Stride Length and Stride Frequency: An Indirect Approach

By Latif Thomas

Under the umbrella of speed development as a whole, improvements in stride length (SL) and stride frequency (SF) are often tagged as the key to short and long term gains in speed, regardless of sport. While this idea certainly appears to be valid in most regards, the approach taken to making gains in these areas can have wildly differing effects on performance as a whole.

For this reason, I argue that SL and SF must be developed indirectly as opposed to spending time in training specifically trying to alter mechanics and patterning to directly improve both SL and SF. Now, with developed athletes, particularly those training to run a specific distance, we will make some modifications in this area. But for the developing athlete this will not be required.

First, let's define the two terms. Stride length is the distance the center of mass (generally the hips) travels during one running stride. Studies have shown that optimal stride length is usually between 2.3 – 2.5 times the athlete's leg length. Stride frequency is the number of steps taken in a given amount of time or over a given distance. And for the vast majority of situations, this is as much as you need to know about SL and SF so far as they require any use of numbers in regards to designing training.

Based on these definitions, clearly any athlete who wants to get from Point A to Point B in less time should seek to improve SL and SF. The problem arises when increasing one results in a lessening of the other. For example, specifically trying to take longer strides will increase SL but reduce SF. Focusing on short quick strides (common with sprinters and 40y dash trainees) increases SF but reduces SL.

It is this direct approach that causes problems because the coach is attempting to specifically address an issue which would naturally take care of itself during the course of a well designed speed, strength and conditioning program. By developing movement and biomotor skills in athletes, they will naturally make the required improvements in both SL and SF. The only reason to ever bring up these terms in training is when speaking of them passively when making comments such as, 'You looked tired over the last 20 yards, I could see your SL breaking down' or 'You were lazy coming out of the blocks, your SF was too slow'.

So let's take a look at two of the most common mistakes people make with the direct approach and the more appropriate way to fix the problem.

Problems with the Direct Approach

Problem: Athlete (usually a taller athlete) has very slow acceleration from a static position, thus runs slow times in short races or gets beat to the ball, etc.

Reaction: Have the athlete focus on taking shorter, quicker steps to generate more power and get up to speed faster. Coaches will often use an acceleration ladder or other markings with increasing distance between rungs/foot placements to develop a pattern for the slow or long limbed athlete to practice and learn.

Solution: An athlete with longer legs will have slower turnover than an identical athlete with shorter legs. This is because their longer legs serve as longer levers. The longer the length of the lever the greater the potential linear velocity at its end. While this bodes well for athletes once they reach top speed and must maintain it, their long levers are not conducive to generating the same degree of force required to overcome inertia over a shorter distance as their shorter legged peers. Often we see shorter limbed athletes excel in sports and events requiring great strength and power, but only short bursts of speed before stopping, i.e. fullbacks, 55 meter dash specialists, etc.

What if the athlete isn't particularly tall, but just slow? The solution in either case is to first improve the absolute strength of the athlete. A stronger athlete will be able to apply more force to the ground in less time, overcoming inertia and propelling the Center of Mass horizontally at a faster rate. Because we know increased ground force is one of the primary (if not **the** primary) factors in faster running speed (see Peter Weyend's article in the Journal of Applied Physiology, "Faster top running speeds are achieved with greater ground forces not more rapid leg movements") strength and power development must be foundational components of any athletic development program.

Additionally, athletes must develop proper, efficient and consistent running mechanics in order to maximize the output of the limbs and muscles during acceleration. Strength training and technique development are the keys to addressing this problem. I utilize all methods of strength and technical development: weight room, plyometrics, medicine ball throws, multi-jumps, speed drills, hill runs, etc.

Problem: Athlete appears to be extremely tight in the hips and hamstrings resulting in shortened SL (particularly teenage male football players). SF isn't particularly slow or low, but athlete doesn't appear to be applying much force to the ground and thus seems to reach top speed quickly and skate across the athletic surface.

Reaction: Have the athlete practice taking longer strides in training to counteract the tightness and stride issues.

