09 March 2022

UNIVERSITY OF GLOUCESTERSHIRE

#Biomechrunning: From Koroivos of Elis to Usain of Jamaica…and into the Future

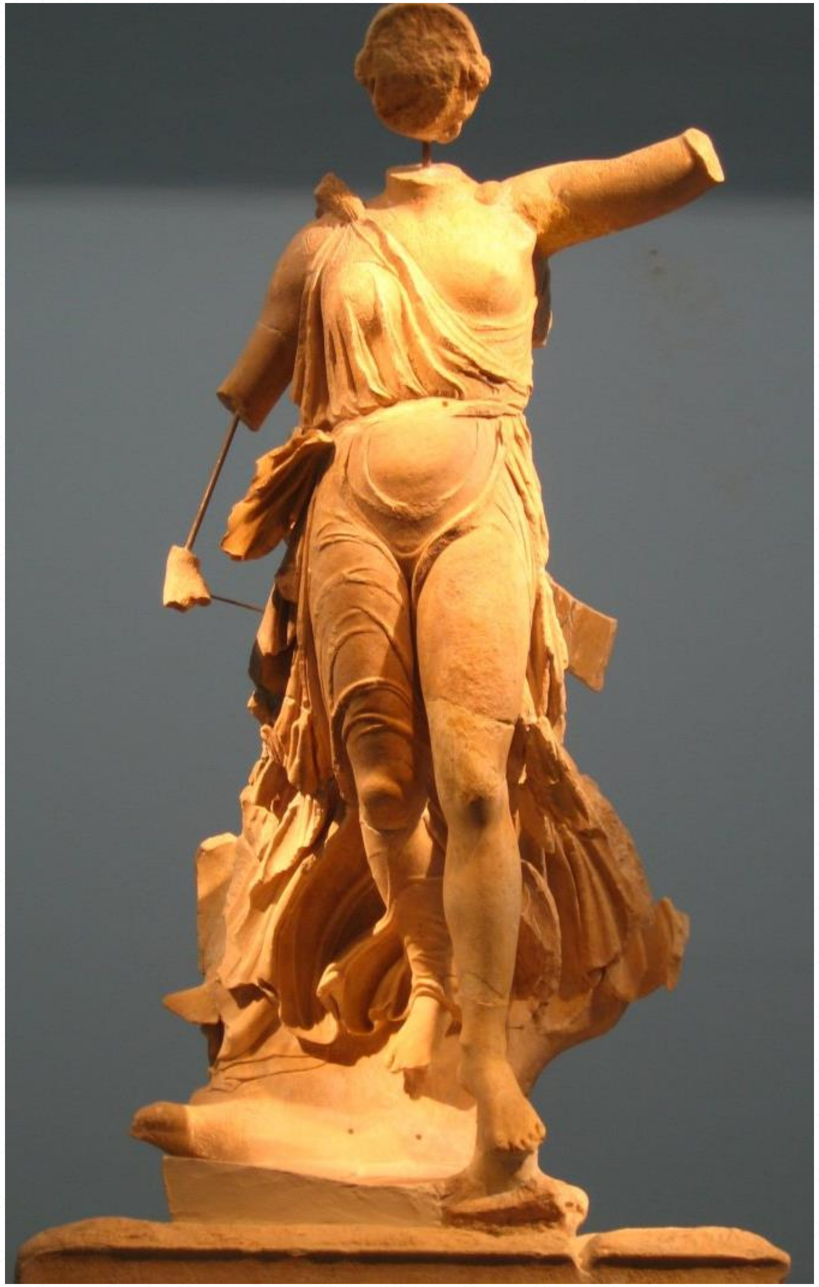
Athanassios Bissas

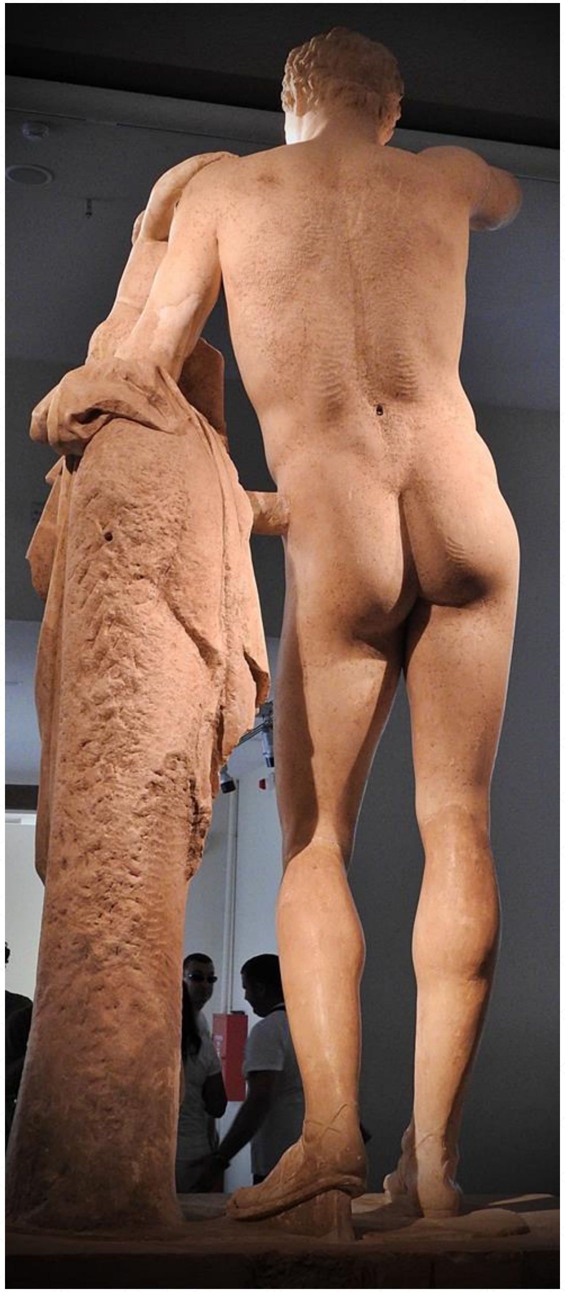
Professorial Inaugural Lecture

Summary

Sprint running is one of the oldest athletic events that has dominated the athletics scene since the first ancient Olympic games in 776 BC. Has this happened through an evolution process where this competitive gait has managed to adapt and modernise itself to remain contemporary? If this is the case, how do the sprinters of the 21st century compare to the ancient runners competing barefoot on plain dirt surface? What does the future of sprinting look like?

Having spent over two decades studying sprint running through a biomechanical lens, Professor Bissas will philosophise about this pure, uncomplicated and aesthetic mode of human locomotion that obeys unfailingly the laws of classical mechanics.





$AE = FD = A'E' = F'D' = 20$ m

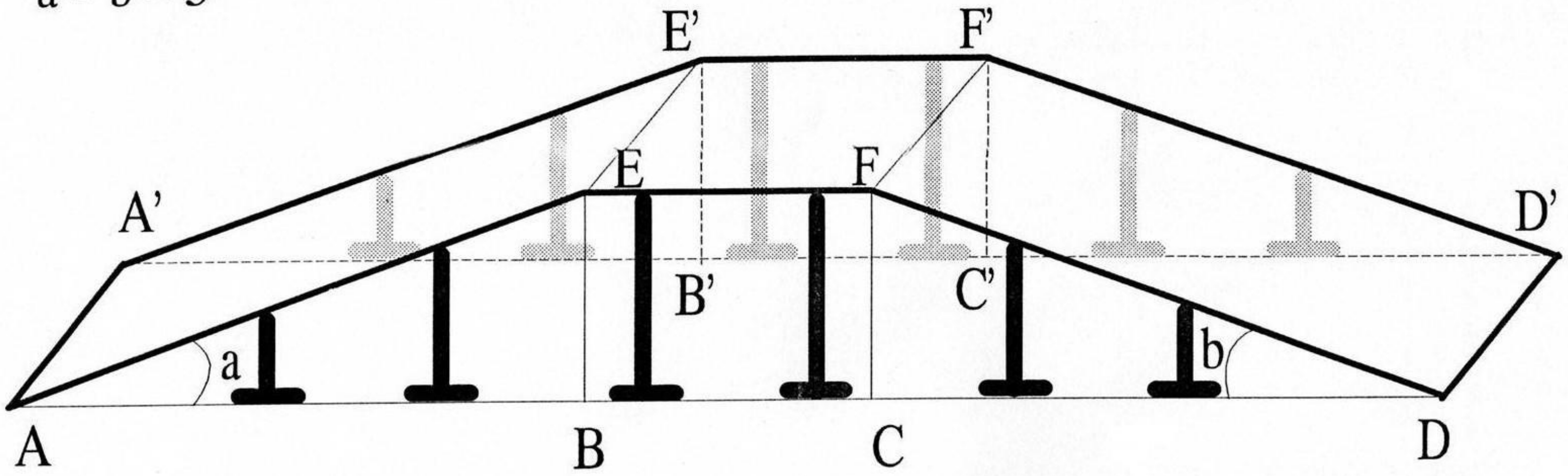
$EF = E'F' = 10$ m

$AA' = EE' = FF' = DD' = 1.20$ m

$AB = CD = A'B' = C'D'$

$BC = B'C'$

$a = b = 3^{\circ}$

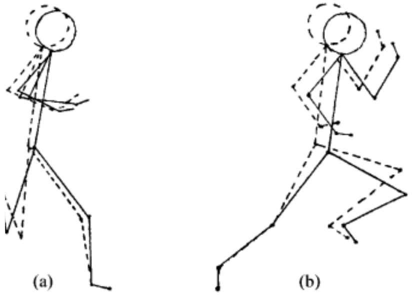



Motion Analysis
by Kodak

Table 3. Postural characteristics of maximum sprinting at touchdown (mean ± *s* of the three trials)

	Trunk angle (°)	Shank angle (°)	Knee angle (°)	Thigh angle (°)	Hip angle (°)	Thigh to thigh angle (°)
Uphill	73 ± 4.0*	88 ± 2.1*	144 ± 4.8	57 ± 6.8	129 ± 8.0	31 ± 4.5*
Downhill	82 ± 3.8	100 ± 4.0*	155 ± 7.0*	54 ± 4.9	136 ± 5.2*	40 ± 7.0*
Horizontal	80 ± 5.0	92 ± 3.5	145 ± 4.1	52 ± 5.6	131 ± 6.2	54 ± 8.2

*Significantly different from horizontal sprint running ($P < 0.05$) as determined by repeated-measures analysis of variance and *post-hoc* Tukey tests.



The 'averaged' postural characteristics of the partici- touchdown (a) and take-off (b) for horizontal (—) and

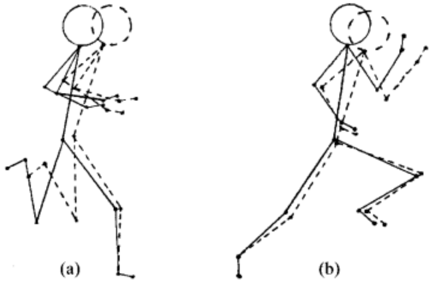


Fig. 5. The 'averaged' postural characteristics of the participants at touchdown (a) and take-off (b) for horizontal (—) and uphill (- - -) running. The common point for (a) and (b)

hill Training and Detraining (2022) 36:1 Journal of Strength and Conditioning Research™

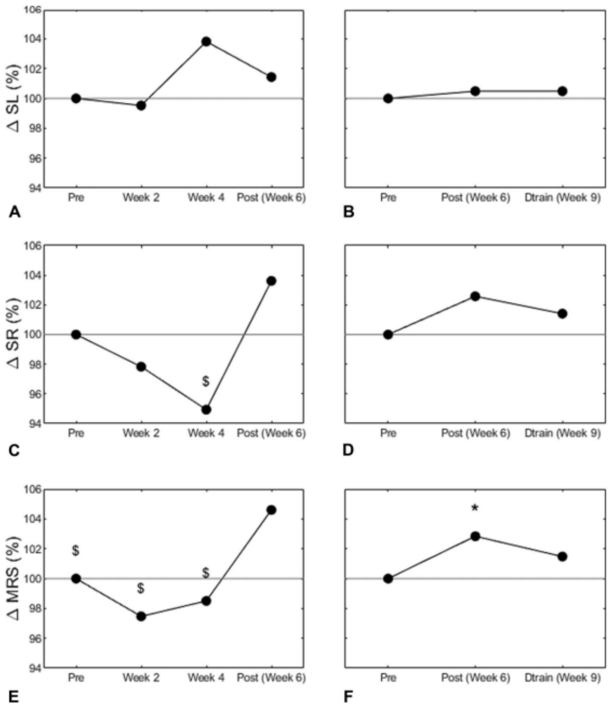
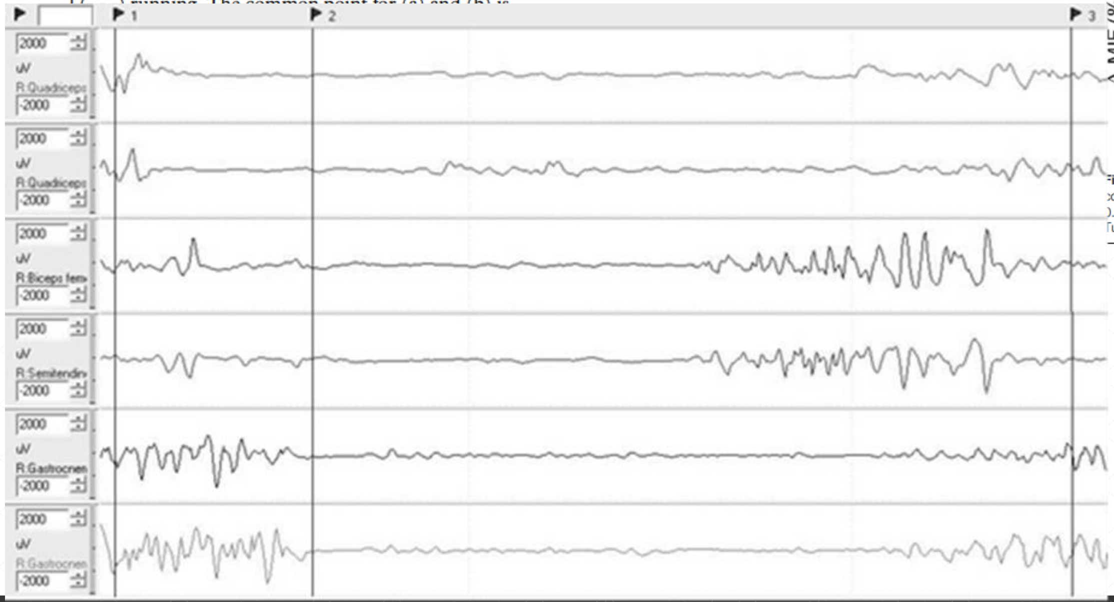
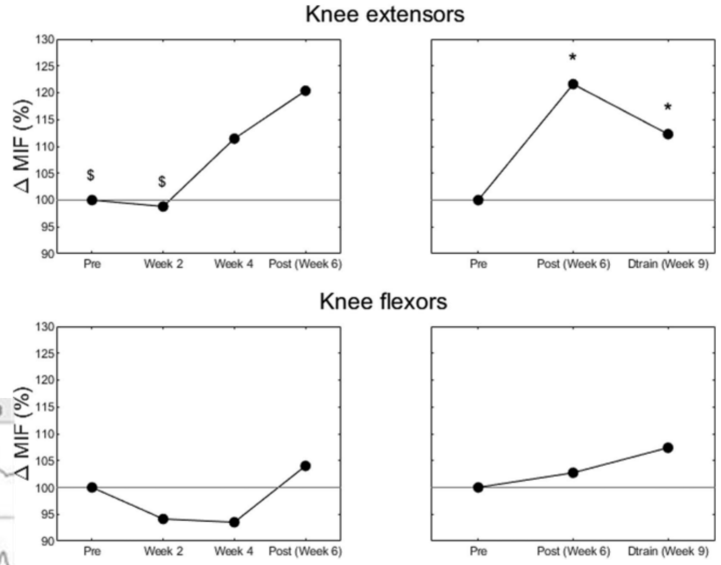


Figure 2. Time series kinematic data of relative changes for the progressive (left column) and training-detraining (right column) U+D groups with the 100% values corresponding to pre-training values. 2A = SL progressive changes; 2B = SL training-detraining changes; 2C = SR progressive changes; 2D = SR training-detraining changes; 2E = MRS progressive changes; 2F = MRS training-detraining changes. *Significantly different from pre-training ($p < 0.05$) and $significantly different from post-training ($p < 0.05$) as determined by repeated-measures analysis of variance and Tukey's HSD post hoc tests. SL = step length; SR = step rate; MRS = maximum running speed.



hill Training and Detraining (2022) 36:1 Journal of Strength and Conditioning Research™ | ww



igure 3. Time series strength data of relative MBIF changes for the progressive (left column) and training-detraining (right olumn) U+D groups with the 100% values corresponding to pre-training values. *Significantly different from pre-training ($p <$ .05) and $significantly different from post-training ($p < 0.05$) as determined by repeated-measures analysis of variance and ukey's HSD post hoc tests.

