and the hips are what we use to make the barbell go back up. ***We lift weights with moment force.*** We *use* moment forces – they don't use us.

The results suggest that front squats may be advantageous compared with back squats for individuals with knee problems such as meniscus tears, and for long-term joint health. Mother of God. They want people with knee injuries to do front squats. Not only do their data not support this allegation, an experienced coach knows that front squats are much harder on the knees than squats. Anybody who has done both movements with post-novice weight knows this too. Again: ***Do You Even Train?***

3. **Optimizing Squat Technique.** The Strength and Conditioning Journal. 2007, Dec;29(6):10-13. This is a review paper, a summary of the literature designed to present an "evidence-based consensus" on the topic of squat technique. Several interesting things are noted, the most interesting of which is this short statement on page 12: *Research suggests that the squat, regardless of technique variation, produces minimal activity in the hamstring muscles (4, 5, 12, 13, 16, 21, 23-25).* They go on to recommend hamstring assistance exercises. Most notable are the ***nine (9!)*** citations from The Literature that the authors feel support their position that, somehow, the hamstrings are not active in a movement that involves both hip extension and the support of a moment arm along the back segment.

So if I understand their position, ***a sprinter with a torn hamstring could squat with no pain.*** Right after the tear. Once again, how would a group of people who had themselves trained with weights feel comfortable with this bizarre statement? Perhaps reliance on surface EMG data should be re-thunk. Or perhaps you should actually learn to squat and get more familiar with the movement before you write a paper about it. And perhaps the reviewers should too.

4. **Gluteal muscle activation during the isometric phase of squatting exercises with and without a Swiss ball.** Physical Therapy in Sport. 2014, Feb;15(1):39-46 From the abstract: *Growing evidence supports hip muscle activation and strengthening exercise prescription to prevent and treat various lower limb injuries. Common prescriptions include single-legged and double-legged squatting, with and without a Swiss ball. We aimed to establish the effect of varying forms of squatting exercises on gluteal muscle activation.* They aimed to establish the effect of doing everything except actually squatting – squatting to a Physical Therapist apparently means anything that unlocks the knees with the feet on the floor.

Surface electromyography (EMG) measures of gluteus medius (GMed) and gluteus maximus (GMax) during the isometric phase of single-legged and double-legged squatting, with and without a Swiss ball were performed. Of course. Without our surface EMG units We Are Nothing.

A greater percentage of maximal voluntary contraction during single-legged squatting was found compared to double-legged squatting for Gluteus Medius and Gluteus Maximus (values given for both). Additionally, the Swiss ball increased GMax activity and demonstrated a trend toward increased GMed activity during the single-legged squat. Both of these options are regarded as squats by these people. And now, the stunning conclusion:

These results indicate single-legged squatting may be more appropriate than double-legged squatting to facilitate strength gains of GMed and GMax. We have here another study conducted by people who think strength can be preferentially obtained through exercises that use fewer muscles in unilateral isolation, as opposed to more muscles in bilateral symmetry, the natural movement pattern of any bilaterally-symmetrical organism – that more strength can somehow be produced by doing an exercise which is inherently incapable of producing more force. Never mind the fact that these two particular glute muscles are merely components of the system that produces hip extension, a system whose components always operate together. No, these guys want you to "facilitate strength gains" ***by performing an assistance exercise that requires the use of light weights.***

By this logic, if exercises that require the use of lighter weights are more effective for producing strength than exercises that permit the use of heavier weights, then exercises that use no weight at all would be the most effective ones you could do. And training aboard the International Space Station would be the key to powerlifting success.

5. **The effect of rest interval length on multi and single-joint exercise performance and perceived exertion.** The Journal of Strength and Conditioning Research. 2011 Nov;25(11):3157-62. From the abstract: *The purpose of this study was to compare repetition performance and rating of perceived exertion (RPE) with 1-, 3-, or 5-minute rest intervals between sets of multi and single-joint resistance exercises.* Why? What will this tell us that we don't already know?

