

# THE MOVEMENT REPORT

GENERATED BY  ARIONSTUDIO





## Why selecting the right shoes for your running style matters — and how ARION can help.

### Welcome to the ARION Movement Report

At ARION, we are on a mission to decode human movement. After a decade of research, six years of operation, and thousands of hours of recorded movement data, one thing has become evident to us. Movement is exceptionally unique.

I have always had a passion for technology and the human body. This led me to study Physics and also Sports, Exercise Sciences, and Biomechanics as a double major at Loughborough University and went on to do a PhD at the Sports Technology Institute.

Since then I have focused on measuring human biomechanics using sensors that included pressure sensing insoles, and co-ordinated research with several institutes across Europe including, the Luxembourg Institute of Health and Maastricht University. After almost 8 years of research we had established a number of patents and a huge amount of knowledge related to human movement, particularly in the field of running and running-related injuries which would ultimately form the basis for our ARION innovations.

Our research shows that there can be no such thing as the one perfect style of running shoes. It all depends on your own utterly unique biomechanics and your individual goals. The movement report aims not to judge individual shoe performance but to highlight the uniqueness of human movement and the importance of undertaking a personal biomechanical analysis before selecting your next pair of running shoes.

We all have our own body types, varied techniques, unique philosophies and personal goals. All of these elements heavily influence the way we move. Each contributes to our individual biomechanical profile into what we call, your unique running identity.

For this experiment, we tested eight of the latest and greatest running shoes. We utilized our groundbreaking technology to demonstrate with data how one style of running shoe can have two very drastic results on two seemingly similar people.

We hope you enjoy our findings and use them to move your brand, your technology, and your products forward!

Kind Regards,

Andrew Statham Co-Founder ARION





# Why selecting the right shoes for your running style matters — and how ARION can help.

## Introduction

We all have our own body types, varied techniques, unique anatomies and personal goals. All of these elements heavily influence the way we move. Each contributes to our individual biomechanical profile, into our unique **running identity**. This report will highlight that there is no such thing as the perfect running shoe for everyone. It all depends on your own completely unique biomechanics and your individual goals.

In this experiment two similar participants have tested eight of the latest and greatest running shoes, running at the same speed. Both participants are female, around the same height and weight and have the same shoe size. This report will highlight the differences a running shoe can make when all other circumstances are the same.

	<b>Manouk (26)</b> PARTICIPANT 171 65 FOREFOOT STRIKER		<b>Elzemieke (26)</b> PARTICIPANT 163 72 HEEL STRIKER	<b>8</b> SHOE MODELS <b>10</b> KM/H <b>800</b> STEPS ANALYZED
<p>Manouk usually runs once every two weeks for a longer run, and every week a couple of short runs to conduct research for ARION. Her preferred distance is around 5k with a pace between 5:15 and 5:30 min/km.</p>		<p>Elzemieke usually runs two to three times a week for longer runs. Her preferred distance is around 5k with a pace between 6:15 and 6:30 min/km.</p>		

			Heel-toe drop	Stack height	Responsiveness
	<b>adidas</b>	Ultraboost 22			
	<b>asics</b>	Gel Nimbus 24			
	<b>BROOKS</b>	Glycerin 20			
	<b>HOKA ONE ONE</b>	Mach 5			
	<b>new balance</b>	1080 V12			
	<b>NIKE</b>	Vaporfly Next% 2			
	<b>PUMA</b>	Deviate Nitro Elite			
	<b>saucony</b>	Endorphin Speed 3			

The heel-toe-drop is the difference between the height of the mid-sole at the heel of the shoe, and the height of the toe of the shoe, i.e. the amount of height drop between heel and toe.

The stack height refers to the difference of the amount of material between your feet and the ground, i.e. the thickness of the mid-sole.

