About Stride Length and Aging
and A Routine for Improvement

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Preface
As runners age, their speed decreases primarily due to a decrease in stride length. Their cadence (stride rate) remains essentially the same, typically about 180 steps per minute (steps/min). (Note, bikers use the term for rotations; thus, 90 is equivalent 180 running.) To illustrate the point, consider the stride-length comparisons for two 30 year-old and 60 year-olds.

Assume a 30 year-old, 40:00min 10K runner, with a 180steps/min cadence. The runner's stride-length is 54.7 inches per step.

At 60, this same runner can expect a time of close to 50:00 for a man and 52:00 for a woman. (This conversion uses the USATF age-graded-factors.) Our man will be doing an 8:00 pace and our woman an 8:22 pace. That's a stride-length of 44 inches for our man and 42 inches for our woman.

Note, the stride lengths have decreased from 54.7in to 44in for the man and 54.7in to 42in for the woman. (Note, both ran the same speed at 30 for this example.) The man's stride length has decreased by 20% and the woman's by ~24%. To double check the calculations: Our man's 10k time has increased 20%; thus, 40:00/.8 = 50:00. Our woman's 10K time has increased 24%;, thus, 40:00/.76 ~= 52:30.

Now suppose our 60 year-old runners could increase their stride length by just **2** inches. They will decrease their 10K times: 42/44 x 50:00 = 47:44 and 40/42 x 52:00 = 49:30. **Just a 2 inch stride-length increase will improve our runners 10K times by over 2 minutes!**

To complete our preface, here is a brief description of the kinematics of running. All of these phases are controlled by the runner's proprioception[1] system. This point is the fundamental basis for the stride-length improvement routine covered later.

Initial contact is the name of the portion when your foot first strikes the ground. *Here the proprioception-system (PS) must accurately align the angle of the foot to, ideally, land mid-foot with a slight supination angle that rotates towards a pronation angle, to properly absorb the shock. The knee should have a very slight bent, again to insure good shock absobtion.*

Midstance is when the foot is on the ground under the hips and taking the load of the body. Your other foot is in the swing phase. *This is an extremely important and complicated phase for the PS to deal with. During this phase the PS must stabilize the runner, dealing with terrain, surface angle, obstacles, etc. Studies show this phase has a major impact on the runner's performance. Elite runners spend about 1/2 the time during this phase as do regular runners.*

Propulsion refers to the moment your leg and foot shifts from an action of support to one of pushing into the ground to create the forces that propel you forward. Once the toe leaves the ground, you're in float phase. *Primarily the PS must allow the hip extension angle and the foot flexion angles to be maximum. And, it must recruit all the muscles required for an explosive push-off by the trailing leg's forefoot.*

Float phase at which time both feet are off the ground. It begins with 'toe off' and ends just before the foot makes contact with the ground again and a new gait cycle starts. *During this phase, the PS must start planning the whole next cycle.*

Preface Conclusion
It should be clear that simply stretching[2] and other special focused exercises will not be particularly effective in improving stride-length and running speed The whole running proprioception-system must be trained to simultaneously improve all of these phases.

Notice that the proprioception[1] system covered above seems to ignore another dimension of the aging affect. Everyone's flexibility and muscle repair, size and strength decreases with age. So, how can some runners start running at, say 65 and older, and become world class competitors? They didn't create new muscles. The answer appears that their proprioception[1] system learned to tolerate higher levels of sensory information from the proprioceptors. Obviously, even this is only a part of the explanation. However, assuming the proprioception-system can be taught to accept higher levels of sensory information, we may be able to mitigate, and perhaps moderately reverse the aging affect. Whitlock broke the age-82 world marathon best by running 3:41:58; breaking the 3:48:35 record set by Ed Benham.

A Routine for Increasing Stride-Length

The routine described below is a hypothesis based on the facts and suppositions, in the Preface above, which will require some basic empirical testing to warrant further acceptance.

This routine can be run nicely between one's warm-up period and his/hers regular runs, or as the first drill of a quality workout session. It should be run at least twice a week, or even before every run. It is not a strenuous and is unlikely to trigger running injuries. It should not be considered a substitute for a good quality workout, e.g., interval and hill sessions.

Increasing one's stride-length will improvement their racing perform proportional to the increase. The principal object is to see how **far** one can run, while mentally ignoring speed.

Count exactly100 one foot steps, doesn't matter which foot. Note, your actual number of strides will be 200.

The following steps correspond to the 4 gait phases above; refer to them for each step below. Concentrate intensely on the following as you attempt to make each stride as long as possible. Ignore your speed.

- **Initial contact-** Forward foot plant landing midfoot, with an equal impact force on your ball and heel. Shin angle should be 90deg to the surface and driving backward.
- **Midstance-** Body, head and arms as steady and controlled as possible. Look straight and far ahead.
- **Propulsion-** Push hard against the surface with the ball of your trailing foot to propel your whole body forward.
  Try to achieve as much "air" time as possible while optimizing the above. Optimize the length of your air time arch, not the height.
  Concentrate on landing with your lead foot way out in front of you, while maintaining a midfoot landing.

Measure the distance you traveled with 100 foot single foot strikes. Record your distance. Don't forget, use 200 steps to calculate your stride length. You likely will, or should, see an increase in your distance every week or two.

It's advantageous if you can do your first routine on the track to get an accurate benchmark distance, though it's not necessary.

A convenient way to do your routines is to pick a particular starting point on any of your standard runs and try to increase your distance every time. You'll be able to estimate your increase in distance accurately enough.

Occasionally, do the routine on hills, up and down.

Footnotes

1] Simple definition**: Proprioception-** A sense or perception, usually at a subconscious level, of the movements and position of the body and especially its limbs, independent of vision; this sense is gained primarily from input from sensory nerve terminals, proprioceptors, in muscles and tendons (muscle spindles) and the fibrous capsule of joints combined with input from the vestibular apparatus.

Detailed definition: **Proprioception-** The sense of position and movement of the limbs and the sense of muscular tension. The awareness of the orientation of the body in space and the direction, extent, and rate of movement of the limbs depend in part upon information derived from sensory receptors in the joints, tendons, and muscles. Information from these receptors, called proprioceptors, is normally integrated with that arising from vestibular receptors (which signal gravitational acceleration and changes in velocity of movements of the head), as well as from visual, auditory, and tactile receptors. Sensory information from certain proprioceptors, particularly those in muscles and tendons, need not reach consciousness, but can be used by the motor system as feedback to guide postural adjustments and control of well-practiced or semiautomatic movements such as those involved in running.

2] Stretching- Position stands from the American College of Sports Medicine and the Surgeon General site a need for strategies capable of enhancing the effectiveness of stretching on flexibility and joint range of motion. One strategy for enhancing flexibility that has received anecdotal support but lacks substantial experimental evidence is the impact of prior exercise. This study compared 5 minutes of static stretching and proprioceptive neuromuscular facilitation (PNF) on hamstring flexibility performed with and without exercise.

Within-group comparisons indicated that PNF resulted in a significant ($p < 0.05$) increase in flexibility after 60 minutes of exercise when compared with baseline (9.6%) and without exercise (7.8%). **No differences were observed with static stretching across time.** In addition, no differences were observed between the groups at any time point. Results demonstrated that **PNF performed after exercise enhanced acute hamstring flexibility,** and implementing a PNF stretching routine following exercise may augment current stretching practices among athletes.