Fifteen resistance trained men (some values listed here) completed 12 sessions (4 exercises × 3 rest intervals), with each session involving 5 sets with 10 repetition maximum loads for the free weight BP, machine leg press (LP), machine chest fly (MCF), and machine leg extension (LE) exercises with 1-, 3-, 5-minute rest intervals between sets. Sounds like a great way to catch a pump. Now, the really novel part of this breakthrough investigation:

For all exercises, consistent declines in repetition performance (relative to the first set) were observed for all rest conditions, starting with the second set for the 1-minute condition and the third set for the 3- and 5-minute conditions. Furthermore, significant increases in RPE were evident over successive sets for both the multi and single-joint exercises, with significantly greater values for the 1-minute condition.

So it turns out that as you get tired, the exercise gets harder. And the longer you rest, the easier it gets. Oh, and heavy stuff is harder to lift than light stuff. This is pointless nonsense, assembled for the sole purpose of obtaining a publication credit. ***But the NSCA actually reviewed this paper and published it in their "research journal."***

6. **Muscle Force Output and Electromyographic Activity in Squats With Various Unstable Surfaces.** Journal of Strength & Conditioning Research: 2013, Jan;27(1):130-36. From the abstract: *The purpose of the study was to compare force output and muscle activity of leg and trunk muscles in isometric squats executed on stable surface (i.e., floor), power board, BOSU ball, and balance cone.* They assessed the force production capacity of a "squat" that doesn't move, and they assayed the muscle activation of a suite of everybody's favorite muscle bellies with surface EMG, again. (Amazingly enough, there was no mention of inactivity of the hamstrings/biceps femoris.)

One familiarization session was executed before the experimental test. Isometric exercises are funny, in that they have to be practiced quite a bit before a lifter can develop a lot of force against an immovable bar. It's really an unnatural effort, and when most people push against something that just will not move, the normal reaction is to stop, so this type of exercise requires some practice. Having considerable experience with both isometric and isotonic-isometric training, I know from experience that for someone unfamiliar with the method it is essentially impossible to produce an accurately measurable maximum contraction under these circumstances. And if they were not attempting to measure maximum force production, what exactly were they trying to do? There is absolutely no way this methodology can produce any useful data.

In conclusion, increasing the instability of the surface during maximum effort isometric squats usually maintains the muscle activity of lower-limb and superficial trunk muscles although the force output is reduced. This suggests that unstable surfaces in the squat may be beneficial in rehabilitation and as a part of periodized training programs, because similar muscle activity can be achieved with reduced loads. If instability reduces force production – and it certainly as hell does – why is reduced force production beneficial in rehab? ***Why are you people always trying to figure out ways to reduce force production?*** Can't we reduce force production by just taking some of the plates off the bar? And if we're talking about rehab, why in the hell would you expose an injured person to an unstable force production environment? A guy has an injured knee, and you put him on a wobble-board to squat? ***Have you actually done any of this rehab stuff before?***

"Do You Even Lift, Professor?"

Over and over again, throughout The Literature, evidence emerges of a common thread running throughout the whole damn thing: these people are not doing research on the lifting of what experienced lifters and coaches would consider to be *heavy weight*. They are administering a sub-clinical dose of exercise medicine and attempting to measure its effect, and perhaps even study its underlying mechanisms. But *sub-clinical doses do not perturb the system sufficiently to produce a meaningful response.* I think the problem is that these people just don't know that what they're doing is actually sub-clinical, because they have no apparent experience that would guide an effective dose/response investigation. How can any conclusions be drawn from these scribblings that are applicable to what we do as strength coaches?

Let me point out that there is good research being done by people with experience in the practical aspects of what they do. Hagen Hartmann, Jeffrey McBride, Brad Schoenfeld, William Kraemer, and others are asking the right questions, applying good methodology and good statistical analysis, and making useful contributions to The Literature. There have been significant advances in our understanding of human performance as a result of good research. But these people remain in the distinct minority, and, in fairness, this is true of any research field. The above examples were not chosen because I feel that they are representative of the field of exercise science as a whole, but as examples of what is capable of passing the peer-review process and entering The Literature.

