The Running Machine Myth

Article · January 2014

CITATIONS
0

READS
431

1 author:

John Kiely
University of Central Lancashire
41 PUBLICATIONS **260** CITATIONS

SEE PROFILE

Australian coach Percy Cerutty (right) and protégé Herb Elliot run barefoot strides in 1958.

Photo: Time & Life Pictures/Getty Images

The Running Machine Myth

How the body adapts to create efficiency and injury resistance.

BY JOHN KIELY

Mention the 1936 Berlin Olympics and inevitably, Jesse Owens springs to mind. But Owens' roommate at those games, 1500m runner Glenn Cunningham, also had a backstory. When Cunningham was 7, he lost most of the flesh from his lower legs, as well as the toes and transverse arch of his left foot, in a schoolhouse fire. Doctors recommended amputation, but with family support he embarked instead on the torturous road to recovery by rehabilitating his damaged legs. By the time Cunningham retired from track in 1940, he had broken multiple world records, won Olympic silver and dominated 1500m racing in the late 1930s.

An incredible feat, but not unique: When Serena Burla underwent a nearly complete removal of a hamstring muscle during surgery to take out a cancerous tumor, the likelihood of her running at any level seemed remote. Nevertheless, within three years she had twice placed second in the U.S. half marathon championships and clocked a 2:28 marathon PR.

We often compare runners to machines. But machines can't accomplish this trick. They can't continue to function after key components are damaged or removed. Humans, however, can survive ill-fitting, injured or — as illustrated by Cunningham and Burla — missing parts. We accomplish this trick thanks to our ability to shape coordination habits around our individual peculiarities.

OUR RUNNING FINGERPRINT

We all conform to a common blueprint. We have the same components arranged in the same order. But, as nature has no means of precisely manufacturing body parts, how our individual anatomy is fitted together varies extensively. Multiple dimensions of running architecture — snugness of bones within sockets, springiness of tendons, rigidity of feet, geometry of muscles — differ between individuals, sometimes subtly, sometimes dramatically.

We learn to run in ways that accommodate these mismatched parts thanks to a pervasive aspect of human biology: plasticity, our capacity to reshape neural and biological structures in response to repeated practice.

Our neuromuscular systems are constantly resculpting microarchitecture in the brain and spinal cord and remodeling tissues in the body, modifications that physically embed movement habits. We become resilient runners not because we are machine-like, but because we evolve coordination patterns tailored to our individual anatomy, capitalizing on strengths, masking deficits. This is visible in each runner's unique stride "fingerprint" and explains why you can pick out your training partner's familiar gait through a crowd of other runners.

This is not our only advantage over machines.

CREATING PATHWAYS

To the observer, when we run, each stride appears a duplication of the last, but that's an illusion. Under the surface, many aspects of running action — relative positions of bones and joints, foot postures, timing and interaction of muscular contractions — consistently vary between strides, allowing us to disperse impact stress throughout extended tissue networks. As a consequence, each stride is unique.

As an analogy, imagine trekking through dense undergrowth. The more you repeat the journey, the more you find yourself converging on a particular path. The more you travel this path, the more energy efficient it becomes. Obstacles are cleared, and surfaces become smoother and more compacted.

Repetition creates the path, shaping neural and biological structures. Variability establishes and maintains the path's width. Without continued variation, the edges of the path become overgrown. Unmaintained, the once-broad thoroughfare narrows to a constraining rut.

Similarly, persistently running in the same manner reduces the variability of our individual stride "signature." Gradually, structures become overspecialized. When excess monotony, fatigue, soreness or injury reduce our ability to vary aspects of our stride, our capacity to disperse mechanical stress diminishes. Loading stress becomes focused on an ever decreasing set of hot spots on — bones, tendons and muscles — and the risk of overuse injuries escalates. Conversely, when our variability options are expansive, which happens naturally in healthy, skilled and rested runners, we run efficiently and safely.

Ultimately, running coordination is shaped by this interplay

between history and exploration. On one side, we have the way our strides have molded around our individual peculiarities into a unique pattern; on the other, we have the ability of our neuromuscular system to efficiently vary each stride, blending the ingredients — the positions and interactions of joints, muscles, bones and tendons — in ever varying recipes to reliably achieve a consistent and predictable running speed.

SOMETHING OLD/ SOMETHING NEW

Coaches have advocated ways to encourage variation for decades, regularly shuffling parameters — pace, distance, terrain, surfaces, footwear — to present the neuromuscular system with opportunities to explore. Such variation allows the body to offload accumulated stress and encourages recruitment and conditioning of dormant, difficult-to-activate tissues. Australian coaching legend Percy Cerutty famously sent miler Herb Elliot on runs through woodlands and sand dunes, and advanced coaches have long advised barefoot strides over grassy terrain to help strengthen the muscles in our feet.