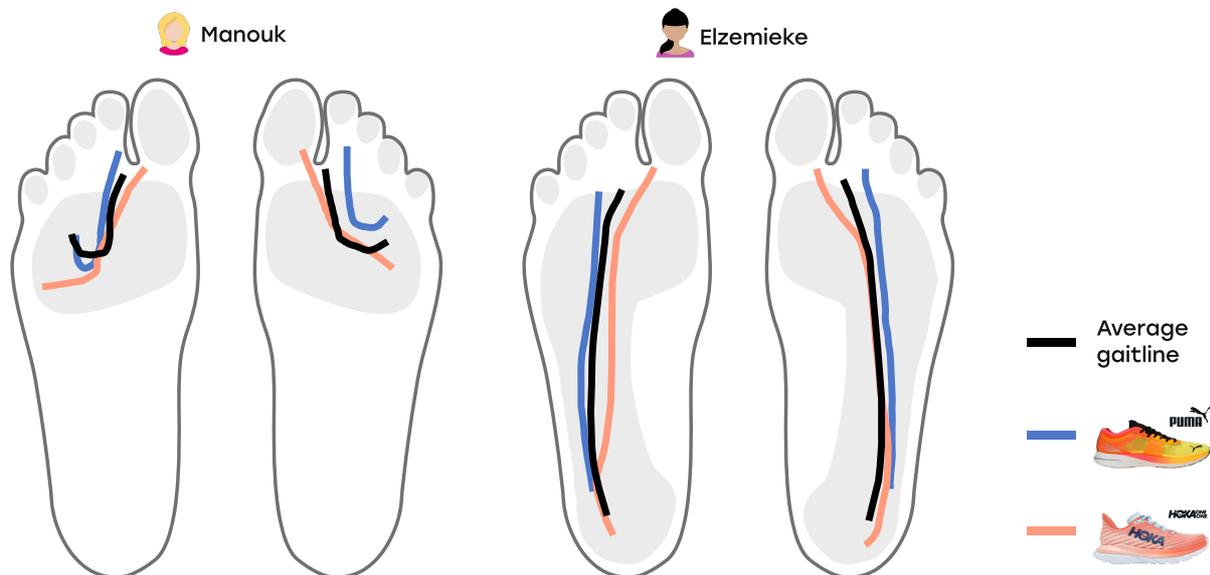
Responsiveness refers to how springy or bouncy a shoe will feel during running. A higher responsive shoe is more likely to feel springy or bouncy.



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## Gaitlines

The gaitline represents the roll of the foot, visualizing the dynamics of the foot during each step. The gaitline can be considered as a representation of the directions in which the foot moves across the ground during a step. In the images below, the average gaitline of all shoes tested is shown in black, and the gaitline while wearing the HOKA in blue and the PUMA in orange. Elzemieke and Manouk have very different gaitlines; Elzemieke lands with her heel first, with the foot rolling through to the forefoot, whereas Manouk lands with the outside of the forefoot, after her foot flattens, before moving forward towards the toes.



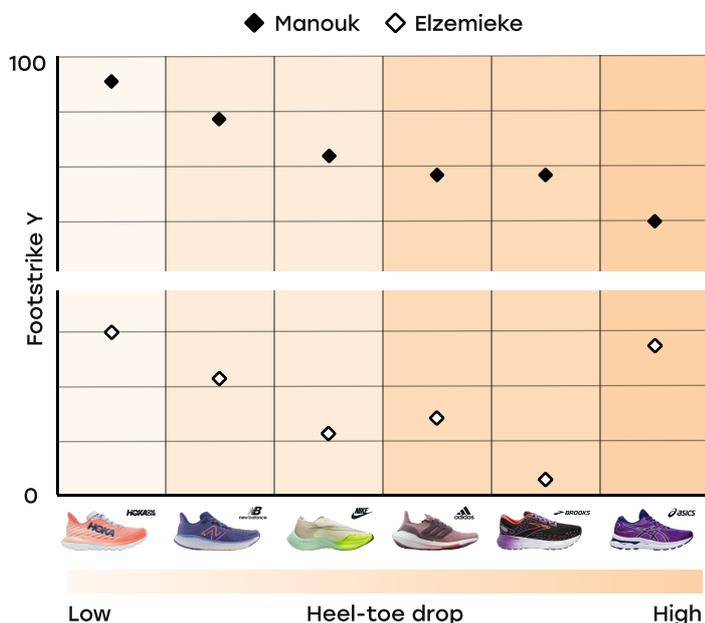
When focusing on Elzemieke, it is visible that for the PUMA her foot lands more towards the heel and for the HOKA more towards the middle of the foot compared to the average gaitline. Manouk, who is already a forefoot lander, lands even further towards her toes when running in the HOKA compared to the PUMA. During mid-stance, the phase where the body decelerates and moves over the foot, for both Elzemieke and Manouk the gaitline in the PUMA shoe moves towards the medial side of the midfoot, whereas the HOKA remains at the lateral side. Lastly, for both shoes and both runners the toe-off, the moment when the foot pushes off the ground, the gaitline is further forward, suggesting that the runners use the toes more actively. However, for the PUMA shoe, the gaitline appears to move more towards the big toe and the HOKA towards the small toes.