International Journal of Sports Science & Coaching **Volume 10 · Number 5 · 2015** 887

Effect of Combined Uphill-Downhill Sprint Training on Kinematics and Maximum

International Journal of Sports Physiology and Performance, 2009, 4, 229-243
© 2009 Human Kinetics, Inc.

Combined Uphill and Downhill Sprint Running Training Is More Efficacious

International Journal of Sports Science & Coaching **Volume 8 · Number 3 · 2013** 543

Changes in Leg Strength and Kinematics with Uphill - Downhill Sprint Training

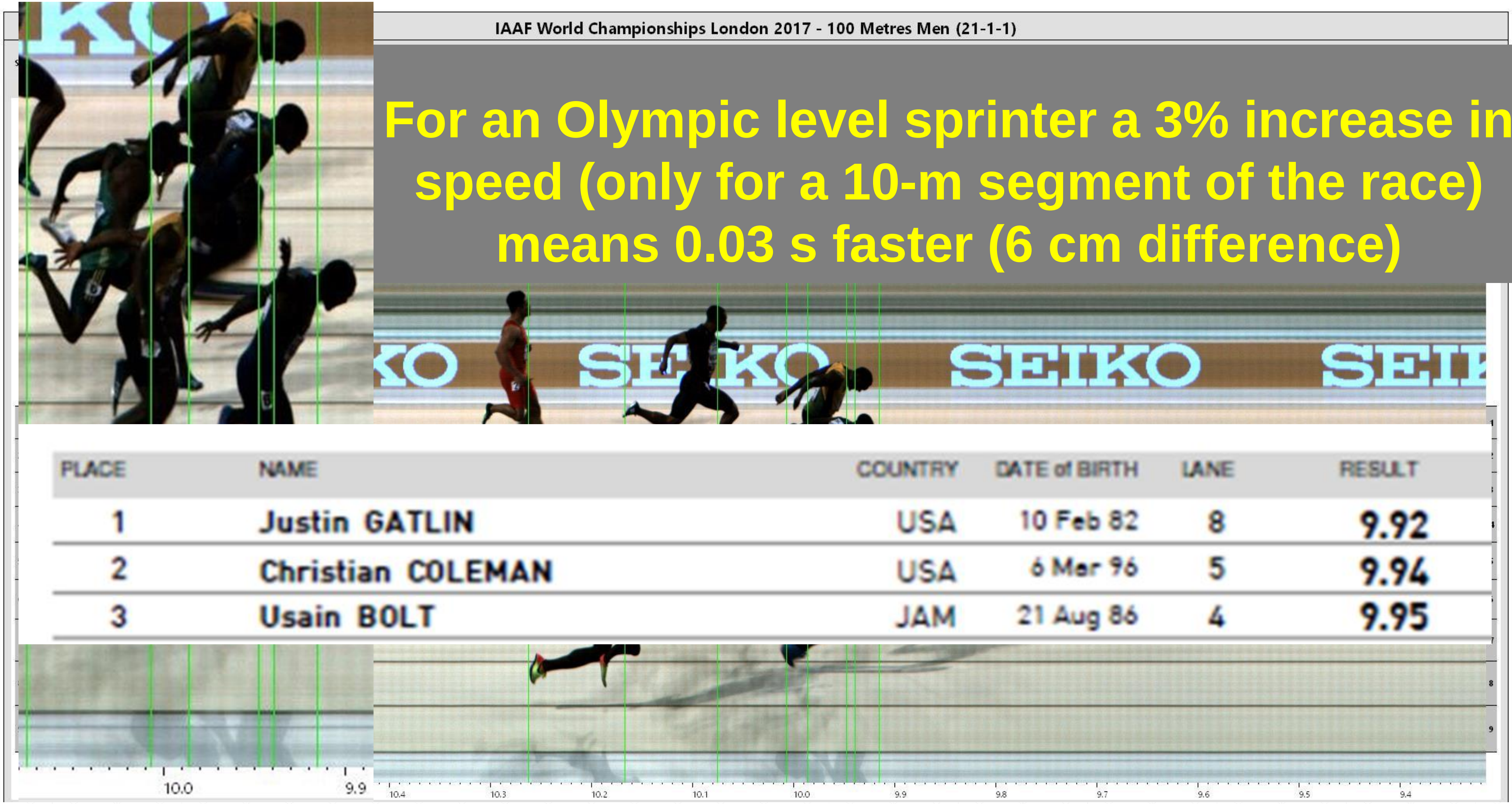
- UD > U, D, H, WT, PL
- UD increases maximum speed by 3 – 8%
- UD increases stride frequency by 3 – 4%
- UD improves contact and flight times by 2 – 8% and 2 – 5%
- UD increased leg strength by 15 – 26%
- UD increase the neural input to the leg muscles by 38%

± 0.18 Hz, $p < 0.05$), and their knee extensors' maximum isometric force by 21% (from 2,242 ± 489 to 2,712 ± 498 N, $p < 0.05$) after training. The time course of changes showed declines for weeks 1–4 (1.4–5.1%), but an ascending trend of improvement compensated all losses by the end of week 6 ($p < 0.05$). During detraining, no decreases occurred. No changes were observed for the H and C groups. The minimum period to produce positive effects was 6 weeks, with a very good standard of performance maintained 3 weeks after training. U+D training will prove useful for all athletes requiring fast adaptations, and it can fit into training mesocycles because of its low time demands.

Key Words: detraining, leg strength, quadriceps femoris, running, sprinting, time-course

(+10.0%). Twelve, eight and seven out of 21 variables significantly distinguished Fast from Slow, Fast from Medium and Medium from Slow sprinters, respectively. Propulsive phase was significantly shorter in Fast vs. Medium (–17.5%) and Slow (–29.4%) as well as in Medium vs. Slow (–14.4%). Fast sprinters had significantly higher vertical and leg stiffness values than Medium (+44.1% and +18.1%, respectively) and Slow (+25.4% and +22.0%, respectively). MRS at 30–35 m increased with performance level during a 35-m sprint and was achieved through shorter contact time, longer step length, faster step rate, and higher vertical and leg stiffness.

spring-mass characteristics



For an Olympic level sprinter a 3% increase in speed (only for a 10-m segment of the race) means 0.03 s faster (6 cm difference)

PLACE	NAME	COUNTRY	DATE of BIRTH	LANE	RESULT
1	Justin GATLIN	USA	10 Feb 82	8	9.92
2	Christian COLEMAN	USA	6 Mar 96	5	9.94
3	Usain BOLT	JAM	21 Aug 86	4	9.95


3.5t
Refreshing
RUSSIA
228
225
227

S

23:4: 27

Initial findings of a biomechanical analysis at the 2008 IAAF World Race Walking Cup

By Brian Hanley, Athanassios Bissas, Andrew Drake

Biomechanical Analysis of Leg Asymmetry in Young International Race Walkers

by Brian Hanley and Athanassios Bissas

The biomechanics of el race walking: technique analysis and the effects fatigue

By Brian Hanley, Andrew Drake, Athanassios

STUDY

© by IAAF
25:2; 39-47, 2010

Biomechanical analysis of elite junior race walkers

By Brian Hanley, Athanassios Bissas, Andrew Drake

ABSTRACT AUTHORS

Sports Biomechanics
June 2011; 10(2): 110–124

Kinematic characteristics of race walking and their vari

BRIAN HANLEY, ATHANASSIOS

Carnegie Faculty, Leeds Metropolitan Universi

Journal of Sports Sciences, 2013
Vol. 31, No. 11, 1222–1232, http://dx.doi.org/10.10

Analysis of lower limb internal ki elite race walking

BRIAN HANLEY & ATHANASSIOS BISSAS

Leeds Metropolitan University, School of Sport, Headingley

European Journal of Sport Science, 2013
Vol. 13, No. 3, 272–279, http://dx.doi.org/10.1080/17461391.2011

ORIGINAL ARTICLE

Kinematic characteristics of elite men's 50

BRIAN HANLEY, ATHANASSIOS BISSAS, & ANDREW

European Journal of Sport Science, 2016
Vol. 16, No. 1, 50–56, http://dx.doi.org/10.1080/17461391.2014.984769

Routledge Taylor & Francis Group

ORIGINAL ARTICLE

Ground reaction forces of Olympic and World Championship race walkers

BRIAN HANLEY & ATHANASSIOS BISSAS

Carnegie Faculty, Leeds Beckett University, Leeds, UK

JOURNAL OF SPORTS SCIENCES, 2018
VOL. 36, NO. 11, 1250–1255
https://doi.org/10.1080/02640414.2017.1372928

Differences between motion capture and video an angles in elite-standard race walking

Brian Hanley, Catherine B. Tucker and Athanassios Bissas

Carnegie School of Sport, Headingley Campus, Leeds Beckett University, Leeds, UK

ABSTRACT
Race walking is an event where the knee must be straightened from first cont midstance. The aim of this study was to compare knee angle measurements and 3D optoelectronic systems. Passive retroreflective markers were placed o walkers and 3D marker coordinate data captured (250 Hz), with 2D video simultaneously. Knee angle data were first derived based on the markers' co by using a 3D model that also incorporated thigh and shank clusters; the v using both automatic tracking and manual digitising, creating four conditions calculated between conditions for stance (using root mean square values), and were few differences between systems, although the 3D model produced la than using automatic tracking and marker coordinates (by 3 – 6°, $P < 0.05$). have occurred because of how the 3D model locates the hip joint, and be marker clusters. 2D videography gave similar results to the 3D model when u it allowed for errors caused by skin movement to be corrected.

Slov

GENDER AND AGE-GROUP DIFFERENCES IN PATTERNS IN ELITE RACE W

Brian HANLEY, Athanassios BISSAS, A
Carnegie School of Sport, Leeds Beckett Universit

Key words:
athletes, electromyography, gait, track and field

Race walking is a complex ac generation by the muscles at whether differences are pres between men and women, o The purpose of this study patterns in elite male and senior age groups. Ten r participated, with five U20 a The athletes were recorded as they race walked down a activity of the gluteus medius rectus femoris was recorded Hz). The hip sagittal angle w average rectified EMG used groups. No differences wer groups for the activity of any midswing, heel-strike and m differences in activity timing groups showed that race wal trained athletes and coache when developing the muscula

J SPORTS MED PHYS FITNESS 2014;54:700-7

Technical characteristics elite junior men and women race walke

B. HANLEY [1], A. BISSAS [1], A. DRA

[1]Biomechanics Department, Carnegie Fac Leeds Metropolitan University, Leeds, [2]National Centre for Race Walking, University S Leeds Metropolitan University, Leeds,

quires a thorough ciples underlying this study was to walkers and iden- women were vid- 8th European Cup tic data were ob- II, Munich). elated with speed ere the kinematic ds. While cadence ior women, there spent in contact. rs for upper body differences with-

such long distances, races for junior men and w en (under 20 years of age) are held over the sho distance of 10 km.[1] The rules of race walking s that no visible loss of contact with the ground sh occur and that the knee must be straightened fr the moment of first contact with the ground until "vertical upright position".[1] Judges issue red c to athletes who they consider to be losing contac not straightening the knee fully. An athlete receiv

JOURNAL OF SPORTS SCIENCES, 2017
VOL. 35, NO. 10, 960–966
http://dx.doi.org/10.1080/02640414.2016.1206662

Routledge Taylor & Francis Group

Analysis of lower limb work-energy patterns in world-class race walkers

Brian Hanley and Athanassios Bissas

School of Sport, Carnegie Faculty, Leeds Beckett University, Leeds, UK

ABSTRACT
The aim of this study was to analyse lower limb work patterns in world-class race walkers. Seventeen male and female athletes race walked at competitive pace. Ground reaction forces (1000 Hz) and high-speed videos (100 Hz) were recorded and normalised joint moments, work and power, stride length, stride frequency and speed estimated. The hip flexors and extensors were the main generators of energy (24.5 J (±6.9) and 40.3 J (±8.3), respectively), with the ankle plantarflexors (16.3 J (±4.3)) contributing to the energy generated during late stance. The knee generated little energy but performed considerable negative work during swing (−49.1 J (±8.7)); the energy absorbed by the knee extensors was associated with smaller changes in velocity during stance (r = .783, P < .001), as was the energy generated by the hip flexors (r = −.689, P = .002). The knee flexors did most negative work (−38.6 J (±5.8)) and the frequent injuries to the hamstrings are probably due to this considerable negative work. Coaches should note the important contributions of the hip and ankle muscles to energy generation and the need to develop knee flexor strength in reducing the risk of injury.

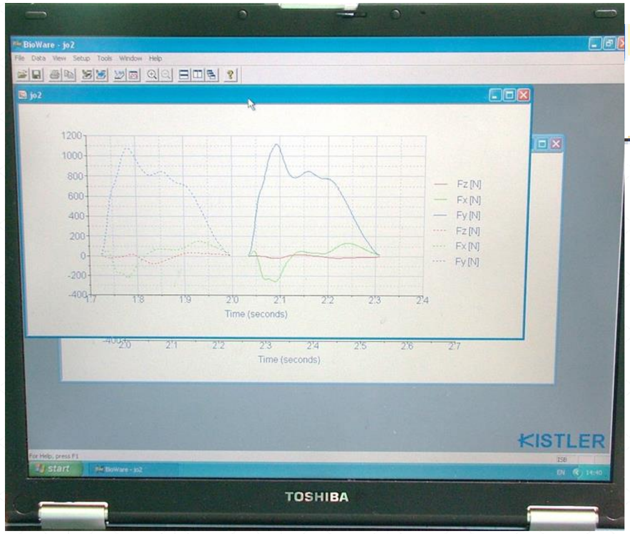
ARTICLE HISTORY
Accepted 22 June 2016

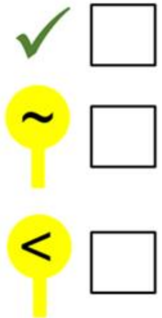
KEYWORDS
Elite-standard athletes; gait; inverse dynamics; performance; track and field

es that racewalkers must have no visible (to the human eye) loss

round and that from first

und until the “ve udy were





Proceed to next video

ORIGINAL RESEARCH article

Front. Sports Act. Living, 08 August 2019 | https://doi.org/10.3389/fspor.2019.00009