Such variation, however, may not provide the full spectrum of potential benefits offered by focused variability training.

One recent breakthrough has emerged not from the sports sciences, but through advances in brain imaging technology. In particular, 40 years of research by University of California San Francisco neuroscientist Mike Merzenich has illuminated how neuroplasticity changes across the lifespan. In youth, we learn effortlessly. Everything is new, and all experiences leave an imprint. As we mature, this explosive plasticity fades. We may still reconfigure neural architecture, but now simple repetition is no longer sufficiently stimulating to drive ongoing refinement.

The key to triggering continued plasticity is surprisingly straightforward. Our brains are perpetually bombarded from multiple sensory sources by overwhelming torrents of information. Some of this information is important, some simply ongoing background interference or "noise." The brain cannot possibly respond to all incoming data (precious neural building materials would be instantly depleted), and so from this flood of sensory information, the brain must identify the cues most relevant to continued survival.

To accomplish this task, the brain uses a simple but powerful trick: It pays attention. Attention is the spotlight directed by our consciousness to highlight important stimuli.

When we dedicate focused attention to specific feelings, we prioritize those sensations, and only sensations prioritized by attention can gain access to the neural materials necessary to drive lasting structural alterations.

PAYING ATTENTION

How do runners focus their attention enough to trigger lasting plastic adaptation? This focus demands challenges that — while remaining within the limits of safety — push us to the margins of our current abilities.

Designing attention-demanding challenges differs subtly from simply providing running variation. Changing paces and terrain alters stride characteristics, but without demanding the rapt attention necessary to drive neural reconfiguration.

Inducing optimal attention, and hence optimal adaptation, requires an additional layer of creativity. Dan Pfaff, coach to Olympic gold medalists Donovan Bailey and Greg Rutherford, strategically manipulates physical and instructional constraints to create shifting movement puzzles.

Pfaff typically "plays" with rhythms, contact times and tempos. Other coaches he has mentored have been known to chalk or tape a course of irregularly spaced lines on the ground and then have runners traverse it at challenging paces. This forces instantaneous, unplanned alterations in the runners' stride pattern. The shifts are driven by changing

Perfect Is As Perfect Does

Priscah Jeptoo's recent London victory, Olympic and world championship silver medals, and 2:20 PR consolidate her status as a great marathoner. Yet when she runs, she does not necessarily look like an elite athlete, with her knees collapsing inward, ankles flicking, feet flailing. Hers is a gait that looks ungainly and uncomfortable.

Traditional lore suggests that such unconventional quirks represent movement inefficiencies, draining energy that could be more productively harnessed and exposing structures to unnecessary strain. Commentators suggest that runners could improve performances and reduce injury risk if they rectified such flaws.

But is this really the case?

An alternative perspective suggests that when we first learn to run, we are shaped by our unique anatomical design. These features exert a bias on movement choice; we instinctively move in ways that steer us away from irritating or wasteful micro-movements. The more we run, the more we customize self-taught compensatory patterns, molding individual styles around our anatomical peculiarities, innate strengths and weaknesses, and individual histories.

Denied strong materials and inexhaustible energy supplies, our intelligent movement system customizes habits to capitalize on strengths and mask deficits. Gradually, we learn to arrange what we have as best we can. Inevitably, some personalized solutions are aesthetically pleasing, fitting our visual model of ideal running form. Many others are not, appearing as unconventional, ugly movement oddities. We instinctively confuse aesthetically pleasing with safe and efficient. Ultimately, however, nature is indifferent to how our running styles may look; it is concerned only with accomplishing the movement goal for the least energy investment and risk of damage.

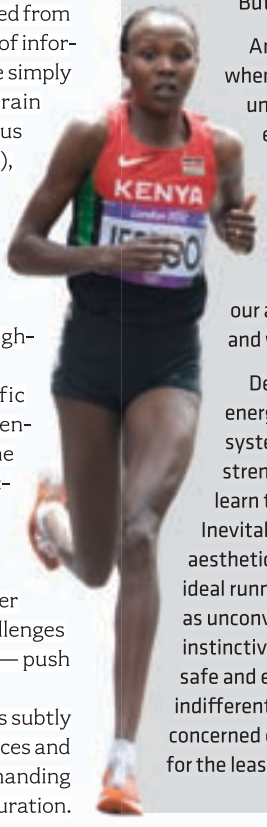

Photo: Victor Sailer/PhotoRun

interrelationships between visual stimuli, proprioceptive feedback and reflex activity.

