QUICK GUIDE

The system

MotionMetrix G2 is an advanced system for biomechanical running analysis. It consists of two measurement modules:

- A marker-free 3D motion capture module that accurately detects the position of every joint in your body.
- A sensitive force sensor integrated in the treadmill that picks up every Newton of force that you apply during ground contact, with millisecond time precision.

Every runner responds differently to different running shoes. With MotionMetrix G2 we can precisely capture your unique biomechanical response and find the shoe that brings out the best runner in you.

The test

You just need to step up on the treadmill and run. The system will immediately start to track your movements and the force you apply to the ground. No body markers are needed.

The first run is always a baseline run since we want a reference point to compare with. You can do the baseline run barefoot or in a reference shoe. If you want your foot size measured, you should be barefoot since we scan your feet prior to the baseline run.

After the baseline run, it is time to start testing shoes.

Shoe performance assessment

From a functional perspective, you would like your ideal running shoe to:

- Assist your forward propulsion so that you can run faster without increased effort.
- Efficiently absorb the impact forces to damp the harmful shock waves that propagate up through your lower body.
- Comply with your natural movement pattern so you don’t need to struggle to maintain balance and flow.

With MotionMetrix G2 the guesswork is over - you get numbers on all these three key properties!

Energy Return

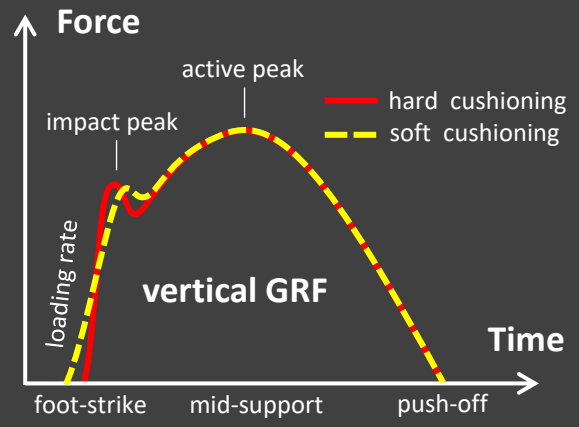
Efficient long-distance running is all about minimizing muscular work and maximizing elastic recoil for forward propulsion. During the first half of the support phase, elastic energy gets stored in the leg and foot in a similar way as when you compress a spring. This energy recoils during propulsion and gives you a free push - Energy Return. The more energy you can store, the bigger the push.

Running shoes are capable of storing elastic energy in the midsole at varying degrees. To what extent you can benefit from this extra contribution of elastic energy depends on how your biomechanics responds to the shoe. This is what the Energy Return parameter will show. If the shoe adds more bounce to your stride (shorter and more powerful ground interaction), the Energy Return score will increase. In practice, it means you can run faster without increased effort.

Shock Absorption

Every time you land, your foot impacts the ground with a certain amount of force. The ground responds with an equal counteracting force on your foot known as the ground reaction force (GRF). An important function of a running shoe is to cushion the impact. A shoe with soft and thick cushioning will distribute the impact force over a longer period of time and therefore make the collision with the ground less dramatic, see example in the graph below.

The Shock Absorption (SA) parameter essentially captures the rate at which the impact force is applied when you hit the ground. In most cases, a well cushioned shoe will yield an improved SA score, especially for heel strikers. However, the lower body has a clever built-in cushioning system as well and we want the shoe to be compliant with it for optimal result. Therefore, we need to account for the cushioning response of the shoe and lower body combined which is what the SA parameter does. Ultimately, it is the bodily response that matters in terms of staying away from impact related injuries.



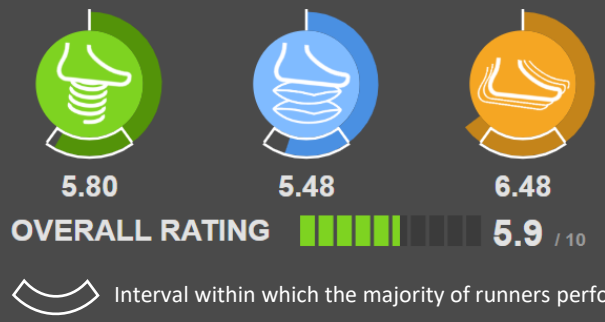
Stride Consistency

Every runner has a unique movement pattern and it is a product of how the musculoskeletal system is built. During running, each body segment strives towards a preferred movement path that presents the lowest resistance and the best balance and flow.