Assessment of IAAF Racewalk Judges' Ab Detect Legal and Non-legal Technique

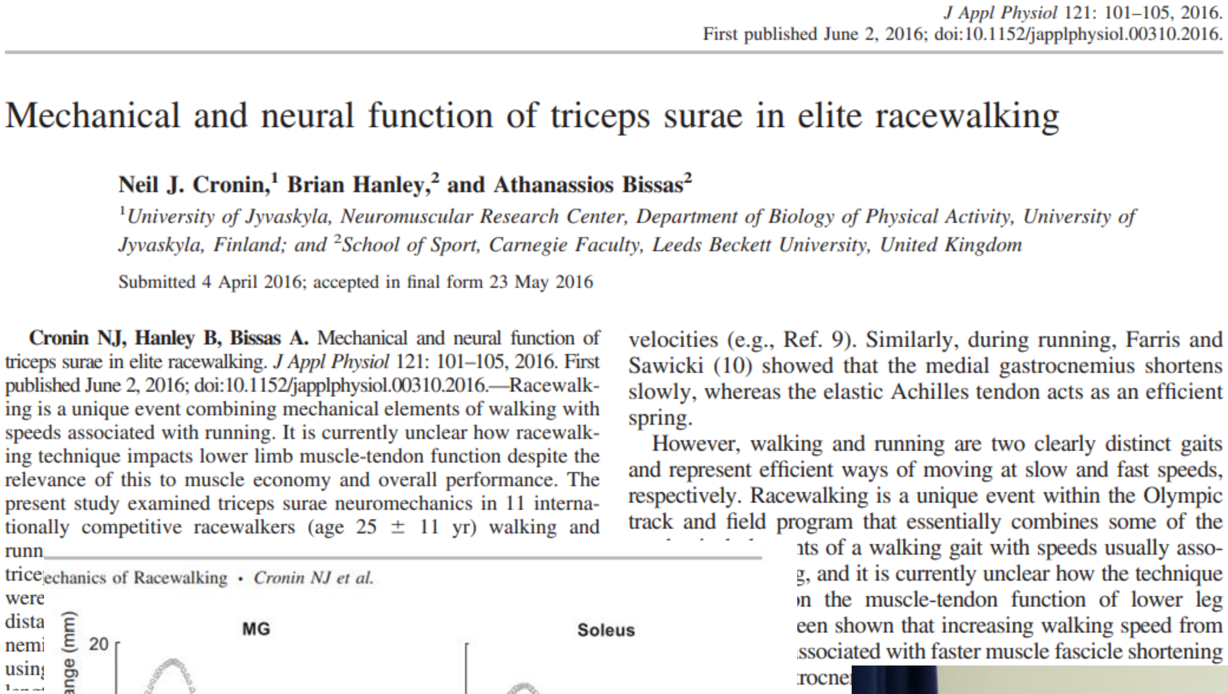
Brian Hanley, Catherine B. Tucker and Athanassios Bissas†*

Carnegie School of Sport, Leeds Beckett University, Leeds, United Kingdom

IAAF Rule 230.2 states that racewalkers must have no visible (to the human eye) loss of contact with the ground and that their advancing leg must be straightened from first

Eighty-three judges of different IAAF Levels (and none) viewed the panned videos online and indicated whether each athlete was racewalking legally. Flight times shorter than 0.033 s were detected by fewer than 12.5% of judges, and thus indicated non-visible loss of contact. Flight times between 0.040 and 0.045 s were usually detected by no more than three out of eight judges. Very long flight times (≥0.060 s) were detected by nearly all judges. The results also showed that what judges generally considered straightened knees (>177°) was close to a geometrically straight line. Within this inexact

definition, IAAF World Championship-standard Level III judges were most accurate, being more likely to detect anatomically bent knees and less likely to indicate bent knees when they did not occur. For the second part, the men racewalked down a 45-m



J Appl Physiol 121: 101–105, 2016.
First published June 2, 2016; doi:10.1152/japplphysiol.00310.2016.

Mechanical and neural function of triceps surae in elite racewalking

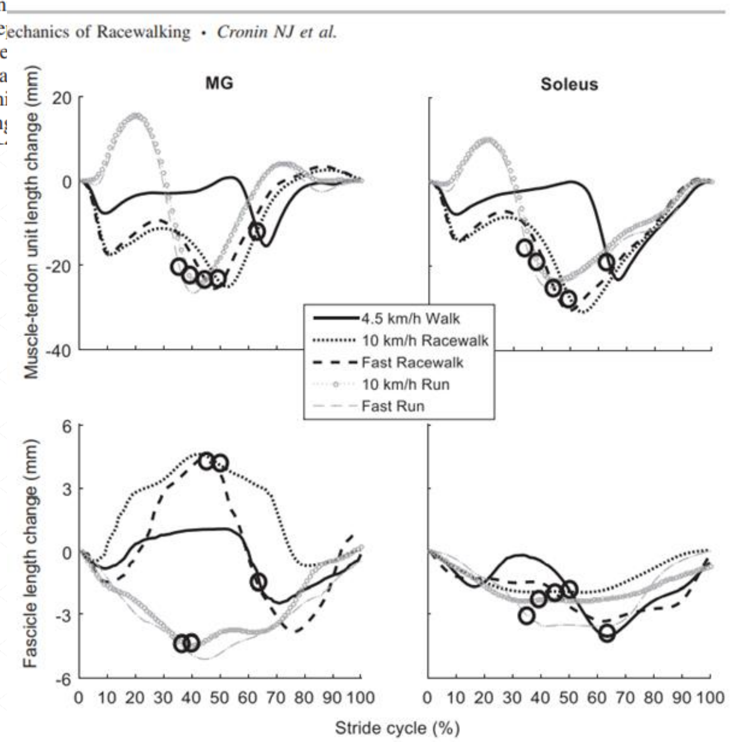
Neil J. Cronin,[1] Brian Hanley,[2] and Athanassios Bissas[2]
[1]*University of Jyvaskyla, Neuromuscular Research Center, Department of Biology of Physical Activity, University of Jyvaskyla, Finland; and* [2]*School of Sport, Carnegie Faculty, Leeds Beckett University, United Kingdom*

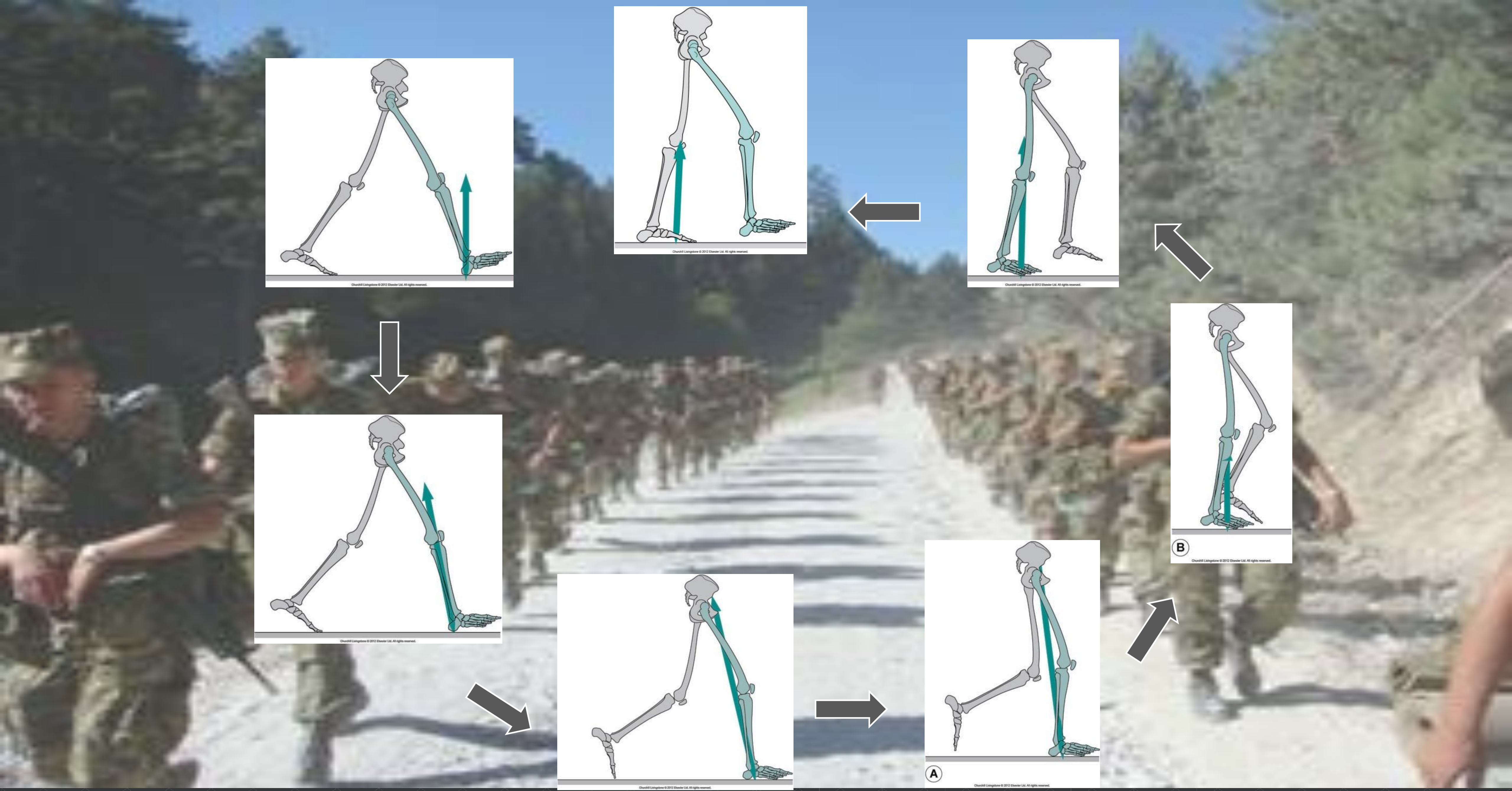
Submitted 4 April 2016; accepted in final form 23 May 2016

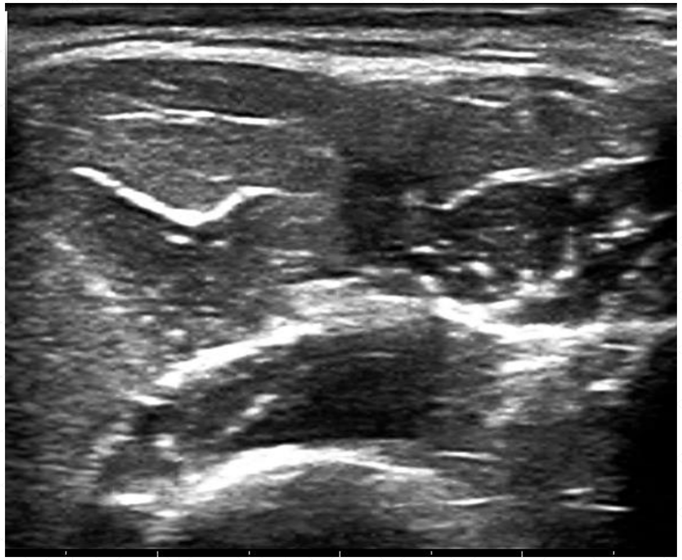
Cronin NJ, Hanley B, Bissas A. Mechanical and neural function of triceps surae in elite racewalking. *J Appl Physiol* 121: 101–105, 2016. First published June 2, 2016; doi:10.1152/japplphysiol.00310.2016.—Racewalking is a unique event combining mechanical elements of walking with speeds associated with running. It is currently unclear how racewalking technique impacts lower limb muscle-tendon function despite the relevance of this to muscle economy and overall performance. The present study examined triceps surae neuromechanics in 11 internationally competitive racewalkers (age 25 ± 11 yr) walking and runn
trice
were
dista
nemi
using

velocities (e.g., Ref. 9). Similarly, during running, Farris and Sawicki (10) showed that the medial gastrocnemius shortens slowly, whereas the elastic Achilles tendon acts as an efficient spring.

However, walking and running are two clearly distinct gaits and represent efficient ways of moving at slow and fast speeds, respectively. Racewalking is a unique event within the Olympic track and field program that essentially combines some of the
nts of a walking gait with speeds usually asso-
g, and it is currently unclear how the technique
n the muscle-tendon function of lower leg
een shown that increasing walking speed from
ssociated with faster muscle fascicle shortening
rocne

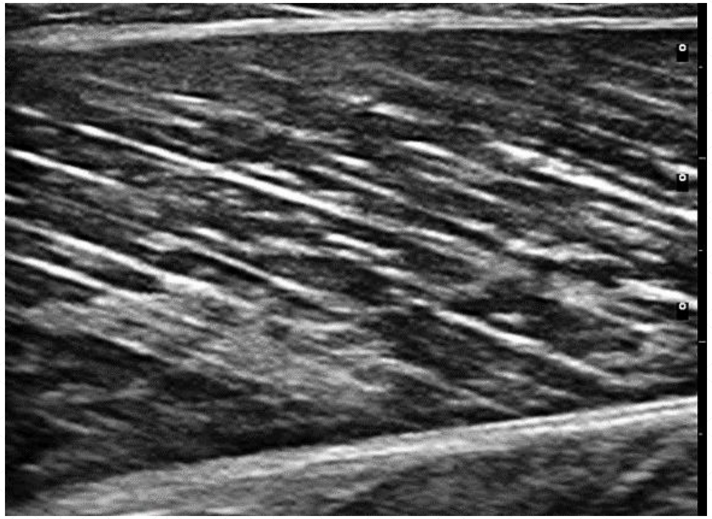
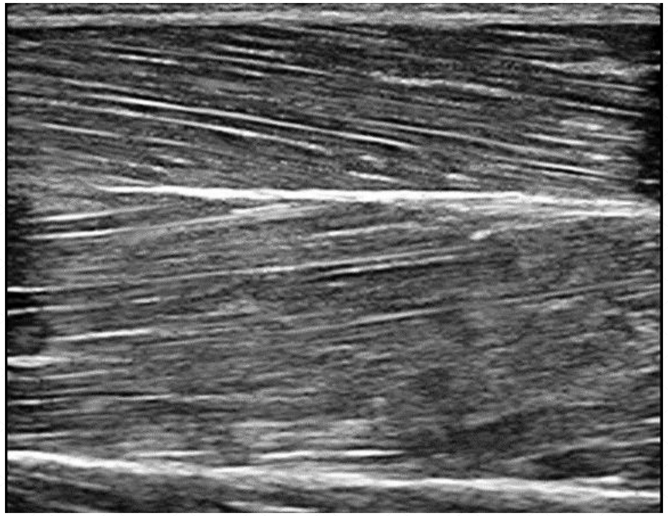
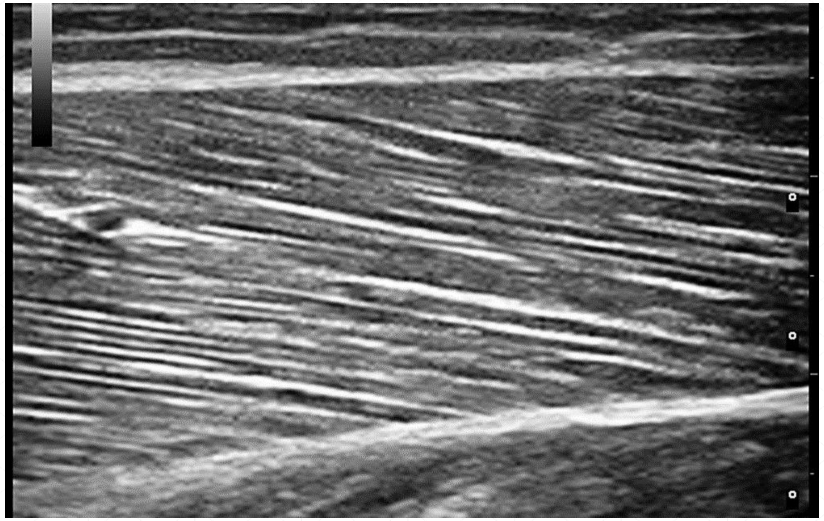
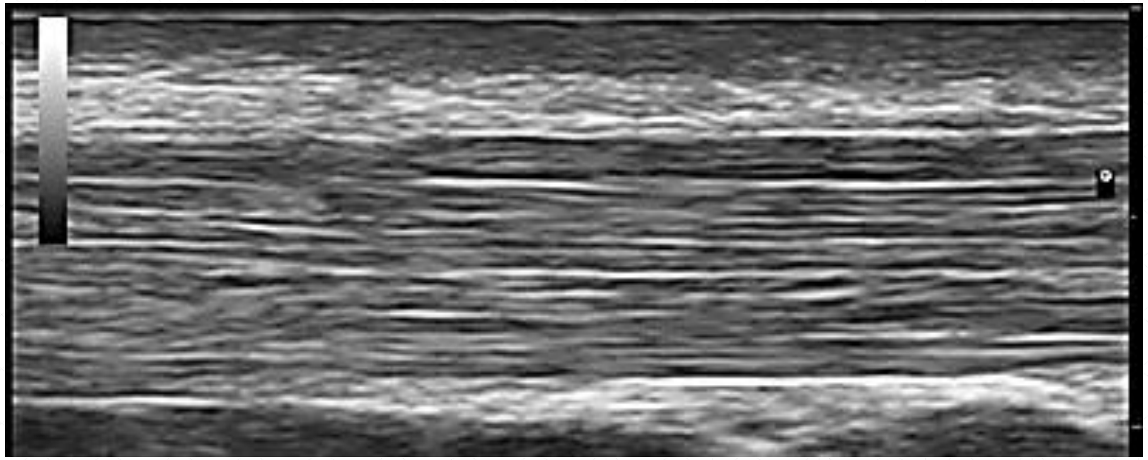
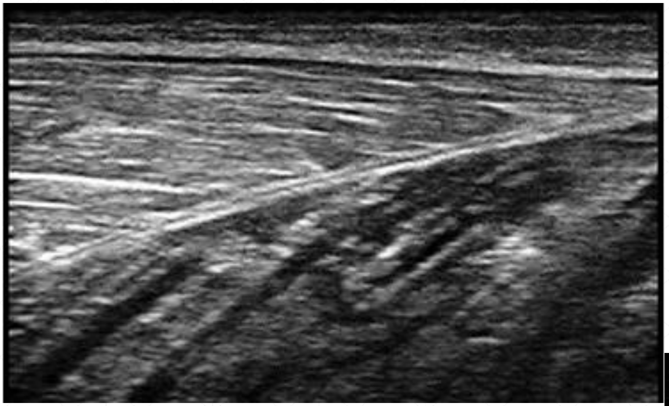
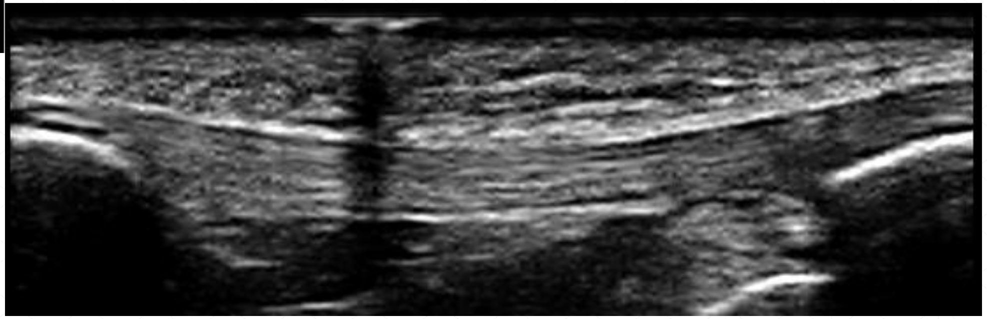
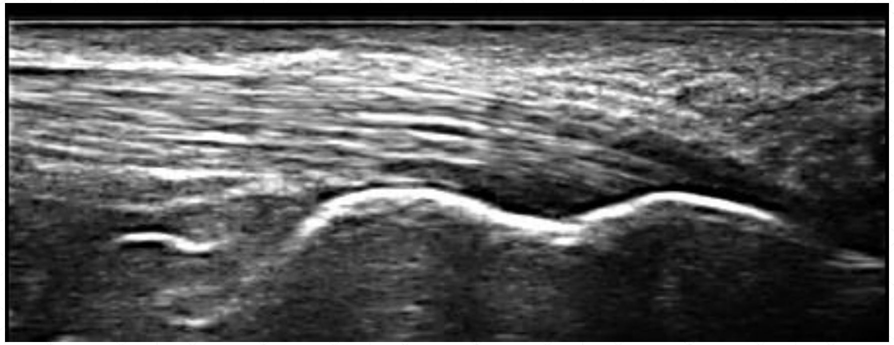