Peer-review is often reduced to the process of disagreeing with things you don't like and affirming the things that comport with your own worldview, whether they make any sense or not, from a position of anonymity and unaccountability. Of all the fields of study represented in peer-reviewed research, exercise science and nutrition are perhaps the worst in terms of academic rigor – ask a chemist or an engineer to read some of it and see what they say. And these examples are drawn only from my field of interest. Imagine what lurks in the creatine studies.

So, a young person in this type of program spends 4-6 years in school, receives no practically applicable training in what might well be the emphasis he had in mind, yet has participated in enough pointless "research" that the impression is made that an education has actually been received. It has not.

The current state of exercise science education does a profound disservice to young people interested in pursuing the topic at the university level. In the majority of cases it represents nothing more than a huge waste of money and time. The coursework lacks academic rigor and applicability outside the classroom, the publication quality is – or should be – an embarrassment, and 4-6 years is a long time to waste getting nothing of any consequence accomplished.

If engineering departments graduated people who built bridges that fall down, we'd notice that. I suppose it's a good thing that our situation is less critical, but as long as a Bachelors Degree in Exercise Physiology means that the Bachelor was taught nothing important about either exercise or physiology, the starting salary will stay at $18,000.

A Better Way

How to fix the situation? I don't know, and I don't really care, beyond my concern for the kids who are already invested in the process.

What is a better way to obtain an education in strength training that can be applied in the pursuit of a career as a productive strength coach? I have some definite ideas about that:

1. Earn a degree in a "hard" science – "hard" in the sense that it is the quantitative study of something, and it requires coursework that uses a calculator. If the program does not require any math beyond college algebra, it cannot be considered a hard science. If it doesn't require the science-majors version of physics and chemistry, it isn't a hard science. A major in math, physics, chemistry, biology, or geology will provide an education of sufficient quality to prepare the mind for the task of thinking critically and analytically. In the huge, gigantically vast majority of universities, the PE department does not offer a hard science degree.

2. Learn the specifics of physiology, either in your undergraduate coursework or on your own. Then apply that background to exercise physiology by reading the hard versions of that material. The aforementioned Brooks and Fahey is the gold-standard on the topic. Learn about how this material applies to strength training.

3. Train yourself in the athletic discipline you wish to coach. The process of learning the material from the inside out prepares you to teach it effectively, because you know where the problems lie and how to solve them. A strength coach who has not personally advanced well beyond the novice level is not prepared to advance anyone else that far.

4. Compete in that discipline, so that your training results matter to you. Elite-level performance is *not* the objective. Not at all. Elite-level performance often indicates a degree of natural athletic ability that – analogous to gifted mathematicians attempting to teach Calculus to college freshmen – most often makes the teaching/coaching process less effective. The best coaches are almost always mediocre athletes who tried very hard to be better, and in the process learned many things about how to do it.

5. Coach other people, probably for free at first, but in whatever scenario is required to practice what you know on other people besides yourself. If you haven't tried it firsthand, it may well be bullshit. But if what you have learned from your own training works for other people, show them, and practice showing them again and again. The accumulation of thousands of hours of weight-room experience is required for a successful coaching career, and the sooner you get started, the better off you and your athletes will be.

This article originally appeared May 5, 2014 on www.t-nation.com

Mark Rippetoe is the author of Starting Strength: Basic Barbell Training, Practical Programming for Strength Training, Strong Enough?, Mean Ol' Mr. Gravity, and numerous journal, magazine and internet articles. He has worked in the fitness industry since 1978, and has been the owner of the Wichita Falls Athletic Club since 1984. Rip was a competitive powerlifter for ten years, and has coached many lifters and athletes, and many thousands of people interested in improving their strength and performance. He conducts seminars on this method of barbell training around the country.

Jonathon Sullivan MD PhD and Stef Bradford PhD helped with the preparation of this essay. I am, as usual, indebted to them both.

This article originally appeared May 5, 2014 on www.t-nation.com