Solution: Speed and power athletes don't need to be overly flexible like a gymnast or ballerina. In fact, some tightness is good. However, many athletes take this to an extreme because they don't engage in dynamic warm ups or passive, static stretching at any point after a workout. I also find that athletes suffering from this issue often have weak cores as well. So they may be the strongest guy on the team, but strength and power is transferred through the core (hips, low back, abs). Limited range of motion, poor mechanics and postural weakness have a cumulative, adverse affect on speed.

The first issue to address is dynamic range of motion. If an inflexible athlete can improve dynamic flexibility by just one inch per stride (fixing nothing else) the athlete can make monumental improvements in their speed. All other things being equal, taking less steps over the same distance will get you there faster. PNF and AIS stretching, dynamic warmups, self myofascial release, hurdle mobility drills and simple static stretching are all methods I use to improve dynamic range of motion. Additionally, a consistent and progressive approach to core development, particularly stabilization exercises, will develop the ability to transfer continuously increasing strength levels to the track or field.

The other problem stems from the common solution. I never advise athletes to try and take longer strides. Optimally, foot strike takes place beneath the Center of Mass, with the support leg perpendicular to the ground. When you tell an inexperienced athlete to take a longer stride, they tend to bound with foot strike taking place far out in front of the center of mass. Not only does this reduce SF, but creates a 'braking' action which slows the athlete down. I compare it to driving a vehicle while constantly pumping the brakes. You won't come to a complete stop, but you waste valuable energy by having to run harder to maintain speed. The athlete will also spend more time on the ground. This is not efficient and will not result in faster running speeds.

Finally, overstriding increases the likelihood of injury. When the foot lands out in front, especially when the foot is plantar flexed, this places great stress on the bottom of the foot (arches, plantar fascia), soleus and calf, back of knee (popliteal tendon) and upper hamstring leading to both acute and overuse injuries such as tendonitis.

To gain SL, the solution is not to try and take a larger stride. Instead, instruct athletes to 'step over the opposite knee and drive the foot into the ground'. By developing mechanical efficiency conducive to greater force application, athletes will naturally and safely increase their SL and SF.

Conversely, the solution to an athlete who naturally over strides is the same as was previously discussed: improved physical, core and elastic strength as well as mechanical efficiency.

These two examples should give you a good overall understanding of why SL and SF are best developed by taking an indirect approach to each of them. But when you think about it, the solution here requires the same solutions that will fix the vast majority of weaknesses found in young athletes regardless of sport: develop a better overall athlete with a foundation of general movement skill and biomotor development.

Ultimately, stride length and stride frequency are natural byproducts of an effective training program.

Improved strength (absolute, core, elastic) results in an increase in the amount of force applied to the ground. In turn, this increased force application will cause the athlete to increase the length of each stride as well as the functional frequency of that stride. Improved running mechanics improves efficiency. A more efficient athlete will maximize the output of the body (in addition to reducing injuries) thus taking advantage of current strength levels which, as was previously mentioned, leads to natural improvements in SL and SF. The same can be said for improving dynamic range of motion. Restricted range of motion reduces stride length. While stride frequency may appear to be reasonable, power output is likely to be compromised significantly.

When all is said and done SL and SF should not be looked at as skills or even mechanical issues that should be directly addressed. I look at SL and SF as two of many diagnostic tools I use to assess an athlete's current level of development, strengths and weaknesses. They help me understand where I may need to place particular training emphasis with a certain athlete, but they are not factors I specifically consider when creating an annual plan because they are only indirectly relevant.

References:

Baughman, M., Takaha, M., Tellez, T. (1984) Sprint Training. NSCA Journal, 34-36,66.

Brown, L., Ferrigno, V. (2005). Training for Speed, Agility and Quickness – 2nd Edition. Champaign, IL:Human Kinetics.

Weyand, Peter G., Sternlight, D., Bellizzi, M., Wright, S. (2000). Faster top running speeds are achieved with greater ground forces not more rapid leg movements. Journal of Applied Physiology, 89, 1991 – 1999