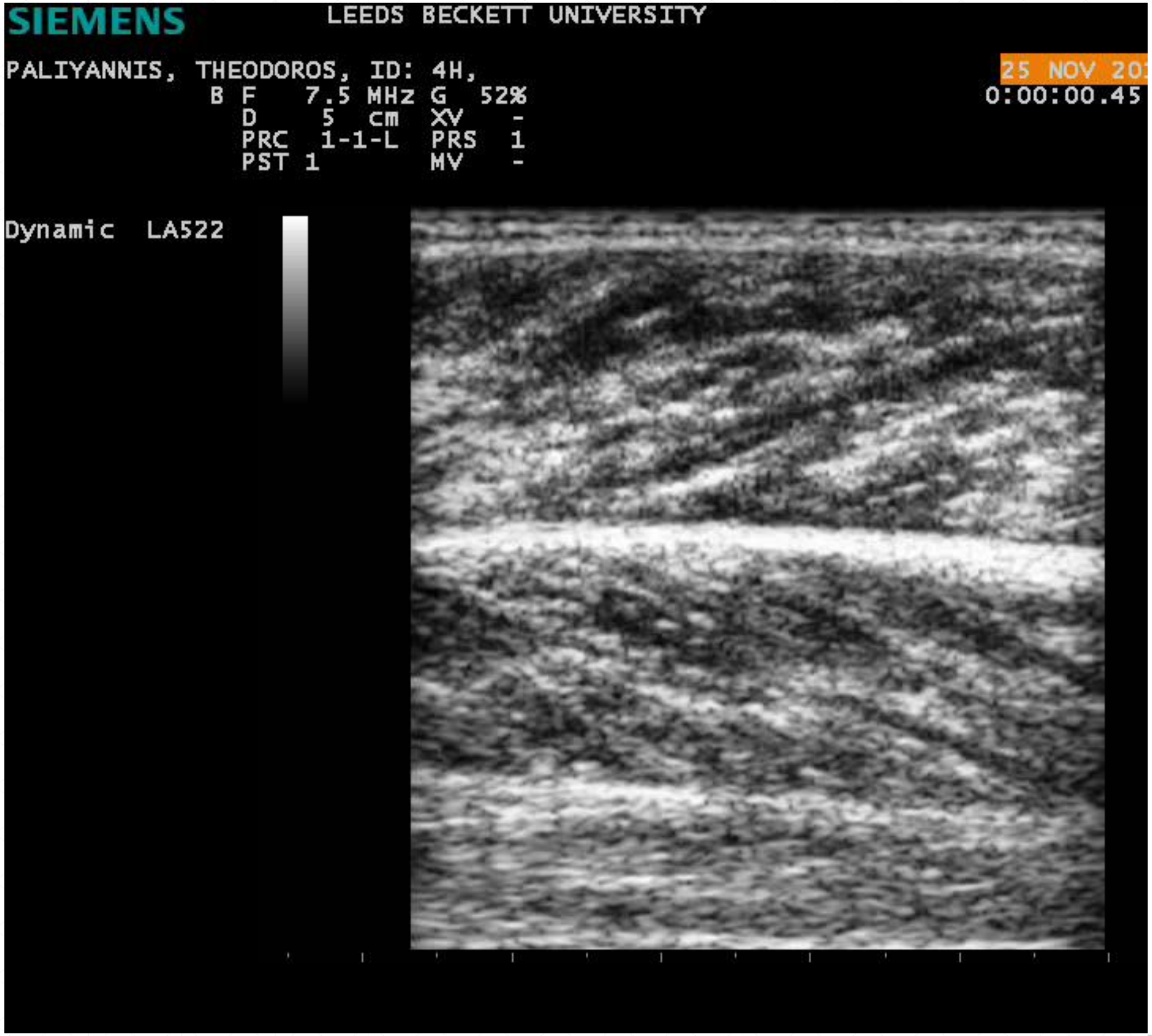

A
B









Received: 4 November 2019 | Revised: 16 February 2020 | Accepted: 13 March 2020

DOI: 10.1111/sms.13669

ORIGINAL ARTICLE

WILEY

Muscle-tendon morphology and function following long-term exposure to repeated and strenuous mechanical loading

Athanassios Bissas[1] | **Konstantinos Havenetidis**[2] | **Josh Walker**[1] | **Brian Hanley**[1] | **Gareth Nicholson**[1] | **Thomas Metaxas**[3] | **Kosmas Christoulas**[3] | **Neil J. Cronin**[4,5]

[1]Carnegie School of Sport, Leeds Beckett University, Leeds, UK

[2]Faculty of Physical & Cultural Education, Hellenic Army Academy, Vari, Greece

[3]Laboratory of Evaluation of Human Biological Performance, Department of Physical Education and Sport Science, Aristotle University of Thessaloniki, Thessaloniki, Greece

[4]Neuromuscular Research Center, Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, Finland

[5]Department for Health, University of Bath, Bath, UK

Correspondence
Athanassios Bissas, School of Sport & Exercise, University of Gloucestershire, Gloucester, UK.
Email: abissas@glos.ac.uk

Present address
Athanassios Bissas, School of Sport & Exercise, University of Gloucestershire, Gloucester, UK and Athletics Biomechanics, Leeds, UK

We mapped structural and functional characteristics of muscle-tendon units in a population exposed to very long-term routine overloading. Twenty-eight military academy cadets (age = 21.00 ± 1.1 years; height = 176.1 ± 4.8 cm; mass = 73.8 ± 7.0 kg) exposed for over 24 months to repetitive overloading were profiled via ultrasonography with a senior subgroup of them (n = 11; age = 21.4 ± 1.0 years; height = 176.5 ± 4.8 cm; mass = 71.4 ± 6.6 kg) also tested while walking and marching on a treadmill. A group of eleven ethnicity- and age-matched civilians (age = 21.6 ± 0.7 years; height = 176.8 ± 4.3 cm; mass = 74.6 ± 5.6 kg) was also profiled and tested. Cadets and civilians exhibited similar morphology (muscle and tendon thickness and cross-sectional area, pennation angle, fascicle length) in 26 out of 29 sites including the Achilles tendon. However, patellar tendon thickness along the entire tendon was greater ($P < .05$) by a mean of 16% for the senior cadets compared with civilians. Dynamically, cadets showed significantly smaller ranges of fascicle length change and lower shortening velocity in medial gastrocnemius during walking (44.0% and 47.6%, $P < .05$-.01) and marching (27.5% and 34.3%, $P < .05$-.01) than civilians. Furthermore, cadets showed lower normalized soleus electrical activity during walking (22.7%, $P < .05$) and marching (27.0%, $P < .05$). Therefore, 24-36 months of continuous overloading, primarily occurring under aerobic conditions, leads to more efficient neural and mechanical behavior in the triceps surae complex, without any major macroscopic alterations in key anatomical structures.

RUNNER'S WORLD SHOES & GEAR TRAINING HEALT

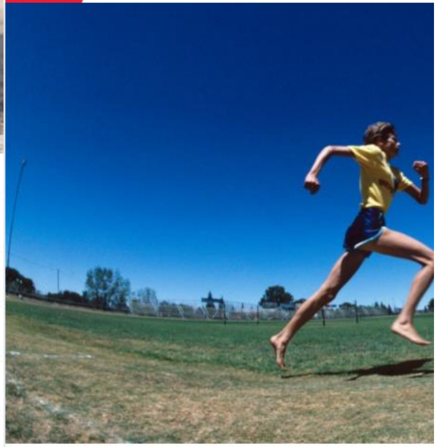
Gear-obsessed editors choose every product we re

Wear Minimal Shoes to Monitor Your Total Mile

A new study finds that minimalist footwear can st carefully.

BY HAILEY MIDDLEBROOK AUG 29, 2018

AW HOME AW CLUBHOUSE



Barefoot runnin cons

Posted by Athletics Weekly | Mar 28, 2014 |

John Shepherd considers whether barefoot is the way to go

Vol 463 | 28 January 2010 | doi:10.1038/nature08723 nature

LETTERS

Foot strike patterns and collision forces in habitually barefoot versus shod runners

Daniel E. Lieberman[1], Madhusudhan Venkadesan[1,2]*, William A. Werbel[3]*, Adam I. Daoud[1]*, Susan D'Andrea[4], Irene S. Davis[5], Robert Ojiambo Mang'Eni[6,7] & Yannis Pitsiladis[6,7]

Humans have engaged in endurance running for millions of years[1], but the modern running shoe was not invented until the 1970s. For most of human evolutionary history, runners were either barefoot or wore minimal footwear such as sandals or moccasins with smaller heels and little cushioning relative to modern running shoes. We wondered how runners coped with the impact caused by the foot colliding with the ground before the invention of the modern shoe. Here we show that habitually barefoot endurance runners often land on the fore-foot (fore-foot strike) before bringing down the heel, but they sometimes land with a flat foot (mid-foot strike) or, less often, on the heel (rear-foot strike). In contrast, habitually shod runners mostly rear-foot strike, facilitated by the elevated and cushioned heel of the modern running shoe. Kinematic and kinetic analyses show that even on hard surfaces, barefoot runners who fore-foot strike generate smaller collision forces than shod rear-foot strikers. This difference results primarily from a more plantarflexed foot at landing and more ankle compliance during impact, decreasing the effective mass of the body that collides with the ground. Fore-foot- and mid-foot-strike gaits were probably more common when humans ran barefoot or in minimal shoes, and may protect the feet and lower limbs from some of the impact-related injuries now experienced by a high percentage of runners.

Running can be most injurious at the moment the foot collides with the ground. This collision can occur in three ways: a rear-foot

transient, M_{body} is the body mass, v_{com} is the vertical speed of the centre of mass, v_{foot} is the vertical speed of the foot just before impact and g is the acceleration due to gravity at the Earth's surface.

Impact transients associated with RFS running are sudden forces with high rates and magnitudes of loading that travel rapidly up the body and thus may contribute to the high incidence of running-related injuries, especially tibial stress fractures and plantar fasciitis[6–8]. Modern running shoes are designed to make RFS running comfortable and less injurious by using elastic materials in a large heel to absorb some of the transient force and spread the impulse over more time[9] (Fig. 1b). The human heel pad also cushions impact transients, but to a lesser extent[5,10,11], raising the question of how runners struck the ground before the invention of modern running shoes. Previous studies have found that habitually shod runners tend to adopt a flatter foot placement when barefoot than when shod, thus reducing stresses on the foot[12–15], but there have been no detailed studies of foot kinematics and impact transients in long-term habitually barefoot runners.

We compared foot strike kinematics on tracks at preferred endurance running speeds (4–6 m s^{-1}) among five groups controlled for age and habitual footwear usage (Methods and Supplementary Data 2). Adults were sampled from three groups of individuals who run a minimum of 20 km per week: (1) habitually shod athletes from the USA; (2) athletes from the Rift Valley Province of Kenya (famed for endurance running[16])

