Can a human ever run 100 m under 9 seconds?
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American Jim Hines was the first person to run 100 m in under 10 seconds in Mexico 1968. Consequently, attention has gradually turned to whether a human can ever run this distance in under 9 seconds? Our thoughts, based on 20 years of investigating the biomechanics of sprinting, are "of course they can"; there is no limit to human sprinting in sight yet. Humans have run competitively (with time records available) for only about 100 years. In the context of human evolution, this is far too short a period to analyse with a view of making long term predictions for the future. Records are still being broken, and training and technology (i.e track surfaces and running spikes) are continuously developed further. In fact, from Jim Hines 1968 to Maurice Green 1999, the World Record improved by 0.16 seconds in 31 years, but since then the record has been improved by 0.21 seconds in only 10 years (as Usain Bolt ran the current World Record of 9.58 seconds in 2009). This does not necessarily imply that the development of the record is speeding up, just that we cannot consider human limits in a short term perspective. There have always been and there will always be humans who make new leaps in these kinds of records. To develop the argument against a set limit in human performance further, why would not Usain Bolt have a son who is just a bit taller, stronger and faster than Usain himself, and so on?
The issue of improving performance is also down to better training and improving running technique. In a recent scientific paper (1) we highlighted the importance of powerful gluteus (bum) muscles for the start performance in sprinting. Athletes and coaches can then train and strengthen these key muscle groups to get out of the starting blocks better. Overall, the sprinting velocity is a product of step length and step frequency. In his world record run in Berlin 2009, Usain Bolt ran at 12.4 m/s in his fastest phase (2). He did this with a step length of 2.77 m and step frequency of 4.49 Hz. For a human to run 100 m in under 9 seconds would require maximum velocity to reach about 13.2 m/s. Such velocity would require, for example, step length to be 2.85 m and step frequency 4.63 Hz, just "modest" increases from Usain Bolt's values. However, the progress is not so easy, as when athlete starts to increase step length at the maximum velocity phase, it has negative effect on step frequency. Longer steps take longer time to make and thus step frequency will go down and vice versa. Thus, it will likely take time before we see that kind of performance. The main issue is how much power (large forces in the shortest possible time) humans can produce and what the requirements are to achieve this.

To produce long steps at a high frequency an athlete has to produce a huge amount of force (approximately 4.5 times body weight) in a very short period of time (around 0.1s). To do this they must maintain a very stiff leg and accelerate it into the ground at foot contact. Recent research has shown that it is this difference in the forces generated in the early part of the stance phase (i.e. just after foot contact) that distinguishes very fast sprinters from the less fast ones (3). The ability to maintain a stiff limb is determined by how muscle force can be generated in the muscles of the leg. This in turn is a function of muscle size, the types of fibres which make up the muscles and the co-ordinated activation of the muscles of the leg to optimise the use of elastic mechanisms to amplify the power from the muscles. A muscle with a high proportion of large, fast twitch muscle fibres will be able to generate larger amounts of force more quickly than a muscle with a lower proportion. Therefore to reach the point at which enough force can be generated quickly enough to produce the step lengths and frequencies suggested above a combination of genetics and training would need to produce bum, thigh and calf muscles which are a ;little bit stronger and faster than the current best sprinters.

The record will start to plateau at some point and it will be harder and harder to be faster than the previous record holder. However, someone will break the 9 second barrier, not necessarily in our lifetime, but it will happen one day.

1) Bezodis, N.E., Salo, A.I.T. & Trewartha G. (2014). Relationships between lower-limb kinematics and block phase performance in a cross section of sprinters. European Journal of Sport Science. http://dx.doi.org/10.1080/17461391.2014.928915
2) IAAF (2009). Scientific Research Project – Biomechanical analysis at the Berlin World Championships 2009.
3) Clarke, K.P., Ryan, L.J, Weyand, P.G. (2014). Foot speed, foot-strike and footwear: linking gait mechanics and running ground reaction forces. J. Exp. Biol. 217, 2037-2040 doi: 10.1242/jeb.099523