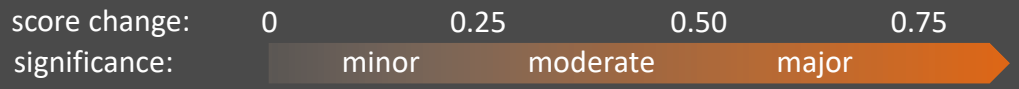
When you put on a running shoe, it may comply to you preferred movement path or oppose to it. In case it opposes, you need to struggle to stay on course which will reduce efficiency of motion and most likely also put excessive stress on your body.

The Stride Consistency parameter measures how consistently you reproduce your running cycles. A high consistency score means that the shoe aligns well with you preferred movement path and you will be able to run with optimal balance and flow with no struggle.

Performance rating



The shoe performance rating scale ranges from 0 to 10 and has been calibrated on a group of 1000 runners from beginners to elite. If you score above 5, you are better than the average runner in that group. Your score will change depending on which shoe you wear and how it influences your biomechanical response. To help determine if the change is significant, the scale below can be helpful



Runner Profiles

- Optimal profile for long-distance performance
- Active compact stride with great elastic bounce
- Best compromise between speed capacity, running economy and injury risk
- Very common profile among elite 5 - 42k runners
- Next lowest injury risk after Quick Steppers

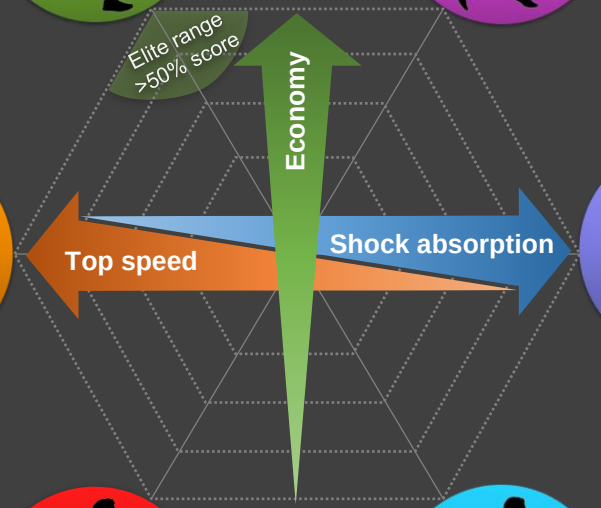
Best overall

ECO SPRINTER

Least injured

QUICK STEPPER

- Rapid footwork with good elastic bounce
- Good economy up to ~16 km/h that then drops due to excessive leg velocity (work to move the segments)
- Gentle loading due to small joint angles and peak forces
- Many top ultra runners and female marathoners belong to this category
- The least injured category among all six



- Profile with highest top speed, very common among middle-distance elite runners
- Long powerful strides with short ground contact
- Stiff springy legs yielding great elastic bounce
- Large vertical peak force acting on the joints
- Highest injury risk, tough on lower leg and calf due to extreme ankle joint power generation

Fastest

POWER RACER

CONSTANT GLIDER

- Short strides with nearly constant ground contact
- Mild joint loading but limited bounce that prevents fast running
- Common among runners with limited flexibility, elasticity or strength
- Many elderly runners in this category
- Slowest category but among the least injured

- Long leaping strides powered by large muscular force
- Excessive overstride and ground contact time
- Common style among strong athletically built runners and mostly male
- Decent sprint capabilities but poor economy due to excessive braking/propulsion
- Next highest injury risk, tough on the knees

