Vertical Force is the Holy Grail
by Tony Holler

Does jogging have a place in your sprint training?

Do you believe speed comes from the weight room?

Have you used parachutes or any other resistance training?

Do you use the coaching cue, “grab the track and throw it behind you”?

Have you taught kids to increase their stride length because \( \text{speed} = \text{stride length} \times \text{frequency} \)?

Do your sprinters trudge up mountainous hills to get strong?

Do you talk to your sprinters about being “fit”, getting “in shape”, and developing an “aerobic engine”?

Do you believe that hypertrophy (big muscles) make you faster?

Do you talk about “speed endurance” before doing repetitions of 200 meters?

If you answer “yes” to the questions above, you must repent.

\textbf{If you have not yet been converted to cat-like sprint training, it’s time to be born again.}

It’s time to learn the science of sprinting.

(BTW, I have been guilty of each and every one of the sins listed above.)

Here’s the good news. You don’t have to go to graduate school. You don’t have to read a book. You don’t even have to buy the latest video from some online snake-oil salesman.

Just learn this one scientific fact.

\textbf{VERTICAL FORCE}

That’s it.

Surrender your sprint training to the pursuit of vertical force. The more force generated, the less ground contact time.

There are no other gods to worship in sprint training. All great sprinters produce lots of vertical force and spend very little time on the ground.

\textit{Elite sprinters fly.}

All sprint mechanics must center on creating maximum vertical force.
All weight lifting for sprinters must reflect a focus on creating vertical force.

All sprint workouts must be fundamentally driven to serve one master, vertical force.

Let’s start at the beginning.

Sprinters must use boatloads of energy to go from A to B. This energy overcomes the forces of nature working against the sprinter. These antagonistic forces are gravity, friction, and air resistance. **Gravity dwarfs the other two.**

Because of gravity, sprinters must generate a vertical force of up to five times their body weight.

Newton’s second law of physics states that force equals mass x acceleration, $F = ma$. In sprinting, your body (the mass) goes through *upward acceleration* during each foot contact. Since there is a large downward force pulling the body down (gravity), an enormous force must be pushed into the ground. This force is generated by triple extension of the hip, knee, and ankle.

The amount of force that must be generated is immense. Remember the body is descending at the moment of foot strike. The following three things must happen:

- Stop the fall
- Hold the body upright
- Launch back into flight
Stop the fall, hold the body upright, & launch back into flight.

During top-speed sprinting, the horizontal forces that must be overcome are tiny compared to the downward force of gravity. A generalized graph of the ground reaction forces during a foot contact is shown in the picture above. The portion of the horizontal force below the line is the braking impulse. Above the line is the propulsive impulse. As you can see, those forces are insignificant compared to the vertical forces.
Flight requires lots of vertical force. Since the entire force is generated with one leg, coordination is critical. Notice the dorsiflexed foot.
Bolt’s height and incredible knee lift allows him to create large forces. No one else on the planet can run 10 meters in 0.80 seconds.
Descending from flight, ready to punch the track.
This is Marcellus Moore, age-14, the fastest freshman in the nation (10.40 in the 100m and 21.28 in the 200m). Marcellus is in a very powerful position here. The focus of sprint mechanics is finding this power position. The higher the hips, knees, and foot, the more vertical force is created.

Has there ever been a more powerful sprinter than Ben Johnson? Due to knee problems, Johnson could not do lots of plyometric work. He compensated by using steroids and becoming the strongest sprinter in the history of the world.
The higher the hips, the more force. Run tall. Once you understand vertical force, you understand Bolt’s advantage. Bolt needed only 41 steps to win the 100 meters in London, 2.44 meters per stride. Bolt averaged 4.2 strides per second.
Carl Lewis in his famous pose. This does not come natural to young athletes. They must be taught and then they must practice sprint mechanics consistently. Jogging does not teach this. Jogging teaches bad sprint habits.

Lets make sure that there is no dissent here. VERTICAL FORCE IS THE HOLY GRAIL OF SPRINTING. I’m not an expert. I’m just a high school chemistry teacher that coaches track after school. So let’s hear from the experts …

Maybe you remember Dr. Peter Weyand.

Dr. Weyand (SMU) is one of the world’s foremost experts on human performance. I attended two presentations by Weyand in 2011. The only thing I wrote down was “vertical force creates minimal ground contact.”
I learned of Frans Bosch from Chris Korfist. Frans Bosch is too complicated for me, but if you read between the lines, he speaks of generating vertical force.