Both runners clearly have a different response in the HOKA and PUMA shoe compared to the average gaitlines. Possible structural shoe differences that could cause this effect, are the differences in heel-toe drop (HOKA: lower and PUMA: medium), cushioning (HOKA: lower and PUMA: medium) or the responsiveness (HOKA: medium and PUMA: carbon plated).

## Footstrike Y

From the gaitline, the footstrike Y can be extracted. This refers to how the foot is placed on the ground at initial ground contact, with lower values indicating contact closer to the heel and higher values indicating contact closer to the toe. In the graph, footstrike Y is visualized against the heel-toe drop of a selection of shoes, ranging from lower to higher drop.

Both Manouk and Elzemieke have a slight increase in footstrike Y (land more away from the heel) for lower drop shoes and vice versa for the higher drop (land more towards the heel). One exception for Elzemieke is the ASICS shoe, in which her footstrike was equivalent to the lower drop shoes. Noticeably the ASICS shoe has a somewhat lower total stack height (30 mm) compared to the other high drop shoes (35mm), which may contribute to this difference.





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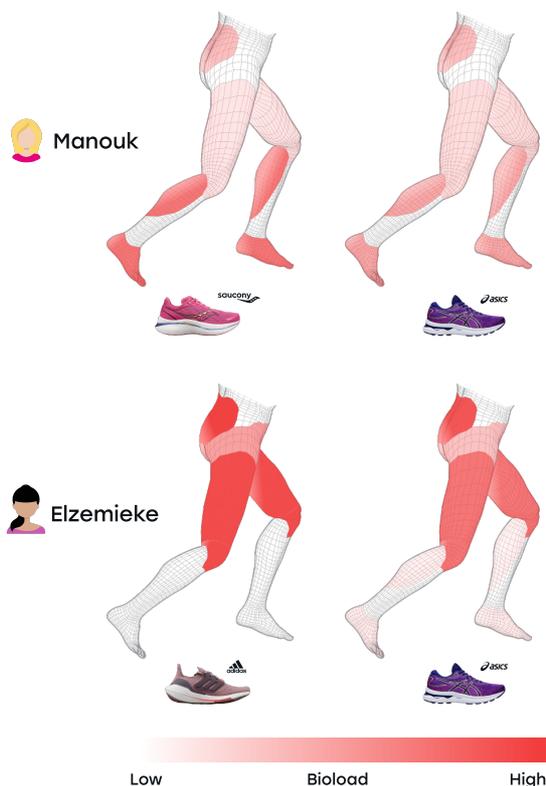
## Bioload

The bioload represents what body parts are experiencing more, or less, loading. The images on the right show the bioload when wearing the Saucony (left) and ASICS (right) for Manouk and the adidas (left) and ASICS (right) for Elzemieke. The deeper the red, the more load on the associated body part.

In general, the bioload is very different for Manouk and Elzemieke; with Manouk experiencing relatively higher loads in her foot and lower leg/calf, whereas with Elzemieke the load appears to be higher in the lower back, upper leg and knees. There are clear differences even when wearing the same shoe (ASICS), highlighting how different two individuals can respond to the same type of footwear.