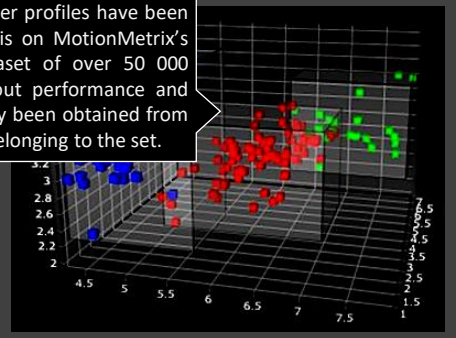
LONG STRIDER

EASY STRIDER

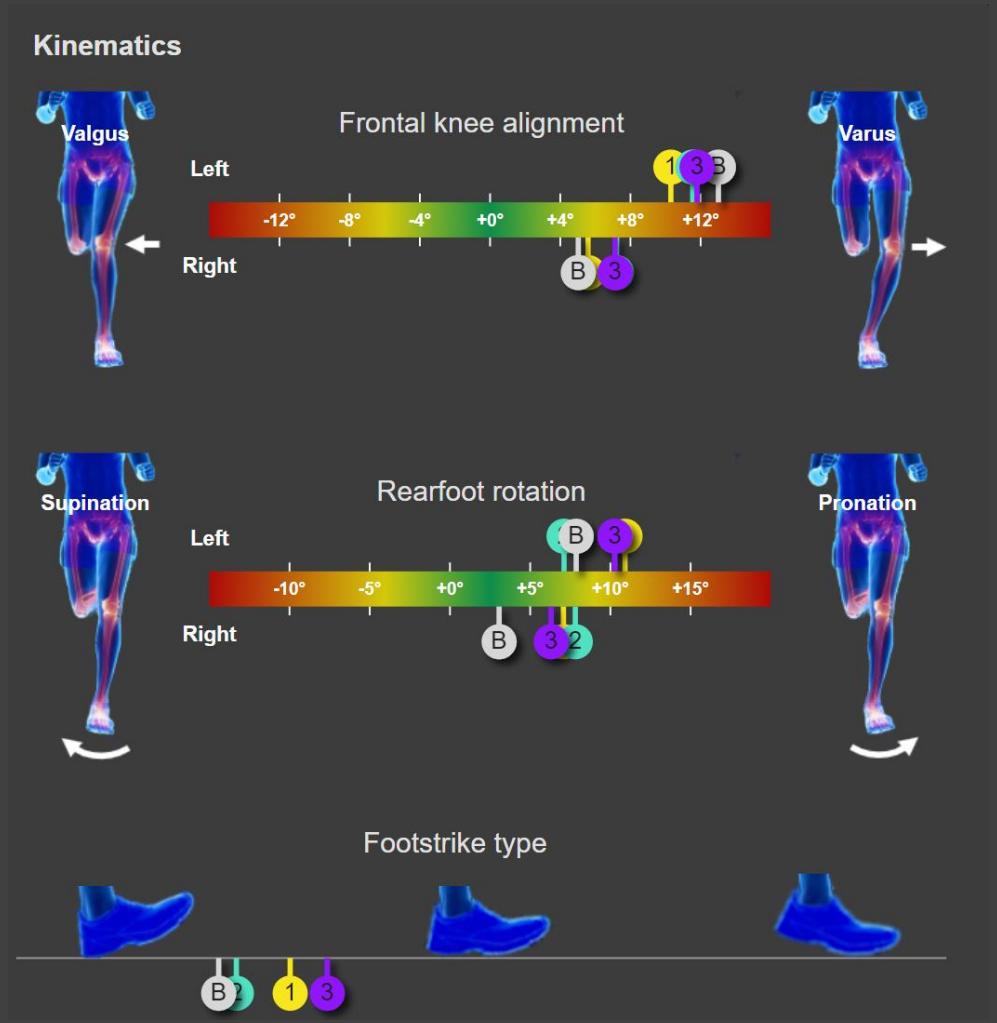
- Easygoing style, follows the law of least resistance
- Most common profile among all six
- Characterized by overstride and a tendency to a seated posture
- Soft knee during support, sensitive to different footwear
- Low to average speed capacity and running economy at medium injury risk