Search jobs Sign in Search UK edition The Guardian News website of the year

Lifestyle More

Home & garden Money Cars

st for most

lots of runners, but ody? One cushioned-

Good for the

t that does not limit sensation

26, 2019

Credit: Getty Images

Evolutionary biologist Daniel E. Lieberman caused an international stir

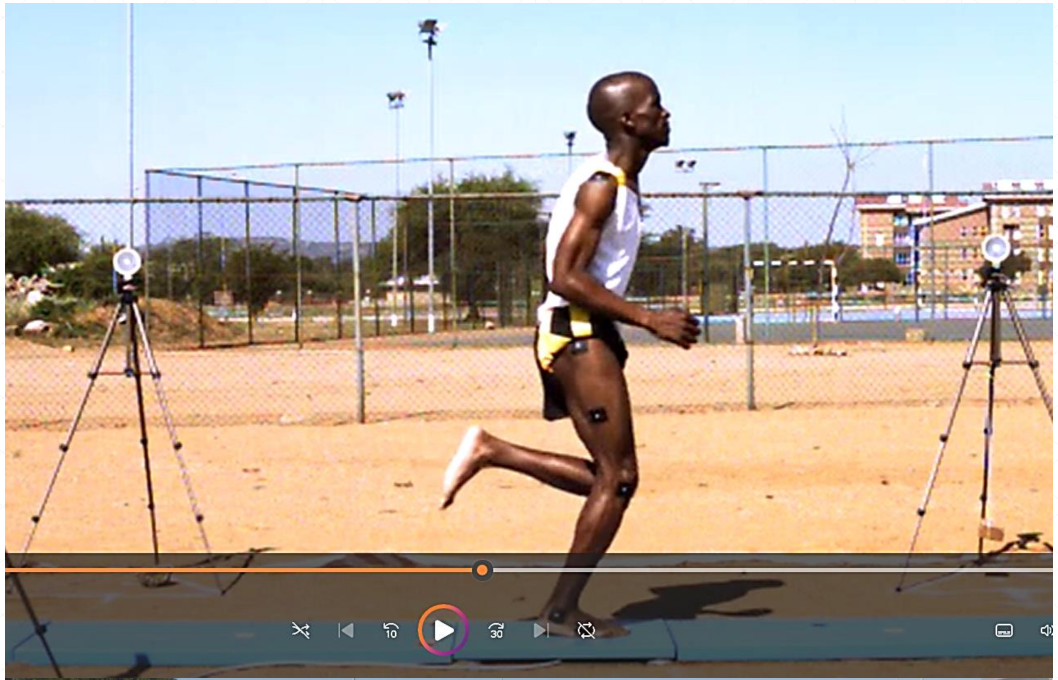
READ THIS NEXT

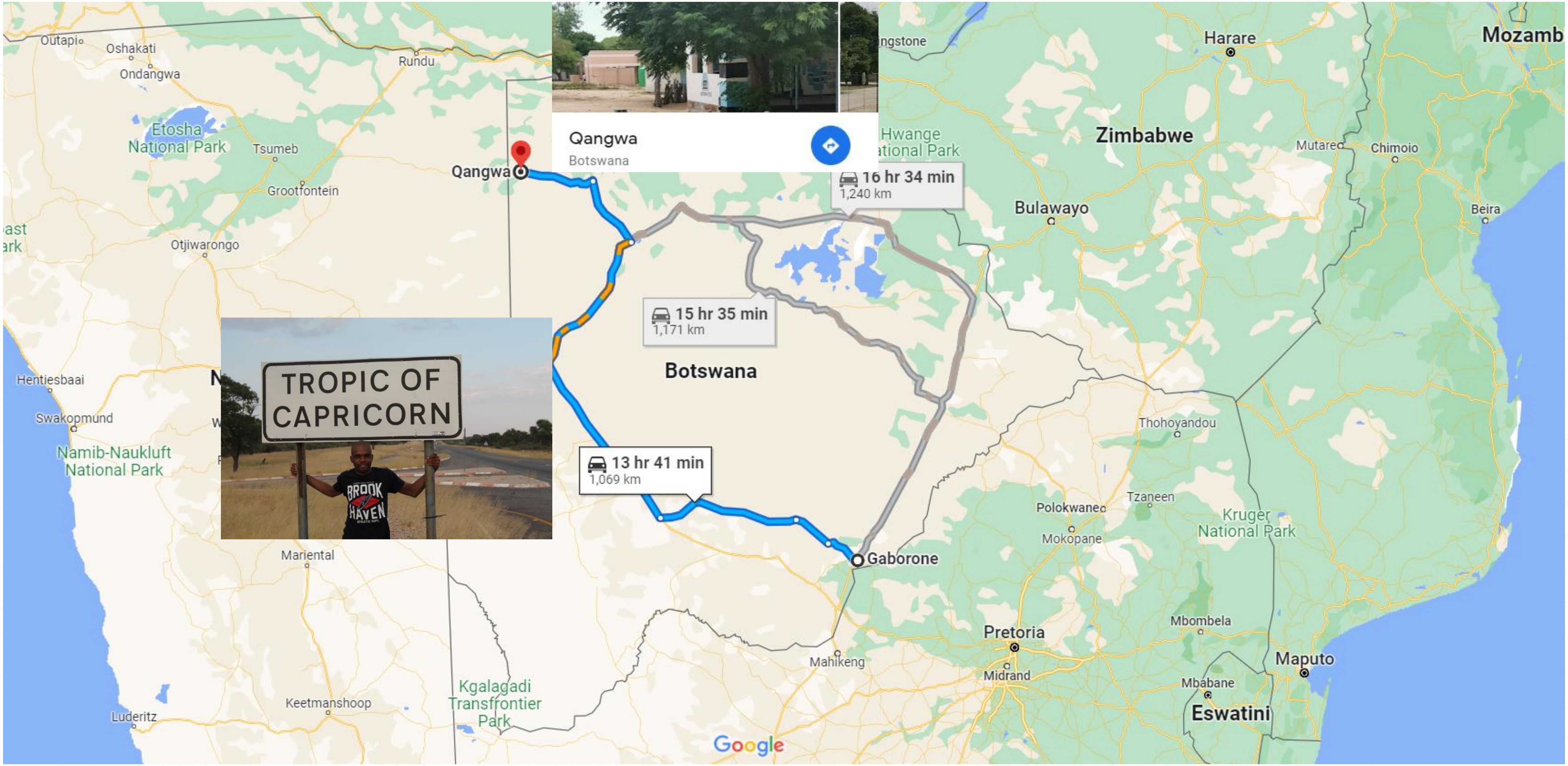
THE BODY
The Science of Barefoot R Personal Journey
Aylin Woodward

WELLNESS
Going Barefoot and 8 Otl Improve Balance
Get-Fit Guy Brock Armstrong

Some Barefoot Runners Back on Heels
Katherine Harmon


Angola
Zambia
Malawi
Comoros
Mayotte
Lusaka
Harare
Mozambique
Zimbabwe
Antananarivo
Namibia
Botswana
Madagascar
Gaborone
Pretoria
Maputo
Johannesburg
Eswatini
Bloemfontein
Lesotho
Durban
South Africa
Cape Town
Gqeberha
Google




Qangwa
Botswana
16 hr 34 min
1,240 km
15 hr 35 min
1,171 km
13 hr 41 min
1,069 km
Botswana
Zimbabwe
Mozamb
Harare
Bulawayo
Hwange
ational Park
ngstone
Mutare
Chimoio
Beira
Outapi
Oshakati
Ondangwa
Rundu
Etosha
National Park
Tsumeb
Grootfontein
Otjiwarongo
Qangwa
Hentiesbaai
Swakopmund
Namib-Naukluft
National Park
Mariental
Keetmanshoop
Luderitz
Kgalagadi
Transfrontier
Park
Gaborone
Mahikeng
Thohoyandou
Tzaneen
Polokwane
Mokopane
Kruger
National Park
Mbombela
Pretoria
Midrand
Maputo
Mbabane
Eswatini
Google
TROPIC OF
CAPRICORN
BROOK
HAVEN


