


VIEWPOINT

## Last Word on Viewpoint: Technological advances in elite sport: Where does one draw the line?

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TO THE EDITOR: We read with interest the 19 commentaries (1–19) generated in response to our Viewpoint (20) and appreciate the opportunity to have the last say. We wish to acknowledge all contributors for their valuable yet differing viewpoints on the use of technologies in competition such as WaveLight technology (WLT), or advanced foot-wear technology (AFT). The position of most contributors were opinion based and not necessarily supported by evidence and this confirms the need for greater scientific input. Some highlights include the response from Kram (9) who claims that technologies such as AFT and WLT should be allowed in competition as these technologies do not cause harm. Similarly, Barrons (10) considers these technologies part of the natural progression in sport, with AFT increasing mechanical efficiency and WLT improving the quality of the pacing feedback without augmenting the athlete's natural performance capacity. However, the use of technologies that increase the athlete's natural mechanical efficiency or affect the natural ability to maintain an even pace are by design created to artificially augment the athlete's natural performance capacity. Ives and DeBlauw (14) and Campo-Beamus and Rodrigo-Carranza (5) dispute our conviction that technologies such as AFT and WLT are mainly responsible for the regular breaking of road and track running records since 2016 and propose other contributing factors such as new training methods. Marocolo and Souza (7) argued that all technologies enhancing athletic performance beyond an athlete's natural performance capacity should not be permitted. We tend to agree and oppose the introduction of technology that enhances the athlete's natural performance capacity that is introduced primarily to appease major sponsors and in the hope of creating a spectacle to attract greater audiences.

Some authors including the Viewpoint by Wilkins and Joyner (21) equate the impact of AFT or WLT to previous milestones such as the technique change in the high jump with the Fosbury flop and the use of synthetic track surfaces, or the impact of altitude during the Mexico Olympics in 1968, claiming that there are no records differentiation in these cases. We believe however that these previous milestones are indeed part of the natural evolution of the sport and in stark

contrast to the introduction of technologies such as WLT, which alters the natural capability of athletes to manage their own effort.

There was general consensus justifying the use of some wearables and technologies during training, especially those helping coaches optimize training methods and loads. However, the use of technology in competition proved more controversial, with authors such as Perrey (1) or Millet and Brocherie (3) arguing that fairness and sport integrity should prevail in competition and therefore all external performance-enhancing technologies should be prohibited. They argue, as we do, that the focus should be on the athlete's physiology and natural management of effort as the main differentiator of athletic performance, although this idea was labeled “romantic” by Beals and Paris (19).

We agree with the need for ecologically valid studies focused on the impact on the sport of any new technology such as AFT (and not only performance proxies such as running economy) and WLT (1–19) but urge that before decisions are taken, proposals must undergo thorough scientific validation, submitted to fairness and sports integrity assessment by a nonconflicted independent body and extensively trialed before being introduced in major sporting competition.

Finally, as founders of the original sub2 marathon project aimed at encouraging technology use over prohibited drugs and methods, our viewpoint is consistent with our focus on developing and implementing technological innovations in sport as evidenced by our numerous efforts (22). However, our position is that integration of any new technology must be consistent with the Olympic ideals and protect the health of athletes and integrity of competition. Technologies that enhance beyond the athlete's natural performance capacity may be more suited to the Enhanced Games planned to take place in 2025; an international multi-sport event masterminded by Aron D'Souza, Australian businessman, where any form of enhancement is encouraged (23).

### DISCLOSURES

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Record holder. C.M. is a professional athlete sponsored by adidas (Herzogenaurach, Germany). Y.P. is the founder of the original Sub2 marathon project now affiliated to Human Telemetrics (London, UK). None of the other authors has any conflicts of interest, financial or otherwise, to disclose.

## AUTHOR CONTRIBUTIONS

B.M.-P. and Y.P. drafted manuscript; B.M.-P., K.B., C.M., and Y.P. edited and revised manuscript; B.M.-P., K.B., C.M., and Y.P. approved final version of manuscript.

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