Ben Johnson’s coach was Charlie Francis.
OK.

Let’s don’t beat a dead horse here.

Let me make this simple and quick.

The enormous downward force while sprinting at top speed must be delivered in a fraction of a second. Elite sprinters have ground contact times of .08 seconds. There are no heavy-footed elite sprinters. If your training includes heavy-footed-long-ground-contact-time-running, you are coaching sprinters to run slow.

Some coaches believe that spikes are designed to grip the track. Spikes grip the track during the drive phase, but at top speed, the advantage of wearing spikes is the fact that spikes have no cushion. Cushion creates longer ground contact and therefore reduces speed.

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There’s no question a sprinter needs to be strong. Ben Johnson could squat over 650 pounds, bench over 450, and bent-over-row 315 pounds at a body weight of only 165. He also tolerated an incredible chemical load. His steroid supplementation is legendary. In 1981, Johnson started with alternating days of 5 mg and 10 mg of Dianabol for a nine-week period. He later added HGH. Then he added Testosterone, Furazabol, oral Turinabol, and Stanozolol (aka Winstrol). Johnson started taking steroids in 1981 and finally tested positive (for Stanozolol) at the Seoul Olympics in 1988. He ran 9.79 but was stripped of his gold medal.
I can’t resist sending advice to world-class sprinter, Tyson Gay. The next time a chiropractor gives you “anti-aging cream”, read the label. See below.

Testosterone and DHEA are both banned substances. The chiropractor providing this cream, Clayton Gibson III from Atlanta, has been linked to several NFL players.

Carl Lewis won nine Olympic gold medals and barely touched weights. Most people on the inside are sure that Carl Lewis was a steroid user but he never tested positive.

It seems safe to say that steroids, directly or indirectly, improves a sprinter’s ability to produce a vertical force.

The science of weight training for sprinters, to me, is not clear.

Imagine thick football players performing squats over a period of a second or two. Does this prepare them to pound the track with up to five times their body weight in only .08 seconds?

Chris Korfist is the best sprint coach I know. Chris dismisses conventional weight lifting. He claims conventional weight lifting is a waste of time and often counterproductive.

Boo Schexnayder is one of the most respected sprint coaches in the world and he sells video showing conventional weight room activity. Boo is a fan of squats.

Even though weight programs are in constant debate, all coaches love strength. I think general strength for high school kids is always a positive thing. I have always encouraged push-ups. I absolutely love pull-ups. Personally, I have lifted weights for over 40 years. I align myself with football coaches who never second-guess the value of the weight room.
But, then again, Jesse Owens ran 10.3 and 20.7 in 1936 on a cinder track and never lifted weights. And we can be sure he did not take steroids.

The early science of weightlifting came from body builders. The modern science of weightlifting is now dominated by football. Both of those groups have an alarming percentage of Neanderthals in their camps.

When hypertrophy is the objective of the weight room, the speed results are almost always negative. Gravity sucks.

The gurus of high school football coaches are usually college and professional coaches. High school football coaches see college players gaining 30 pounds and getting faster, and then try to replicate those results. In my opinion, this is impossible without steroids. Steroids are everywhere in college and pro football. Everywhere. Testing? Ha. Marion Jones and Lance Armstrong never failed a test. NEVER FAILED A TEST.

In 1970, only one player in the NFL weighed over 300 pounds. In 2010, there were 532. Better nutrition?

The Green Bay Packers won Super Bowl I with their largest player weighing 260 pounds.

Don’t base your coaching knowledge on professional athletes. They are freaks and cheats.

If I trained college football receivers and running backs entering the NFL combine, I would train explosive power, speed, & jumping. Then I would restrict their food intake to raw fruits and vegetables with a steady diet of lean meat. I would allow no calories in drinks. I would error on the side of greyhounds, not mastiffs. #speedkills

Last Sunday, Plainfield North alum Kapri Bibbs had a disappointing NFL Combine (this was originally written in 2014). He re-aggravated his turf toe doing the standing long jump and then ran only 4.67 in the 40. Despite the turf toe, I believe his weight (5’9” 212) was the bigger issue. Don’t get me wrong. Kapri looked like he belonged on the cover of Flex magazine. The problem is gravity. Hopefully his highlight video will offset his forty time. (As of 2017, Kapri owns a Super Bowl ring from the Broncos and was traded this year to the 49ers).

