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## Usain Bolt: Case Study In Science Of Sprinting

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One year from now, the 2012 Olympic Games will begin in London, where all eyes will be on the incomparable Usain Bolt -- the Jamaican sprinter who is more than living up to his name.

Since 2008, Bolt has taken a jackhammer to the 100-meter world record, lopping off a whopping .14 seconds. That might not sound like a huge chunk of time until you consider it's twice as much as any other sprinter has shaved off the world record since the advent of electronic scoring.



Logically, one would think that Bolt did so by moving his legs faster than anyone else. Only he didn't.

Speed, as it turns out, may be completely misunderstood.



When Bolt established the current 100-meter world record in the 2009 world championships, running it in 9.58 seconds, he did so by moving his legs at virtually the same pace as his competitors. In fact, if you or I were to compete against Bolt, our legs would turn over at essentially the same rate as his.

This is a theory put forth by academics and track coaches alike who contend that running fast has more to do with the force one applies to the ground than how quickly one can move one's legs.

More than a decade ago, Peter Weyand, a science professor at Southern Methodist University, conducted a study on speed. Comparing athletes to non-athletes, Weyand clocked both test groups as they ran at their top speed. What he found shocked him.

"The amount of time to pick up a leg and put it down is very similar," he says. "It surprised us when we first figured it out."

So if leg turnover is the same, how does one person run faster than another?

Weyand discovered that speed is dependent upon two variables: The force with which one presses against the ground and how long one applies that force.

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Think of the legs as springs. The more force they can push against the ground, the further they can propel the body forward, thus maximizing the output of each individual step. In a full sprint, the average person applies about 500 to 600 pounds of force. An Olympic sprinter can apply more than 1,000 pounds.

But force isn't the only factor. How quickly that force is applied factors in as well.

For this, think of bouncing a beach ball versus a super ball. The beach ball is soft and mushy and when bounced on the ground sits for a while before slowly rebounding back into the air. Conversely, a super ball is hard and stiff and when bounced rebounds almost instantaneously -- and at a much faster speed than the beach ball.

The average person's foot is on the ground for about .12 seconds, while an Olympic sprinter's foot is on the ground for just .08 seconds -- a 60-percent difference.

"The amount of time [one's legs are] in the air is .12, regardless if you're fast or slow," Weyand explains. "An elite sprinter gets the aerial time they need with less time on the ground to generate that lift -- or to get back up in the air -- because they can hit harder."



So what makes Bolt faster than even the elite sprinters? And can he run the 100 meters even faster than 9.58 seconds?

Bolt's superiority is often explained by his unique combination of height, strength and acceleration.

At 6-foot-5, Bolt is two inches taller than fellow Jamaican Asafa Powell (pictured together below) and has six inches on American Tyson Gay -- two of his closest challengers. While it takes most elite sprinters 44 strides to complete 100 meters, Bolt does it in 41.



"Would you rather take 44 steps to your car or 41?" asks Dan Pfaff, who coached Canada's Donovan Bailey to the 100-meter gold during the Atlanta Games in 1996.

Pfaff, now working in London to help boost Great Britain's track-and-field hopes for 2012, says Bolt's height gives him a distinct leverage advantage.

"If you're digging a hole in the ground, you have to get a longer lever to pry [out a rock]," he explains. "If you can control those levers and make them work efficiently, it's a huge advantage."

It's Bolt's ability to control the levers that is so unusual for a sprinter his height.

While taller sprinters may be able to reach a higher top-end speed, getting up to that speed isn't as easy. This can be explained physiologically -- smaller people can exert more force in relation to how much they weigh --

but Weyand prefers a more simple visual to show this to be true.

"You can easily imagine a 4-foot-10 gymnast doing a triple back flip, but imagine Shaquille O'Neal or Yao Ming doing it," he says. "You know they can't do it."

Bolt, it seems, is the exception to this rule. Though he's not doing triple back flips, he does get up to speed nearly as quickly as his more diminutive competitors.

"He has a very unusual combination of being extremely tall and relatively massive and being able to accelerate well. Those things are at odds with each other," explains Dr. Mike Young, a strength and speed coach who trains professionals in track and field and other sports. "He accelerates better than all but one guy in the world -- behind Asafa Powell -- but because he's so massive, he takes fewer strides. If you're that large, once you're moving, you stay moving."

This would help explain why Bolt still managed to break the world record during the Beijing Games in 2008 despite throwing up his arms in celebration some 20 meters before the finish. As Young explains, if the "average athlete is a motorcycle, Usain Bolt is a dump truck," and it takes a lot more resistance to slow down a dump truck than a motorcycle. Thus, when he fatigues, he slows down more slowly.

"He has the holy triumvirate," Young contends. "He's one of the top accelerators, has the highest top-end speed and the highest endurance. It's something that's never been seen before. Carl Lewis had the highest top speed, the highest endurance, but he was not the best accelerator."

Bolt, just 24, has set his goal of running the 100 meters in the 9.4 range, explaining to Britain's BBC Radio: "Because that's where I think the record will probably never be beaten."



While Young doesn't think Bolt will break 9.5 in London, Weyand, through his research, says it's possible. Though if Bolt pulls it off, it won't be because he moves his legs any faster.

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