Occurrence	6.3%	22.9%	12.8%	11.6%	29.6%	16.80%
10k race time (mean)	40:12	43.42	45:50	49:30	46:30	45:12
10k race time (top 10%)	30:23	32.29	36:15	41:12	36:06	37:20
Injury rate (2 years)	84%	62%	59%	64%	75%	77%
Primary injury sites	1) lower leg 41%	1) knee 27%	1) knee 46%	1) knee 52%	1) knee 35%	1) knee 37%
	2) calf 28%	2) foot 21%	2) lower leg 24%	2) lower leg 21%	2) achilles 17%	2) hamstrings 17%
	3) knee 22%	3) lower leg 15%	3) calf 23%	3) achilles 17%	3) hamstrings 16%	3) hip 15%
Shoe pref. (light/stable)	75%/25%	63%/37%	55%/45%	30%/70%	15%/85%	10%/90%
Distr (men/women)	55%/45%	44%/56%	39%/61%	31%/69%	61%/39%	65%/35%

The six fundamental runner profiles have been derived by cluster analysis on MotionMetrix's large biomechanical dataset of over 50 000 runners. Information about performance and injuries have subsequently been obtained from interviews with runners belonging to the set.



Lower body kinematics



The frontal knee alignment is analyzed at mid-stance when the vertical ground reaction force peaks. More valgus alignment will in most cases yield increased frontal hip torques whereas more varus alignment yields increased knee torques. A change in rearfoot rotation can induce a change in frontal knee alignment.

Here we look at the maximum rearfoot rotation during the stance phase. The rearfoot rotation can vary significantly between shoes depending on their lateral stability and it can also affect the knee and hip alignment. For instance, a runner with pronounced knee varus alignment and excessive knee torque can improve by selecting a shoe that promotes more pronation.

Variations in foot landing angle can modify the impact force and therefore also the Shock Absorption. A better cushioned shoe will in most cases yield an improved SA score for heel strikers but not always for mid- or forefoot strikers.

Q&A

Q: Why do I need to do a baseline run?

A: We want a baseline to be able to understand your basic running mechanics since that can help selecting appropriate shoe types. The baseline run should preferably be done in a neutral reference shoe.

- A high baseline Energy Return score indicates that you naturally run with good elastic recoil and high leg stiffness. Research has shown that stiff runners benefit more from shoes that are specifically designed to improve ER.
- A low baseline Energy Return indicates that you would benefit more from exercises aimed at improving your internal ER rather than selecting an ER promoting shoe.
- A high baseline Shock Absorption indicates that you have a soft impact stride and may not need that much cushioning in the shoe.
- A low baseline Shock Absorption indicates that you have a hard impact stride and that you would benefit from soft and thick cushioned shoes.
- A high baseline Stride Repeatability score indicates that you naturally have a balanced and fluent stride. You probably don’t need to pay special attention to improve your SR by trying stability shoes or motion control shoes.
- A low baseline Stride Repeatability score indicates that you are not in perfect balance and flow. You could potentially benefit from shoes with more support or motion control.

Q&A

Q: I did not improve my ER even though I ran in a shoe that they say should improve ER, why?

A: While most runners see an improvement, some will not and it can be due to that

- The recoil of the shoe is not well synchronized in time with your push-off
- Your leg stiffness is too low to really see the effect (your baseline ER is low)
- You are not laterally stable with the shoe which may lead to more extreme rearfoot rotation, frontal knee or hip alignment or degraded SR all of which could have a negative effect on ER

Q: Will a thick and soft cushioned shoe always improve the SA score?

A: In many cases yes, especially for heel strikers, but it has been shown in scientific studies that some runners who wear soft cushioned shoes also increase their leg stiffness which can cancel out any SA improvement from the shoe.

Q: How is it possible that I get better SA when running barefoot?

A: Some runners are rearfoot strikers with shoes but forefoot strikes when they run barefoot, that can influence the Shock Absorption in this way.

Q: I often get knee problems from running, what can I do?

A: You should take a careful look at the Max Knee Torque chart in the Loading section and select the shoe that yields the lowest torque. If that shoe also provides the best Shock Absorption score, it is a given choice.