THIS IS MY PHOTO BOMB T-SHIRT

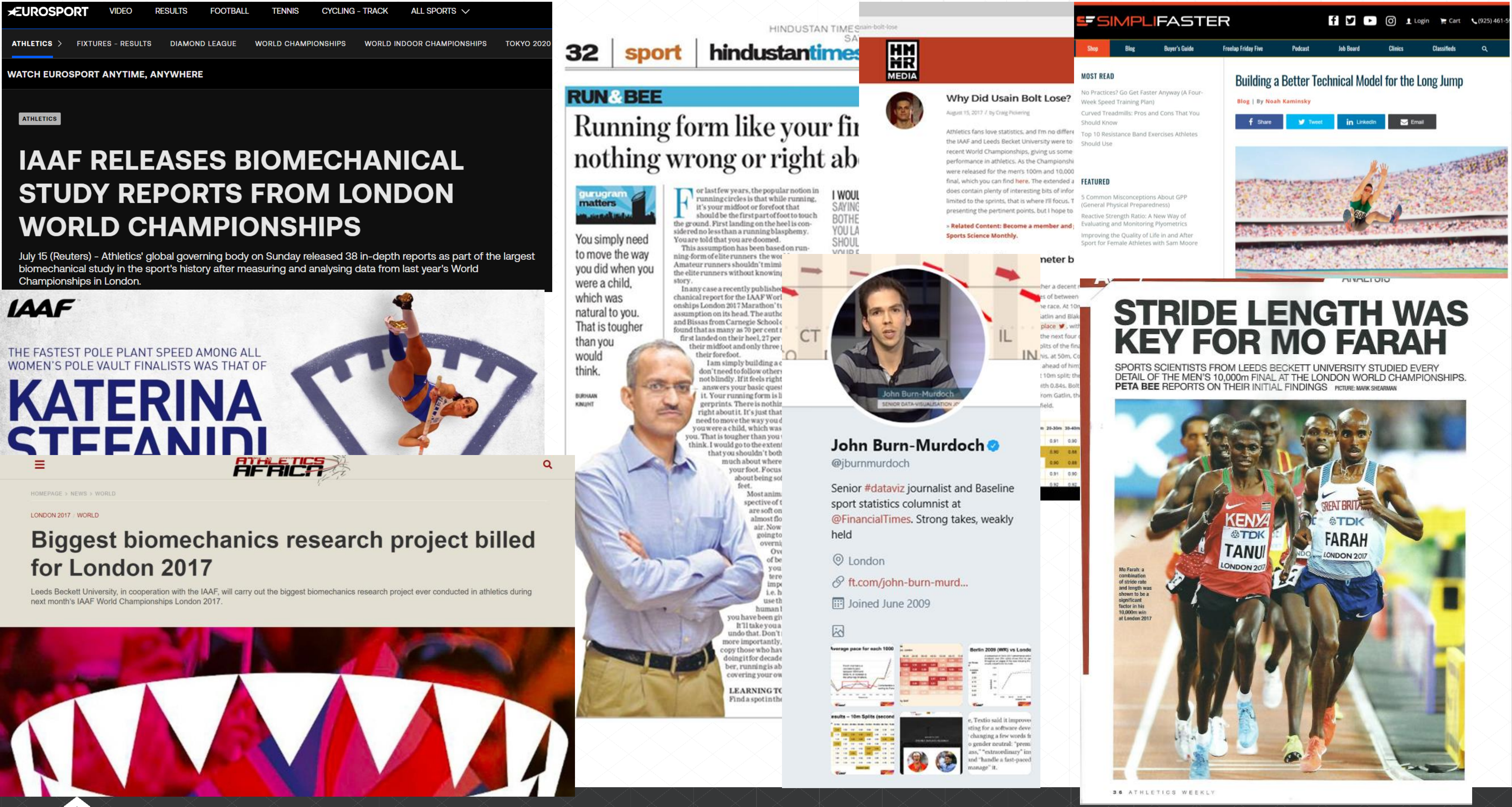

B262BCF


LEFT HEEL
WOMEN
RIGHT TOE LENGTH

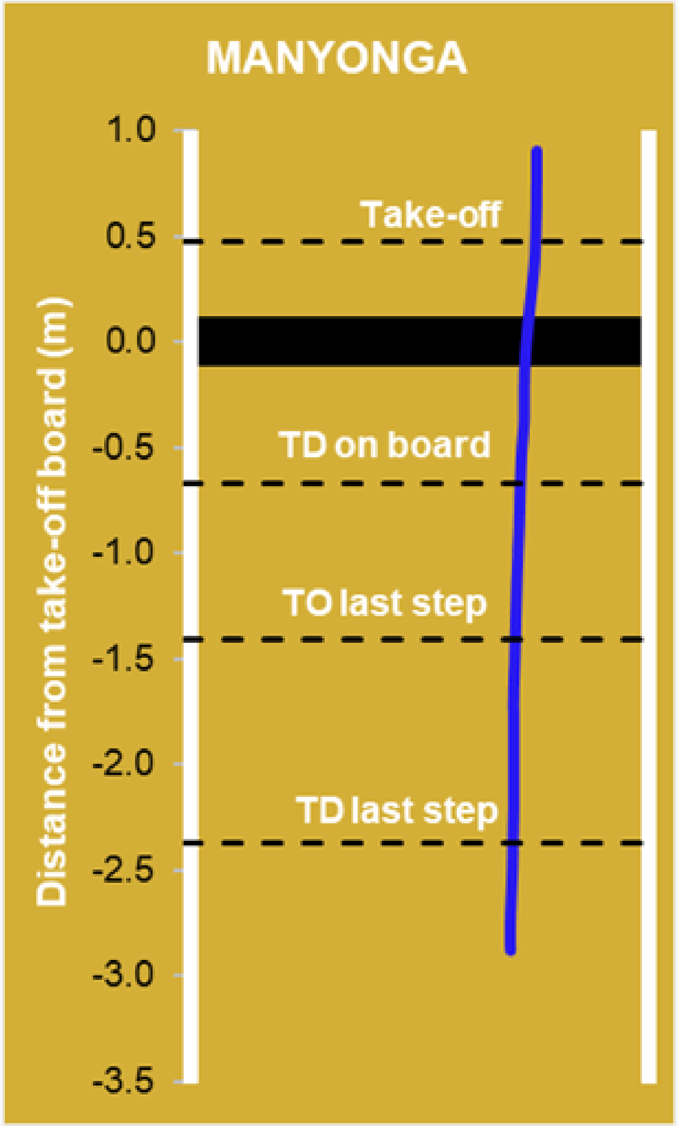
IAAF

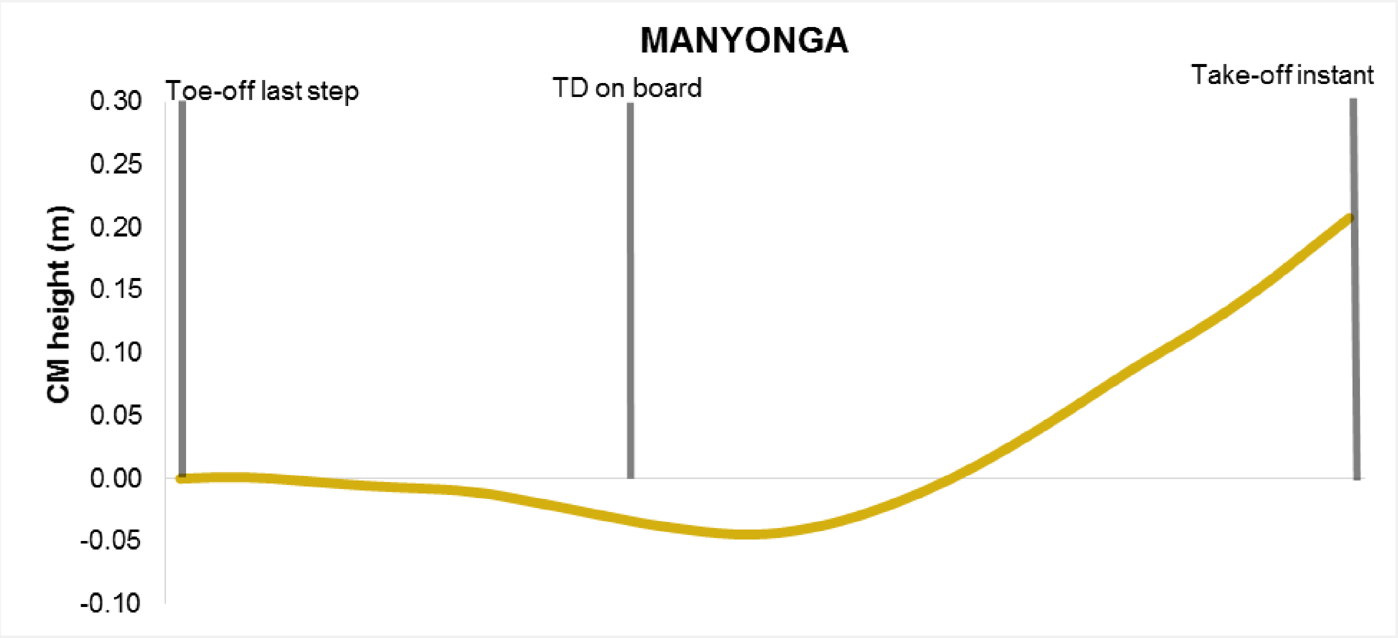
BIOMECHANICS RESEARCH PROJECT

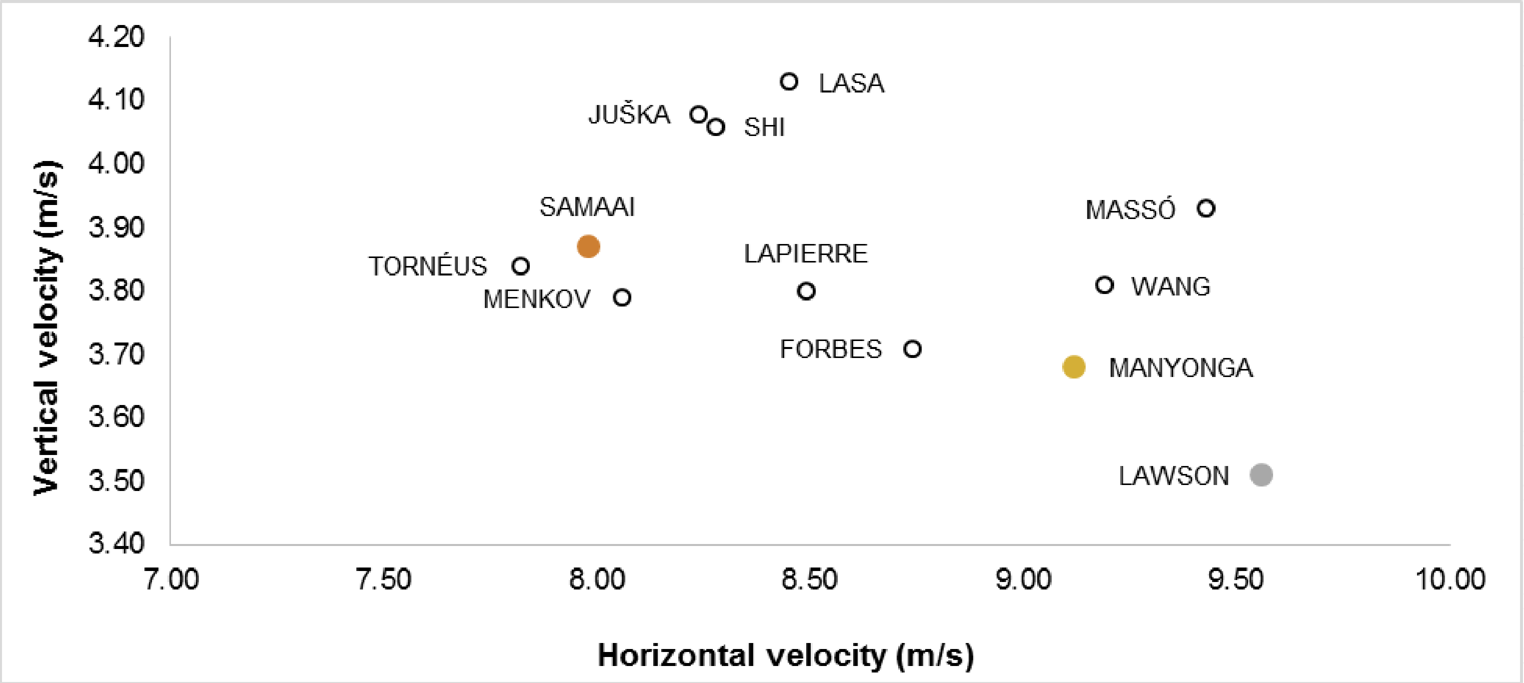
Development department


EUROSPORT
VIDEO
RESULTS
FOOTBALL
TENNIS
CYCLING - TRACK
ALL SPORTS
ATHLETICS
FIXTURES - RESULTS
DIAMOND LEAGUE
WORLD CHAMPIONSHIPS
WORLD INDOOR CHAMPIONSHIPS
TOKYO 2020
WATCH EUROSPORT ANYTIME, ANYWHERE
ATHLETICS
IAAF RELEASES BIOMECHANICAL STUDY REPORTS FROM LONDON WORLD CHAMPIONSHIPS
July 15 (Reuters) - Athletics' global governing body on Sunday released 38 in-depth reports as part of the largest biomechanical study in the sport's history after measuring and analysing data from last year's World Championships in London.
IAAF
THE FASTEST POLE PLANT SPEED AMONG ALL WOMEN'S POLE VAULT FINALISTS WAS THAT OF
KATERINA STEFANIDI
ATHLETICS AFRICA
HOMEPAGE › NEWS › WORLD
LONDON 2017 / WORLD
Biggest biomechanics research project billed for London 2017
Leeds Beckett University, in cooperation with the IAAF, will carry out the biggest biomechanics research project ever conducted in athletics during next month's IAAF World Championships London 2017.
32
sport
hindustantimes
RUN & BEE
Running form like your fi
nothing wrong or right ab
gurugram matters
You simply need to move the way you did when you were a child, which was natural to you. That is tougher than you would think.
HM MEDIA
Why Did Usain Bolt Lose?
John Burn-Murdoch
@jburnmurdoch
Senior #dataviz journalist and Baseline sport statistics columnist at @FinancialTimes. Strong takes, weakly held
London
ft.com/john-burn-murd...
Joined June 2009
SIMPLIFASTER
MOST READ
No Practices? Go Get Faster Anyway (A Four-Week Speed Training Plan)
Curved Treadmills: Pros and Cons That You Should Know
Top 10 Resistance Band Exercises Athletes Should Use
FEATURED
5 Common Misconceptions About GPP (General Physical Preparedness)
Reactive Strength Ratio: A New Way of Evaluating and Monitoring Plyometrics
Improving the Quality of Life in and After Sport for Female Athletes with Sam Moore
Building a Better Technical Model for the Long Jump
Blog | By Noah Kaminsky
STRIDE LENGTH WAS KEY FOR MO FARAH
SPORTS SCIENTISTS FROM LEEDS BECKETT UNIVERSITY STUDIED EVERY DETAIL OF THE MEN'S 10,000m FINAL AT THE LONDON WORLD CHAMPIONSHIPS. PETA BEE REPORTS ON THEIR INITIAL FINDINGS
PICTURE: MARK SHEARMAN
Mo Farah: a combination of stride rate and length was shown to be a significant factor in his 10,000m win at London 2017
36 ATHLETICS WEEKLY

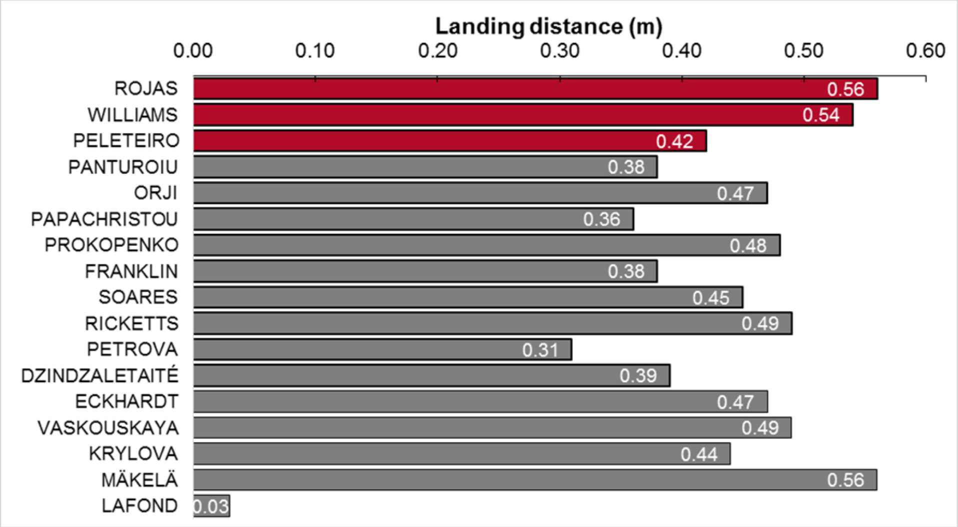
LONG JUMP …

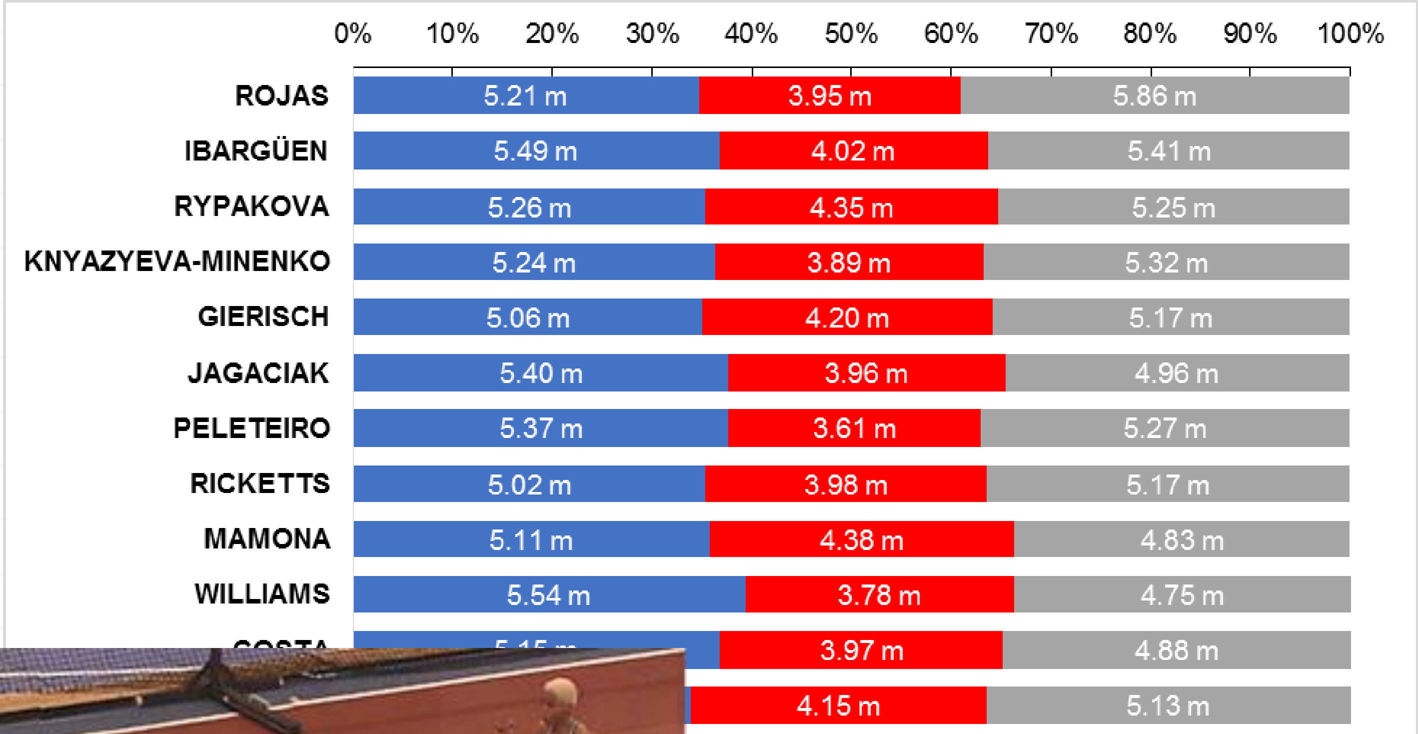

MANYONGA
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
Distance from take-off board (m)
Take-off
TD on board
TO last step
TD last step

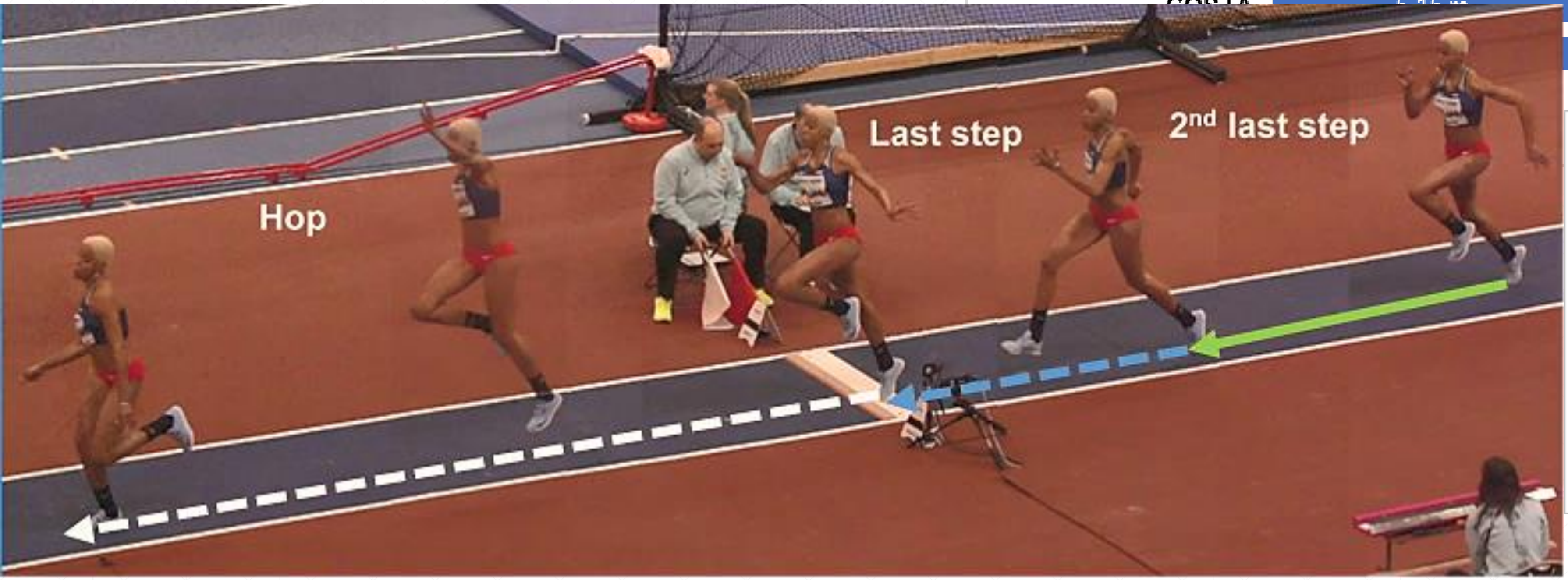

MANYONGA
Toe-off last step
TD on board
Take-off instant
CM height (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10

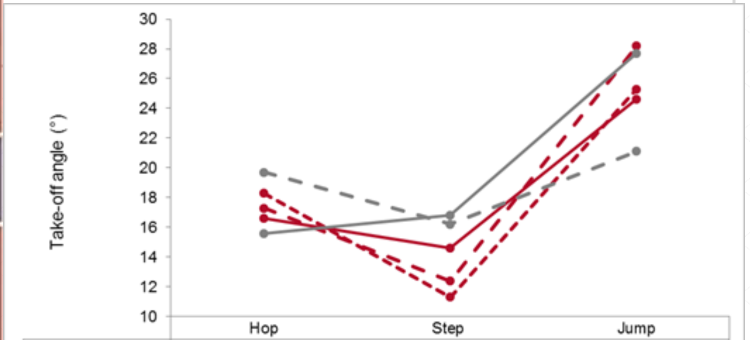

Vertical velocity (m/s)
4.20
4.10
4.00
3.90
3.80
3.70
3.60
3.50
3.40
LASA
JUŠKA
SHI
SAMAAI
MASSÓ
TORNÉUS
LAPIERRE
MENKOV
WANG
FORBES
MANYONGA
LAWSON
7.00
7.50
8.00
8.50
9.00
9.50
10.00
Horizontal velocity (m/s)