Coaching cues can further serve to direct attention. For example, Andrew Kastor tells of a time when his wife, Olympic medalist Deena Kastor, was working with Pfaff after she finished rehabbing the foot she broke in the Beijing Olympics. "Deena began getting a little sloppy with her running form drills," Andrew recalls, "and Coach Pfaff shouted at her, 'With purpose, Deena! Think about what you're doing and why you are doing it.'" Understanding the subtle distinction between mindlessly going through the motions and mindfully attending to the proprioceptive and technical cues necessary for optimal benefit, Pfaff directed his athlete's attention.

Andreas Behm, coach of Olympic gold medalist and 110m hurdle world record-holder Aries Merritt, uses horizontal ladders and "wickets" (low hurdles) as obstacles to force athletes to disrupt ingrained running patterns. "Once athletes have stabilized a pattern, we oftentimes switch up spacings or even omit wickets at the end to continually introduce a new element to a familiar task," Behm says. Echoing Pfaff, he explains, "We always demand a high level of focus, or 'paying attention,' when these drills are executed."

WHERE NOW?

We once believed running skill was optimized by monotonously replicating movements the same way, over and over. Today it's clear that coordination thrives not on regimentation, but on exploration. Accordingly, the goal of coordination training is not to imprint formulaic technical solutions but to build flexible problem-solving responsiveness.

Glenn Cunningham's unlikely achievements illustrate how, with sufficient motivation and practice, brain and body can adapt to accommodate even severe injury. We, too, can capitalize on these same processes to continually refine running coordination. As experience grows and natural plasticity wanes, continued improvement requires that we become more inventive in designing attention-demanding challenges that progressively drive ongoing coordinative refinement.

Kastor sends the Mammoth Track Club elites out on single-track trails laced with roots, rocks, dips, sharp turns and other obstacles two or three times per week. Other times they do repetitions in a grassy park, intentionally encountering divots, uneven footing and a slower ground reaction time. Both settings require quick judgment calls, Kastor says, and demand the high-quality focus necessary to maximize adaptation. Similarly, elite coach Brad Hudson instructs runners to consciously vary pace, as well as stride length and frequency, in the middle of runs, designing workouts over hills and differing terrain to force variability. Kastor and Hudson believe this is an essential area of training, often overlooked by recreational runners, who tend to prioritize maintaining an even pace.

Because we cannot see or easily measure changes in coordination, we have tended to ignore it. Yet efficiency and injury resilience are ultimately dependent upon this much under-appreciated dimension of running performance. With more understanding, runners can and should modify their training, persistently altering the nature of the running challenge while building the skill of running through attention-demanding variations. RT

Wharton's Simple Solutions

no. 12

ANKLE STABILITY

Injuries to the ankle joint are among the most frequent of all athletic injuries. I often hear an offhand comment like: "Oh, I forgot to mention the ankle sprain. It was years ago, and it feels better when it warms up. I didn't figure it mattered, but I just don't seem to have the power or pushoff on it anymore." Unfortunately, these old, niggling injuries do matter and can plague a person's form for years. The ankle joint is vitally important.

WHAT IT IS

The flexor and extensor muscles on both sides of the lower leg, from the knee down, support the leg during the impact of landing, pushoff, and through the constant variances in landing surfaces. Strengthening these muscles is invaluable for runners engaging in speed work or faster training, when they must use a midfoot or forefoot strike; runners who are transitioning to minimalist footwear; runners who race cross country, trail races or other events on uneven surfaces and need extra stability; and runners with weak ankles.

STABILIZE IT

SOCK WITH WEIGHT

Part 1: Sit on a counter or other elevated, stable surface. Place a towel roll under your knee to take pressure off your back. Place something that weighs 1 to 2 pounds in the bottom of a long sock. Feed the open end of the sock between your first two toes, wrap the sock around your ankle and tie a knot to hold it there. The weighted sock should now be suspended between your big and first toes. Allow your ankle to extend to its full range of motion toward the floor. Pause. Bring your ankle up toward the ceiling without using your hip. Repeat for two sets of 10 to 12 repetitions.

Part 2: Keeping your body and sock in the same position, point your ankle downward. Now bring your ankle upward diagonally toward the midline of your body, as if drawing one side of a "V" shape with your toes. Pause. Slowly return to your fully extended downward position. Bring your ankle upward diagonally away from the midline of your body, drawing the other half of a "V" shape. Pause. Repeat for two sets of 10 to 12 repetitions.

Illustration: Dan Hanafin