Only seven guys at the NFL Combine ran under 4.40 in the forty (2014). The average size of those seven guys should not surprise you … 5’10” and 188 pounds. The fastest guy was Dri Archer (5’8”, 173) of Kent State who ran 4.26. Add 25 pounds to those guys and see what they run. Add 25 pounds to Usain Bolt (6’5” 190) and see if he runs 9.58 in the 100.

Here is the good news. The two most important areas of sprint training do not involve weights or gadgets.

The most important thing a sprinter can do is sprint.

The next best thing is plyometrics. Plyometrics can be described as landing and jumping at the same time. Get it? Large vertical forces with lightning-fast ground contact, just like sprinting !!!

I use the cue “bounce off the ground”. Force absorption and force generation.

That’s it. All that complicated science boils down to sprinting and jumping.

The bad news is that you CAN’T sprint and jump for two hours. You CAN’T sprint and jump seven days a week. The body can only take limited doses of sprinting and jumping. I consider both to be poisons that stimulate in small doses, inhibit in moderate doses, and cause damage in high doses. Hormesis.
Less is more. Rest is an important workout. Speed grows slow. Speed grows like a tree.

*Don’t treat your cats like dogs.*

Slow running creates bad habits and confuses the nervous system of a sprinter.

Where does running mechanics come into this discussion? Teaching someone to sprint is all about preparation for enormous downward force.

RUN TALL (my main sprint cue)

![Diagram of a runner in a sprint position with labels indicating running mechanics.](image)

Running tall creates tall hips and allows for a greater vertical force. If runners are hunched over or running with a forward lean, large vertical forces are impossible.

By the way, the runner-diagram above has a plantar-flexed foot. Yikes. The foot must be dorsiflexed (cocked upward). Not only does a dorsiflexed foot shorten the lever (short levers are faster than long levers). More importantly, the foot can hit the ground explosively, not passively. The foot, when dorsiflexed, acts as a loaded spring that can effectively bounce off the track quickly with ground contact times approaching .08 seconds.

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Longer stride length may seem like a good idea but try generating enormous vertical force from this position. Mechanics matter.

What needs to be taught? Run tall. “Get BIG in the front and SHORT in the back”.

The mistakes:

- **Resistance training.** Sprinting against resistance provides a significant opposing horizontal force. The logic is simple. If you get accustomed to running against resistance, running without it will be much easier. However, horizontal power does not help a sprinter run faster. Using resistance in an upright sprint also puts a lot more stress on the hamstrings, which are already at risk during a sprint. **Most important, the resistance slows down the top speed of the sprint, lengthening ground contact time and decreasing the demand for power pushing into the ground, which is what a sprinter really needs.** For these reasons, sprinting in an upright position against a light resistance is NOT a useful tool. Sell your parachutes on eBay.

- **Training when tired.** Do I have to explain? When you run tired, you run slow. When you run slow you have long ground contact time (heavy feet). When you are tired you can’t generate that enormous vertical force. **Running tired teaches you to run slow.**

- **Over-training.** It’s impossible to do two hours of effective plyometric and sprint work. If you try this, your athletes will eventually become crippled with injuries. Injuries are bad enough with limited plyometrics and limited sprint training. Sprinters need to be trained with a minimum effective dose.

**This low volume approach requires consistent sprint training ... early & often ... with lots of rest & recovery.**

Build a program that attracts speed. Teach mechanics that allow kids to exert an enormous vertical force. Plan your workouts to help your fast runners develop sprinter’s habits. Eliminate resistance running. Eliminate jogging. Increase rest and recovery times. Do low-volume plyometrics to gain power and decrease ground contact time. Learn how much is too much. Happy and healthy should be goals #1 and #2.

Don’t think like a distance coach. Stop progressing from quantity to quality, from high volume to low volume, from low intensity to high intensity. It’s not that complicated. Sprinting is the best way to train for
the sprints. Sprint and jump in relatively small doses with lots of rest. Sprint in the off-season and in the pre-season. Use “Record, Rank, and Publish” as system of sprinter motivation. Be patient with speed development. Speed grows like a tree.

“Heredity only deals the cards, environment and training plays the hand.”

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