TRIPLE JUMP …



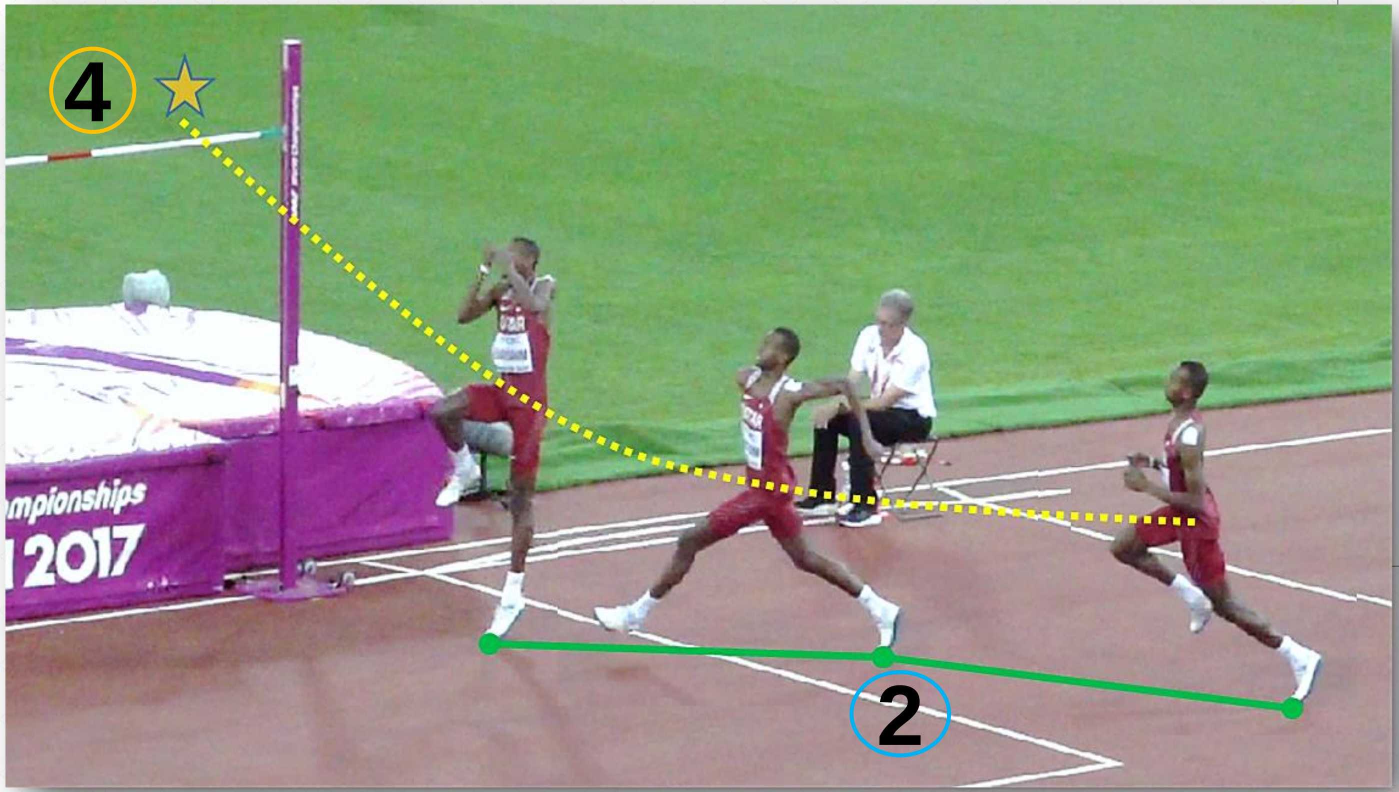


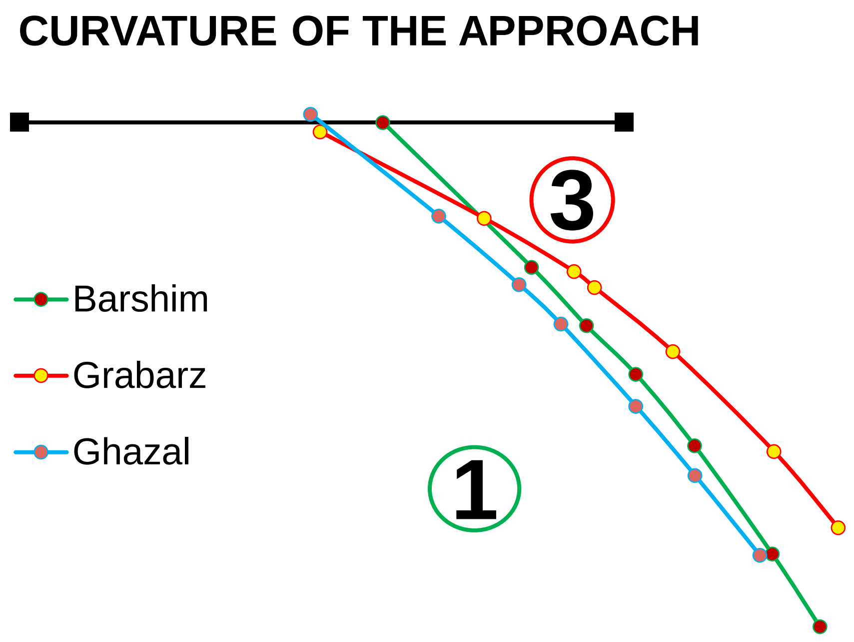




	Hop	Step	Jump
ROJAS	16.6	14.6	24.6
WILLIAMS	17.3	12.4	28.2
PELETEIRO	18.3	11.3	25.3
PANTUROIU	15.6	16.8	27.7
ORJI	19.7	16.2	21.1

HIGH JUMP …





1 GENTLY CURVED APPROACH

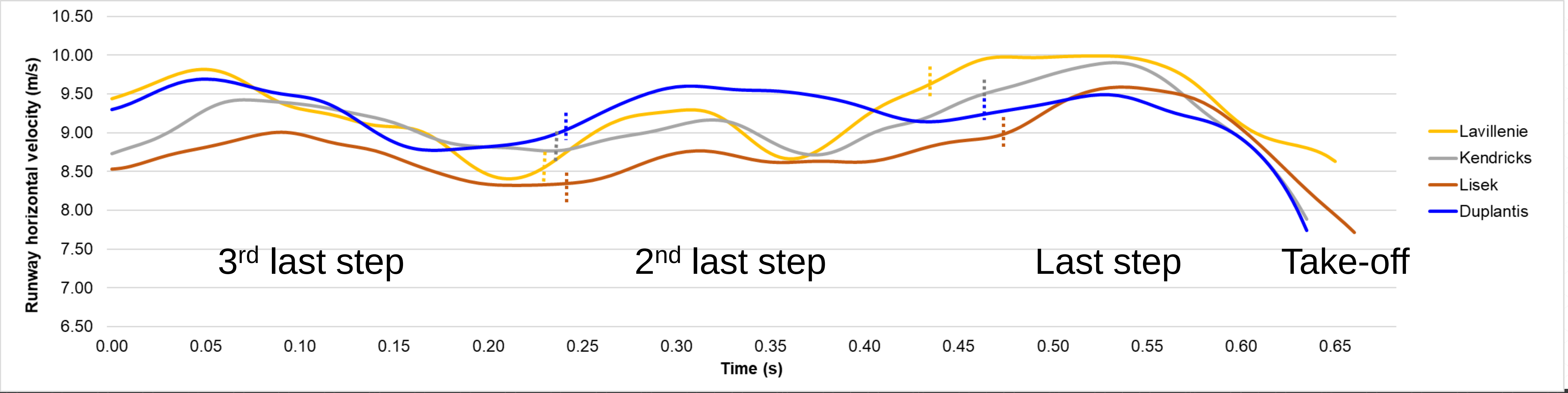
2 SHORT CONTACT TIMES

3 LARGETAKE-OFF DISTANCE

4 BAR CLEARANCE

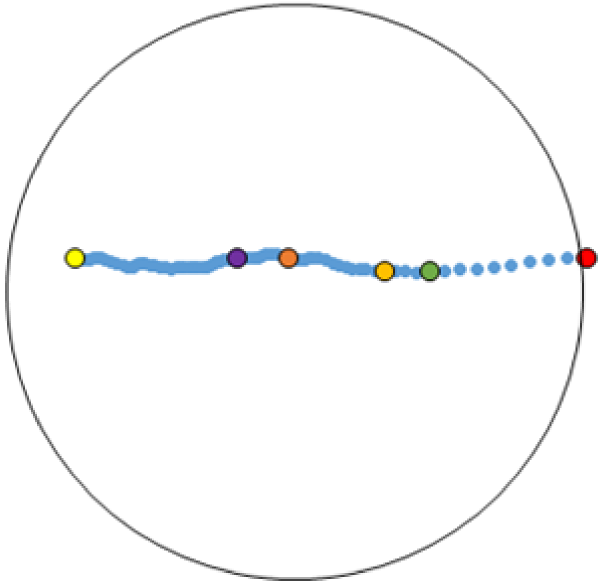
POLE VAULT …

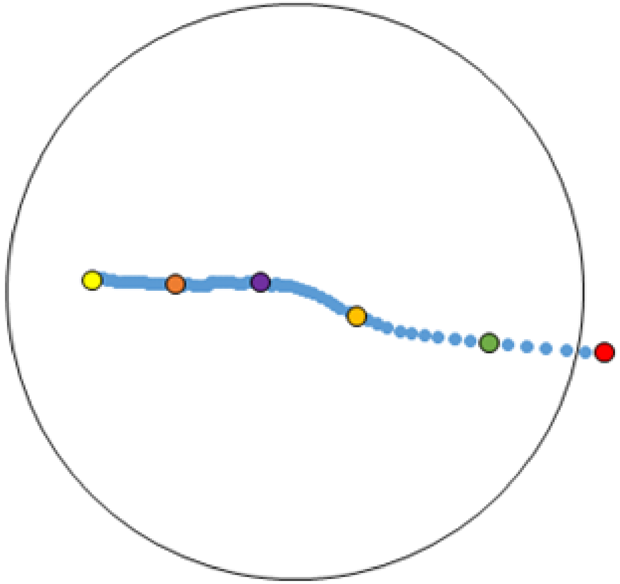
+.04 m
–.14 m
–.25 m
–.22 m

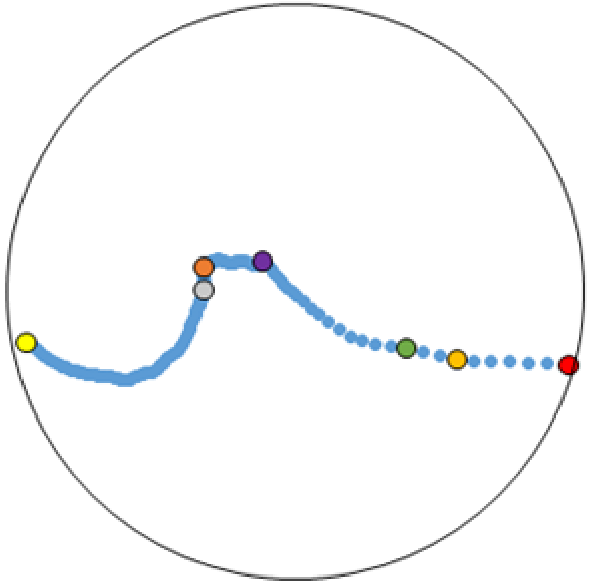


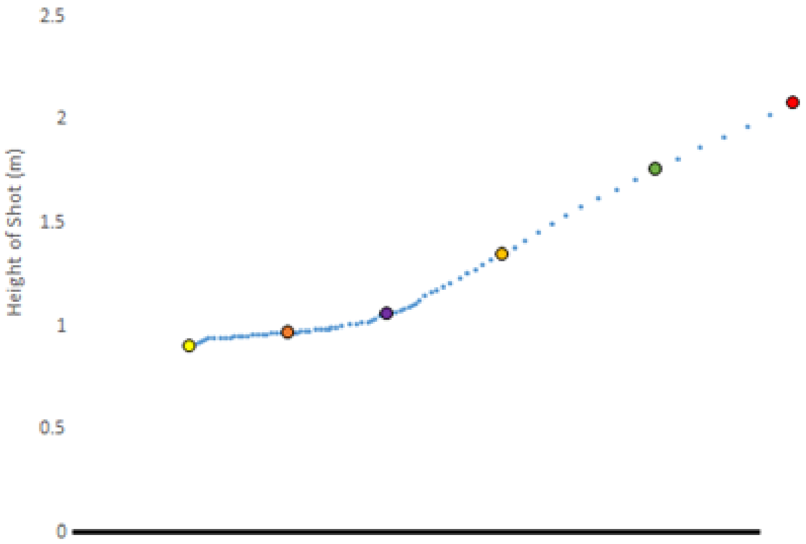
Runway horizontal velocity (m/s)
10.50
10.00
9.50
9.00
8.50
8.00
7.50
7.00
6.50
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
Time (s)
3rd last step
2nd last step
Last step
Take-off
Lavillenie
Kendricks
Lisek
Duplantis

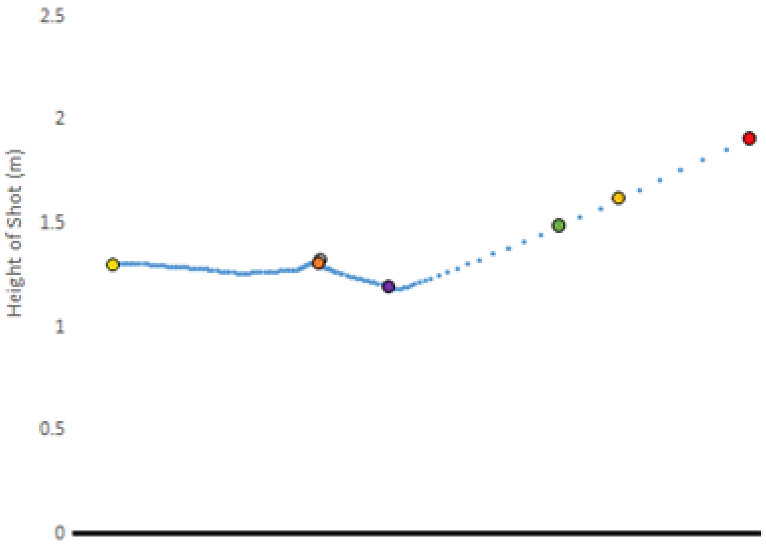
SHOT PUT …

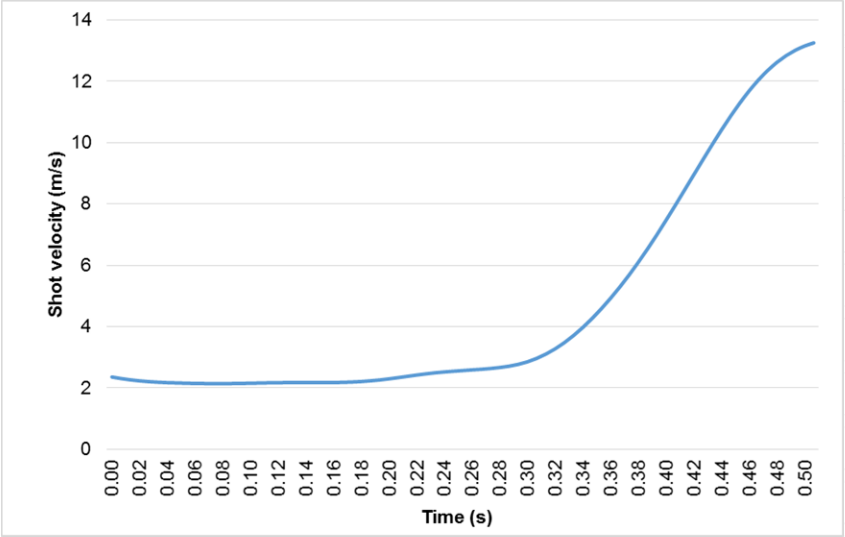




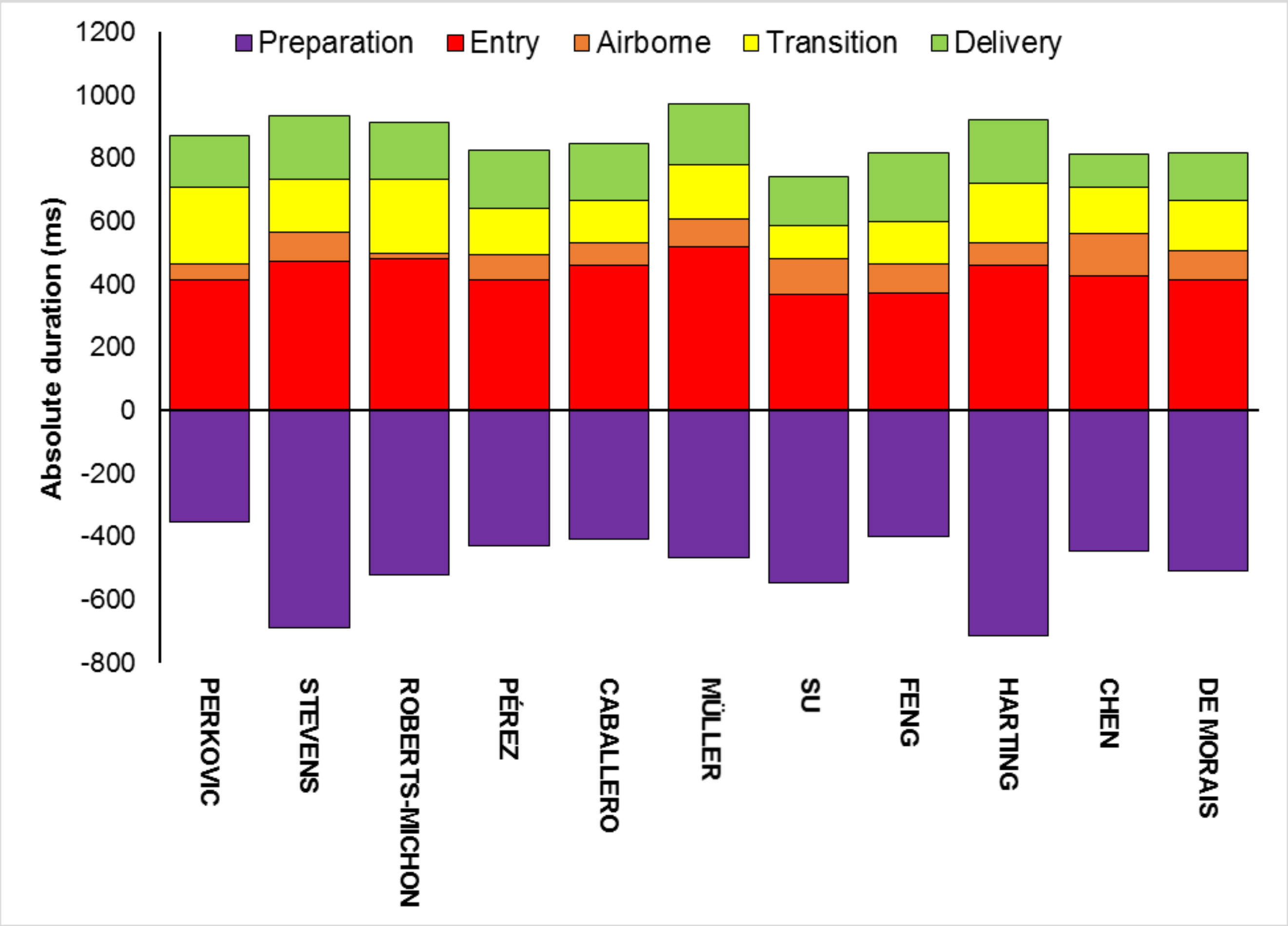



2.5
2
1.5
1
0.5
0
Height of Shot (m)

