# DAWN OF THE SUPER ATHLETE

**These days, the technique which enables Portuguese footballer, Cristiano Ronaldo, to take the perfect free-kick is no longer solely dissected by football pundits but also by scientists, biomechanics and engineers. Every twitch of muscle, transference of energy and body posture is analysed by sensors and computers so that we can build a greater understanding of what it takes to make the ultimate athlete.**

In the 1950s, the introduction of fiberglass poles saw pole-vaulters leap to new heights.

In the 1970s, the replacement of wood in tennis rackets with a combination of fibreglass and graphite saw tennis players smash former limits.

At the 2008 Beijing Olympics, swimmers wearing a new bodysuit sent world records tumbling.

Over the last few decades, technological advancements in sport have been moving the benchmark of human limitations. Some of them, like the examples above, are easy to understand: the poles became more flexible; the rackets helped accuracy; and the suits reduced drag—so much so that they were later banned.

But while these advances may have been game changing at the time, a new era of technology has arrived that seeks to lift the lid off the secrets to our biomechanics and help push both professional and amateur athletes to greater heights.

In every sport, and at every level, companies are now supplying equipment, clothing and gadgets in a bid to revolutionise the way professionals and amateurs train, compete and recuperate.

## MADE TO MEASURE

For instance, if it wasn't for 3D technologies, Australian skeleton racer, John Farrow, may never have competed in this year's Winter Olympics in Sochi.

In 2011, whilst training, Farrow suffered a horrific knee injury which left him with a nerve paralysis condition called foot drop. After initially relying on a rigid carbon foot-brace made with friends, Farrow's run-off times greatly improved after his doctor designed an ankle foot orthotic (ATO) based on a 3D model of his foot and leg.

"The ATO was more dynamic and gave me a fluid movement. It was comfortable and my performance improved greatly. It also allowed me to train better in sprints and at the gym in the lead up to the Games," says Farrow, who finished 17th at his debut Games in Sochi.

Before Sochi, Farrow also underwent 3D body scanning to ensure his clothing was perfectly moulded to his body. Although the difference clothing makes is minor, small margins increasingly matter in elite sport.

## CUSTOMISATION IS THE KEY

Professor of biomechanics at Brunel University, Bill Baltzopoulos, uses 3D technology specifically to map human motion and help athletes gain that split second advantage and at the same time protect them from injury. He has even welcomed Jamaican Olympic sprinting champion, Usain Bolt to his lab.

"In the field of research, these 3D models tell us what factors contribute to Bolt's performance. What makes him unique is his build and how it enables him to exert a huge force over a short period of time and maintain it."

"Technology has advanced so much that you can measure whatever you want, but it is how you incorporate this into the athlete's regime that's important," says Baltzopoulos.

Baltzopoulos and his team combine sensor technology with 3D software to measure movement in the athletes' body against the forces that are applied to equipment, such as a treadmill.

When it comes to improving performance, Balzopoulos believes this kind of real-time feedback is vital as it allows coaches to alter a training session mid-way through to suit their athlete's needs.

"Customisation is the key. Everyone has a different running style – from sprinters to long-distance runners. There are different stresses applied, so to be able to provide an optimal shoe [for example] you need to understand the way these people run," he says.

David Epstein, author of the Sports Gene, agrees. "Every individual has completely inimitable biology and psychology so, for peak performance, they would need to have unique [requirements]. When we fail to understand the kind of training people with differing muscle types need, we lose them to injury."

"There is no cookie cutter training that works for everyone, just as medical genetics has shown that there is no single medication that works the same for everyone," says Epstein.

In the recent years consumers have demonstrated a growing desire for customized footwear, clothes and accessories. Today it is possible to choose the color and design of your shoes online or in a physical store and have them delivered to your doorstep in just a few weeks. This has been made possible because brands have been leveraging technology to help them understand consumers and develop the products the market wants with ever-shorter lead times. So you can imagine how fast these brands could adopt 3D modelling and printing technology—and many of them have already—to offer footwear moulded and shaped for individuals at a commercial level.

Although professional athletes have greater support and access to use and trial these kinds of technologies, Susan Olivier, vice president of consumer goods and retail at Dassault Systèmes, believes 3D modeling techniques will soon be readily available to the public.

"The cost and size of 3D scanning is going down dramatically. I can imagine in three to five years that before shopping we will visit a booth that scans our feet and other body parts. Then we can take the scan to our favourite sports outlet who will be able to design equipment, clothing and footwear to our specifications," says Olivier.

## FEEDBACK

This thirst for real-time feedback has propelled a rise in sensor technology which Olivier Ribet, vice president of the high tech industry at Dassault Systèmes, says has dramatically improved over the last two to three years and is accelerating..

It is now common for sensors to be placed in shoes and on bikes to track statistics such as distance, incline, speed and power. One recent breakthrough has seen French equipment company Babolat release a smart tennis racket, which uses sensors to give feedback on your game, including the power of shots, variety of shots and level of spin.

"The difference that sensors of this kind make to performance will probably be around 0.1%. But these margins can still be significant over a long match or race. It won't turn a mediocre athlete into a world class one. It is more incremental than that," says Ross Tucker, an exercise physiologist and high performance sports consultant.

## SHARING THE KNOWLEDGE

Technological developments do not always originate from the sports industry itself. Inventions created for the military, aerospace companies and Formula One are often adapted for the sports industry. When Formula One teams invent a new material, it is often used to design safer equipment and helmets for sportsmen and women.

Although technology has helped make helmets more durable, the last couple of years has seen the media highlight the dangers of playing high impact sports such as ice hockey and American Football.

In August 2013, the National Football League, for instance, paid a $765 million settlement deal to thousands of football players who claimed the league hid the truth about head injuries, such as concussion and long-term brain damage. In the hope of minimising damage, specialised helmets with real-time sensors have been developed that track knocks to the head and send alerts to a device such as a smart phone.

In spite of these now tangible solutions, nobody can predict just how much more technology will improve performance and safety further, says Ribet. "Some people think one day we will swallow a pill and this pill will be in our body forever and used to track health and movement," says Ribet. "Then there are those who say we will put a patch over or even under the skin to track changes contextually and in real time. Then there is the less extreme idea that we will wear a necklace or band which will process information very quickly and tell us exactly what pressure the body is under."

With technological developments occurring at such a rapid rate in the sports industry, it is unclear how much more they can improve our fundamental biomechanics. From the American runner, Thomas Burke's 100 metres in 12 seconds in 1896 to Bolt's record breaking 9.58 seconds in 2012, who knows how many more milliseconds sprinters will shave off that time another century on.

As both professional and everyday athletes race towards perfection, technology sprints alongside helping to develop devices that could push them a little bit further. Those chasing Bolt, or on the road to recovery like Farrow, will take every advantage they can get.

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