Developing Speed in Distance Runners

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Why speed?

For the distance runner, improved speed provides more-powerful “kicks” at the ends of races and heightened “surges” within competitions.

But, there is another reality about which many coaches and runners are unaware:

- Among distance runners, *maximal speed* is a very strong predictor of performance.
- When a distance runner upgrades his/her maximal speed, performances improve at all distances of 3K and above.
The Line-Ups

The old way of thinking about endurance performance:

• If 100 similarly trained distance runners are lined up according to performance time in the 10K, from fastest to slowest, and then lined up again according to maximal aerobic capacity (VO$_{2\text{max}}$), from highest to lowest, those two lines should look similar.

• If the endurance runner’s heart is large and has strong, thick walls, it will function as a fantastic pump and send lots of oxygenated blood to the muscles.

• If an endurance runner’s muscles are great at receiving and using that oxygen which the heart has kindly sent their way, oxygen consumption will soar and VO$_{2\text{max}}$ (which is simply a runner’s maximal rate of oxygen utilization) will peak.

*Big heart + O$_2$-greedy muscles = High VO$_{2\text{max}}$ & Performance*
The Machine

Machine Theory of Distance Running

- The heart and muscles are the “machine” which powers a distance runner.
- Fortify the heart’s pumping ability and also expand the leg-muscles’ capacity to accept and utilize the oxygen sent to them by the cardiac pump, and the machine will be much stronger and thus the runner can perform at a higher level.

A key problem is that VO$_2$max (which measures the machine’s capacity) does not predict performance well among similarly trained runners.
Let’s Line Them Up Again

Let’s go back to those same 100 similarly trained distance runners:

- First, line them up according to 10-K performance, from fastest to slowest.
- Then, let’s line them up according to maximal running velocity, from speediest to most-lethargic.

*It’s a match!*
Having a high maximal velocity is a great predictor of endurance performance. How can this be true, and what does it mean about training endurance runners?
How Do We Optimize Max Speed?

The “gait cycle” consists of just two things:

1. Stance - when a foot is in contact with the ground
2. Flight - when the runner is airborne, flying from one foot to the other

For the novice runner, stance eats up about 70 percent of gait time, while flight grabs a measly 30 percent.
Stance Breakdown

- When a runner’s foot hits the ground, a braking force is produced initially, so that the runner’s body is stabilized and does not move in an uncoordinated way.
- Then, propulsive forces are applied to the ground, and the runner eventually takes flight (the foot finally comes off the ground).

For the novice runner, the braking phase may eat up more than 60 percent of total stance time, with the propulsive phase taking the other ~ 40 percent.
Improvements

- The relative time spent in stance drops steadily to a mere ~ 45-50 percent of gait for the distance runner who makes it all the way to elite status and to a stunning 40 percent of total gait time for the world’s fastest sprinters.
- The time spent in the braking phase of stance also decreases significantly, dropping to around 40 percent in the fastest runners.
It Makes Sense

Distance runners should shape workouts so that the overall training program relentlessly pursues greater air time and shorter braking time. Training should enhance the way in which the nervous system controls the reaction of the leg, ankle, and foot with the ground on every step.

These changes have nothing to do with the Machine, and yet care of the Machine dominates most endurance-runners’ training schemes.
Summing Up So Far

1. Maximal running velocity is a better predictor of endurance performance, compared to the capabilities of the Machine ($VO_2$max).

2. The Machine can not control or produce these positive and necessary changes.

3. The heart can not influence the way the legs and feet interact with the ground.

4. Muscles are actually just anserine slabs of beef which hang between the bones.
The Nervous System

• It is the nervous system which controls how the leg, ankle, and foot react with the ground.

• It is the nervous system which controls changes in stance time, braking time, propulsive force, stride rate, and stride length.

• We must foster development of the nervous system if we want to optimize max speed – and thus endurance performance.
No Mystery for Max Speed Upgrade

As we have learned, max velocity is so important: Move maximal speed upward, and performances in the 5K, 10K, half-marathon and even marathon will improve.

Max speed is simply an optimal combination of stride length (SL) and stride rate (SR).

Max Velocity = SL \times SR
Improving SL & SR

Improving Stride Length

- Increase the amount of propulsive force you apply to the ground with each step, without taking longer to apply that increased force.

_The training methods for accomplishing this include running-specific strength training and hill running._

Improving Stride Rate:

- Produce the same amount of propulsive force per step but take less time to produce that force.

_The training methods for accomplishing this include explosive drills, high-speed running, and fast downhill running on a 3- to 5-percent incline._
Form is so Important!

1. Don’t land with a straight leg.
   This produces a braking effect on every single step which hinders the development of speed.

2. Don’t be a heel-striker.
   Landing on the heel expands the stance phase of gait by about 15 milliseconds, because you still must get the foot down on the ground before you can take off again.
Form is Important (continued)

3. Don’t land with your foot in front of your center of mass. Again, this produces a braking effect.

4. Use a cadence of 180 steps per minute (or greater). The use of a relatively high cadence helps get the landing foot back under the center of mass and promotes a mid-foot landing.

5. Lean forward from the ankles. Lean forward slightly, from your ankles not your hips, and you will bounce forward, as desired, toward your destination.
Form Elements Controlled by ...

All of these positive form elements are controlled by the nervous system and must be rehearsed, practiced, and drilled.

The Machine can only produce the best-possible performances when its energy is channeled into producing lots of propulsive force per step in minimal amounts of time. This requires great form and outstanding control by the nervous system.