For Manouk, the Saucony results in an increase in the loading on the foot and calf muscles and a slight decrease on the upper leg compared to the ASICS. With the ASICS the bioload is more equally distributed over the lower body. A possible reason could be the nylon plate in the Saucony shoe, intended to increase the shoe's responsiveness, compared to the softer ASICS shoe with a higher heel-toe drop.

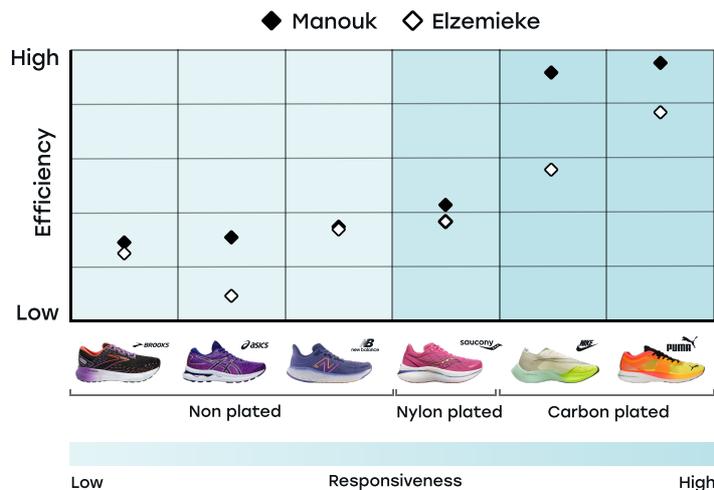
When wearing the adidas, the bioload for Elzemieke increased for the upper leg and knee compared to the ASICS. When wearing the ASICS, the bioload decreased slightly for the hip, upper leg and knee and increased for the lower leg and foot, suggesting that the load is more evenly distributed over the body. Possible structural shoe differences that can cause this are the differences in stack height (adidas: higher vs ASICS: medium) and responsiveness (adidas: medium vs ASICS: lower).



## Efficiency index

The efficiency index indicates the amount of energy used by the runner, where a high efficiency index indicates a lower energy consumption. In the graph, the efficiency index is visualised against the responsiveness of the shoe, categorized as non-plated, nylon plated and carbon plated shoes.

For both Manouk and Elzemieke the highest efficiency indexes were seen for the carbon plated shoes, suggesting a more reactive and potentially more efficient running style. The nylon plated shoe (Saucony) showed the next highest efficiency index, whereas the non-plated shoes showed the lowest.



## Discussion

If we step back from all the data insights, overall, the findings clearly show that Manouk and Elzemieke respond rather differently to all the shoes, even though they have a similar demographic profile. Biomechanically, Elzemieke is a rearfoot lander and Manouk is very clearly a forefoot lander. A higher heel-toe drop often encourages runners to land further back on their feet and both runners showed this response, Elzemieke landed further back towards her heel, and Manouk, back towards her mid-foot. The bioload was also differently distributed, for Manouk her foot and lower leg/calf experienced a higher load, whereas for Elzemieke the lower back, upper leg and knee appears to experience relatively higher loading. Lastly, both runners displayed higher efficiency indexes in the plated shoes (nylon and carbon plates), with the highest for the carbon plated shoes. Whilst both runners displayed an increased running efficiency index in the carbon plated shoes, it seems Manouk has a slightly stronger response to these shoes than Elzemieke.

## The importance of running identity

At ARION we are on a mission to decode human movement. After a decade of research, six years of operation, and thousands of hours of recorded movement data, one thing has become very clear to us. Movement is exceptionally unique and is only confirmed by this movement report. The unique combination of your personal running characteristics and the available shoe technologies is the reason why at ARION, we focus on your unique running identity, combining your individual biomechanics with specific shoe technologies that bring you the biggest possible benefits.

“ We digitize human movement to accelerate breakthrough innovations that move the world forward ”

## Would you like to get in touch?

The movement report is an example of how our ARION innovations utilize cutting edge technology to unlock value at every level of the sports and health industries. It represents a true reflection of our brand statement.

Want to see how our data can move you forward? Reach out to our team and subscribe to our social channels to receive the latest insights from the ARION Lab.



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