Attaining best-possible performances depends on Form and Max Speed. Form is improved with Form Drills, and Max Speed is advanced with the use of Explosive Training.
Explosive Strength Workout (ESW)

1. Warm up thoroughly, utilizing a variety of drills and a blend of easy running and quick “strides”

2. Skip on the balls of your feet for 30 seconds, using very quick leg action. Rest for a moment, and then repeat.

3. Double-leg hurdle jumps: Position eight hurdles in a row, 45 inches apart, with the height of each hurdle set at a height of 12 inches. Starting from one end, jump over each hurdle, landing and taking off on two legs, until all eight hurdles have been cleared (movement is continuous). **As skill improves with the double-leg hurdle jumps, a key progression is to carry out this activity on one leg at a time.**
4. One-leg hops in place: 2 sets of 40 seconds on each leg.

- Stand with your left foot forward and your right foot back, with your feet about one shin-length apart (they should be hip-width apart from side to side).
- Place the toes of your right foot on a block or step which is six to eight inches high. All of your weight should be directed through the middle-to-ball portion of your left foot.
- Then, hop rapidly on your left foot at a cadence of about three hops per second (30 foot contacts per 10 seconds) for the prescribed time period.
- After completing the first set, rest for a moment, and then repeat the one-leg-hopping action on your right leg.
- Rest again, and perform one more set on each leg.
5. Diagonal-hop for 45 seconds, rest for 15 seconds, and then diagonal-hop for 45 more seconds. Jog for a few strides and then move diagonally to the right with your right foot. When your right foot makes contact with the ground, hop quickly in place. When your right foot comes down to earth from this single hop, explosively hop diagonally (at about a 45-degree angle) to the left, landing on your left foot. When your left foot strikes terra firma, hop once in place and then explode diagonally to the right. Your right foot will then hit, and you will hop once and then explode (not literally, of course) diagonally to the left, and so on.
6. One-leg squats with jumps (2 X 10 reps per leg). These are just like “regular” one-leg squats, except you jump high in the air when ascending after each squat. When returning to earth after each vertical jump, land smoothly, and immediately and smoothly begin the next squat.
7. **Complete 8 greyhound runs.** Carry these out in an area which has at least 100 meters of unobstructed surface. Accelerate for 20 meters and hold close-to-max pace for 80 meters. Rest for 20-30 seconds (walking), and repeat your high-speed running in the opposite direction. You are finished with this drill when you have completed eight 100-meter bursts (four in each direction).

8. **Perform 2 X 10 one-leg squats with lateral and medial hops on each leg, with a one-minute break between sets.** Stand with your left foot forward and your right foot back, with your feet about one shin-length apart (they should be hip-width apart). Place the toes of your right foot on a block or step which is six to eight inches high. Most of your weight should be directed through the mid-foot of your left foot. Bend your left leg and lower your body until your left knee reaches an angle of 90 degrees between the thigh and lower leg. Once your left knee reaches an angle of 90 degrees between the thigh and lower leg, hop laterally with your left foot (your right foot stays in place) about six to 10 inches, hop back to center, and then hop medially (to the right when your left leg is forward) for six to 10 inches, before coming back to center position and then returning to the starting (straight-leg) position, maintaining upright posture with your trunk (that completes one rep). Be certain to perform a close-to-90-degree squat in each position (medial and lateral, as well as center).  

*See photos on next page.*
9. Complete 15 high-knee explosions, rest for a few seconds, and repeat. Stand with erect but relaxed posture with your feet directly below your shoulders. Jump very lightly in place, but then suddenly – while maintaining fairly erect posture – jump vertically while swinging both knees up toward your chest. Land back on your feet in a relaxed and resilient manner, jump lightly for a few moments, and then repeat 14 more times. Make certain that you do not carry out the basic movement by hunching your upper body forward to meet your knees; your upper body should be fairly erect at all times. The key action is the dramatic upward acceleration of the knees toward the chest. Eventually, this drill should be conducted on one leg at a time.
10. Drop jumps (12 per leg).
11. Perform 3 X 20 seconds of Shane’s In-Place Accelerations (SIPAs). Stand with erect but relaxed posture with your feet directly below your shoulders. Begin by simply jogging in place, then begin to dramatically increase your in-place “stride rate,” building up fairly quickly to as rapid a rate of striding as you can sustain. Keep your feet close to the ground as you do this; you are not shooting for high knee lift but rather for dramatically minimized foot-contact times. Maintain erect but relaxed posture. When you are learning this exercise, it sometimes helps to turn your legs slightly outward at the hips as you build up toward “top speed.”
ESW (continued)

12. Downhill hops: 3 X 20 meters on each leg on a hill which provides a 3- to 5-percent declination. Jog back up after each “hop-down.”
13. Downhill running: Run very fast downhill (relatively gentle declination of 3 percent) for 70-100 meters, using a mid-foot strike pattern. Jog easily back up after each run-down to recover. Complete four of these very quick run-downs.
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14. Fast running: While staying relaxed and running rhythmically and with good form, sizzle 4 X 400 at close to max speed, with 2- to 3-minute jog recoveries.

15. Cool down with about 2 miles of light running, followed by thorough stretching.

Note: At least at first, it makes sense to complete the above activities on a “forgiving” surface (soft dirt, grass, cushioned artificial turf, compliant track, or wooden gym floor).
Running Science

- An easily comprehended collection of running research
- A wealth of insights distilled from great sport and exercise scientists, coaches, and runners
- A do-it-right reference for a host of techniques and tactics
- An array of the most credible and widely used training principles and programs
- A celebration of the latest science-based know-how of running

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