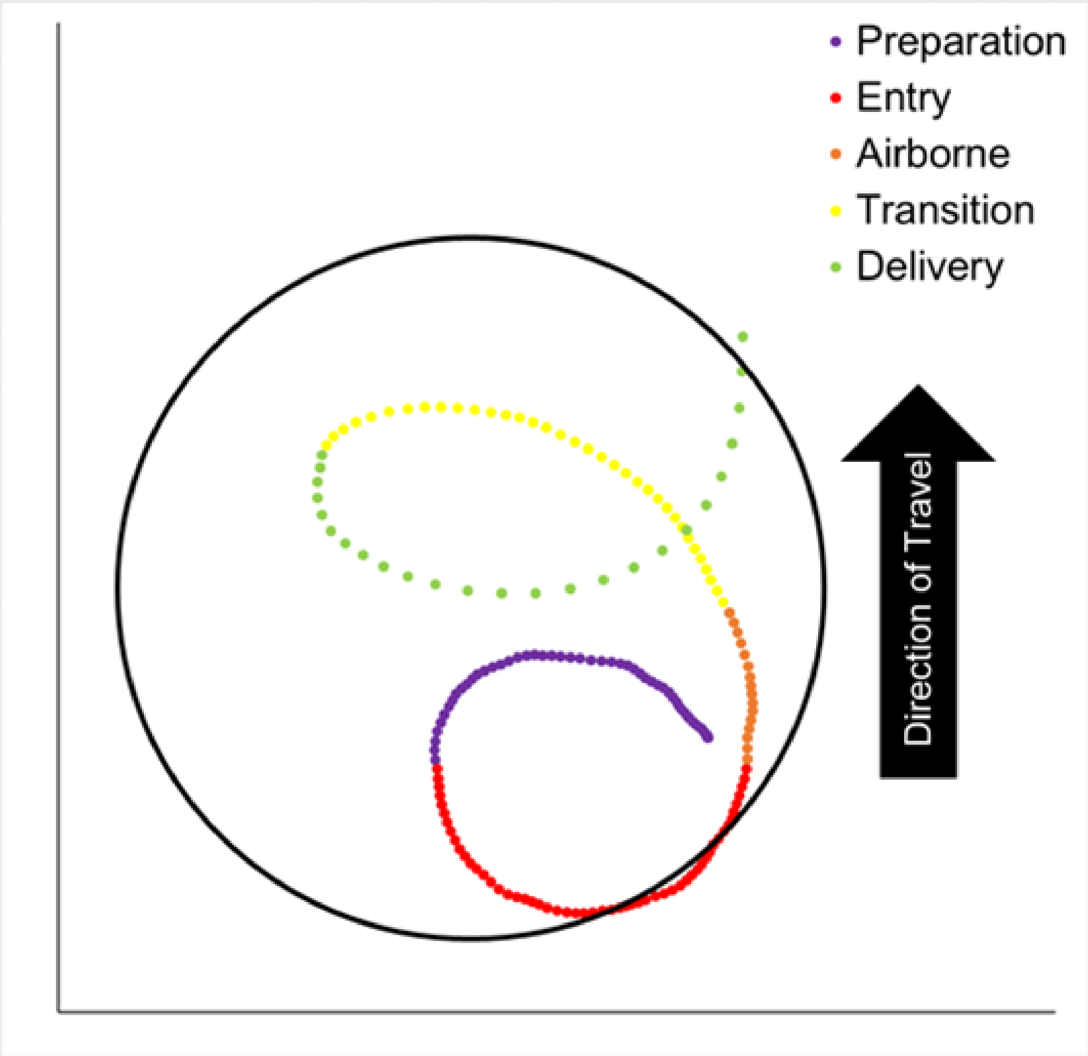

2.5
2
1.5
1
0.5
0
Height of Shot (m)


14
12
10
8
6
4
2
0
Shot velocity (m/s)
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20 0.22 0.24 0.26 0.28 0.30 0.32 0.34 0.36 0.38 0.40 0.42 0.44 0.46 0.48 0.50
Time (s)

DISCUS …

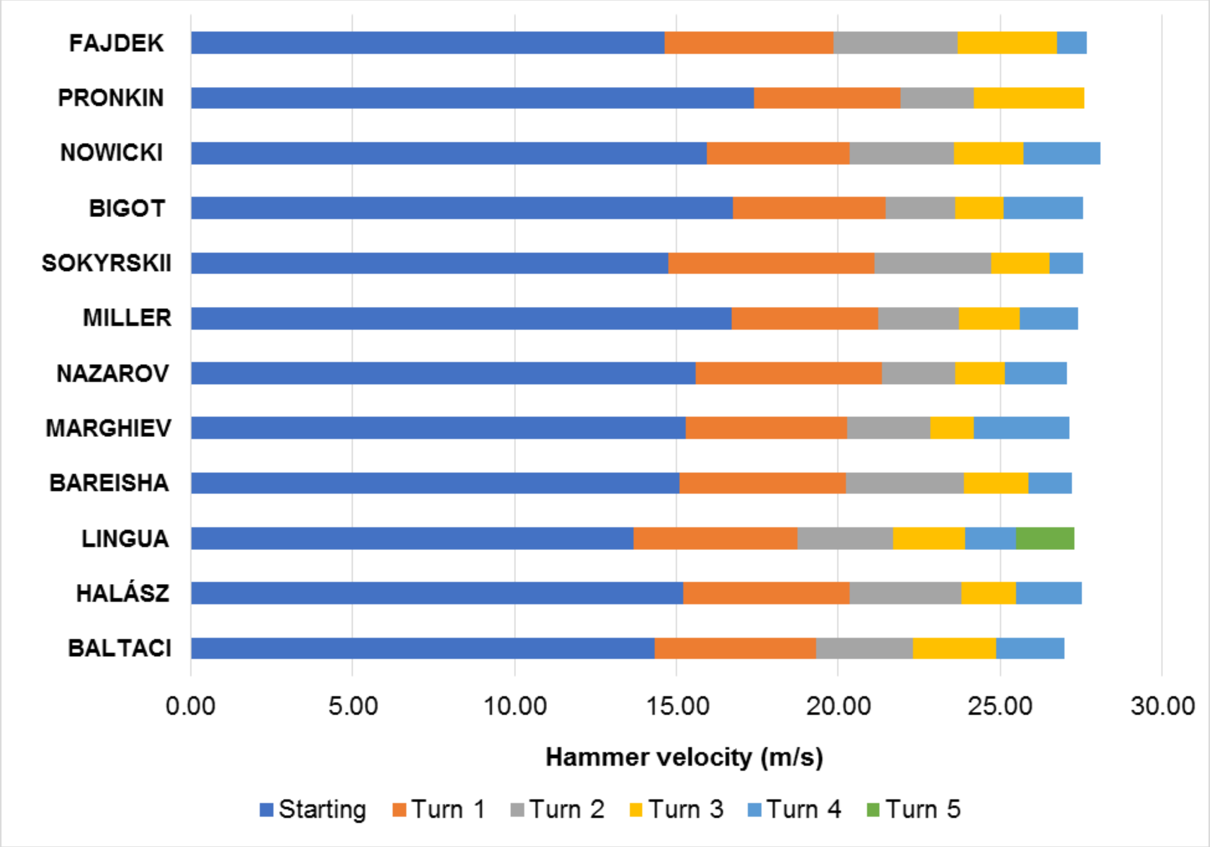


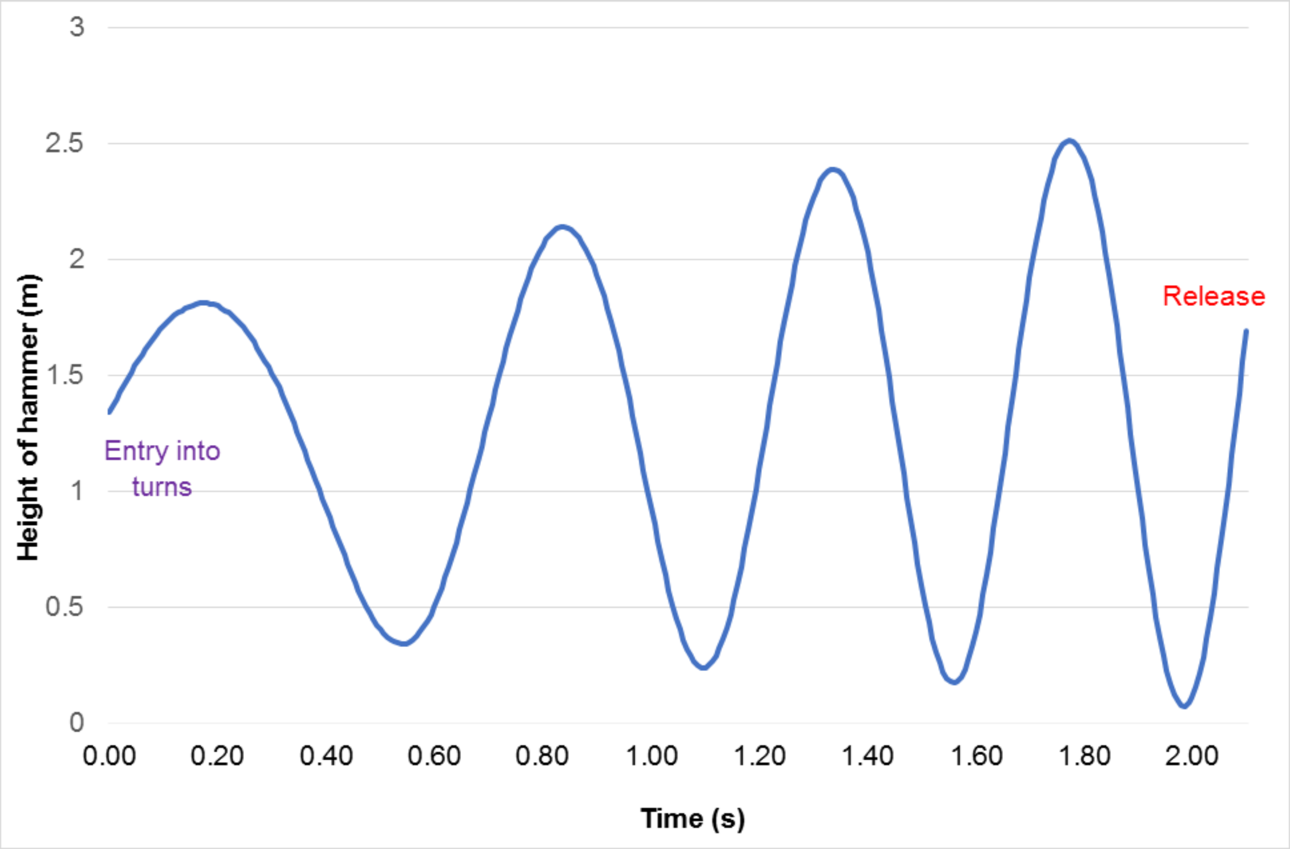
Preparation
Entry
Airborne
Transition
Delivery
Absolute duration (ms)
1200
1000
800
600
400
200
0
-200
-400
-600
-800
PERKOVIC
STEVENS
ROBERTS-MICHON
PÉREZ
CABALLERO
MÜLLER
SU
FENG
HARTING
CHEN
DE MORAIS



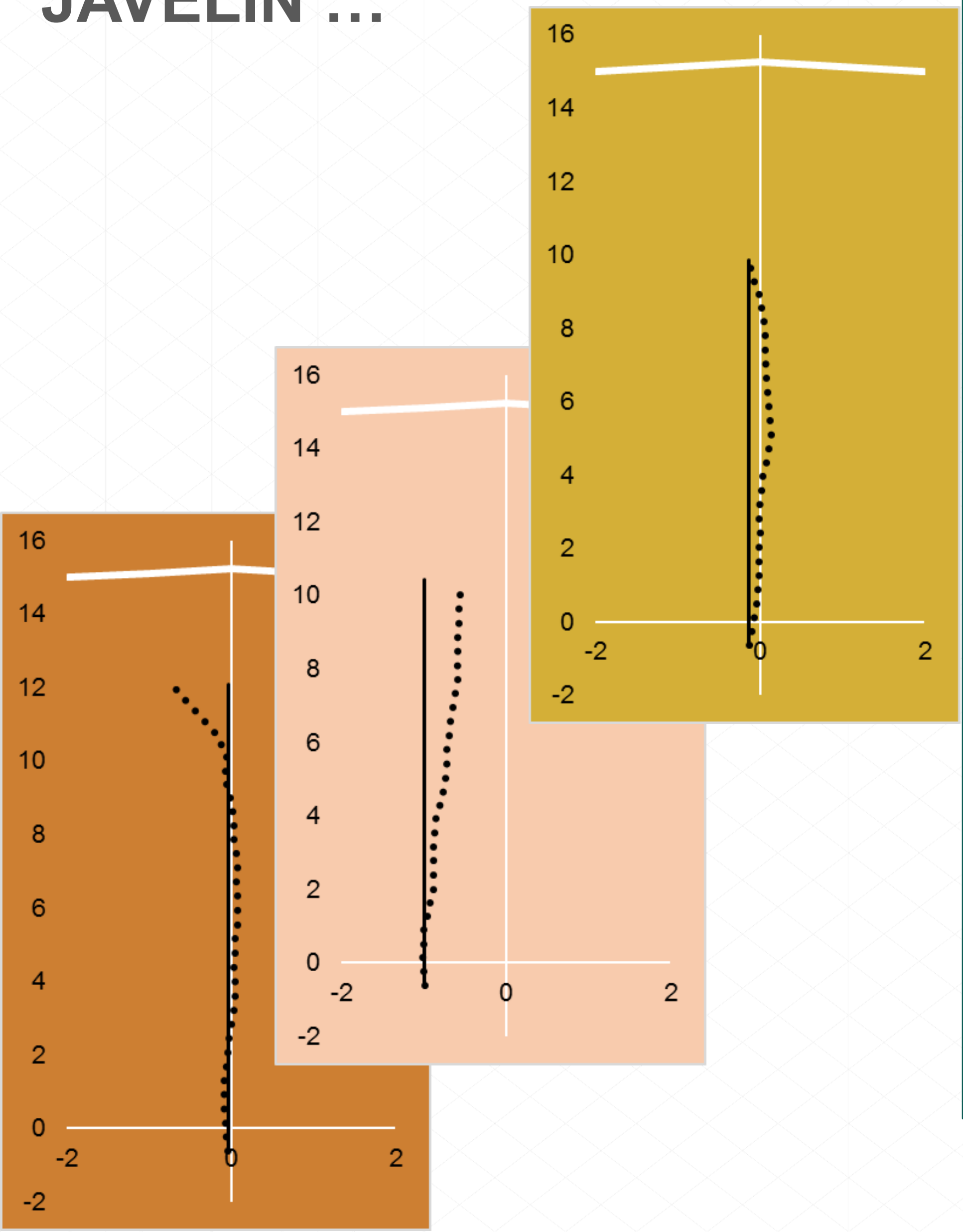
Preparation
Entry
Airborne
Transition
Delivery
Direction of Travel

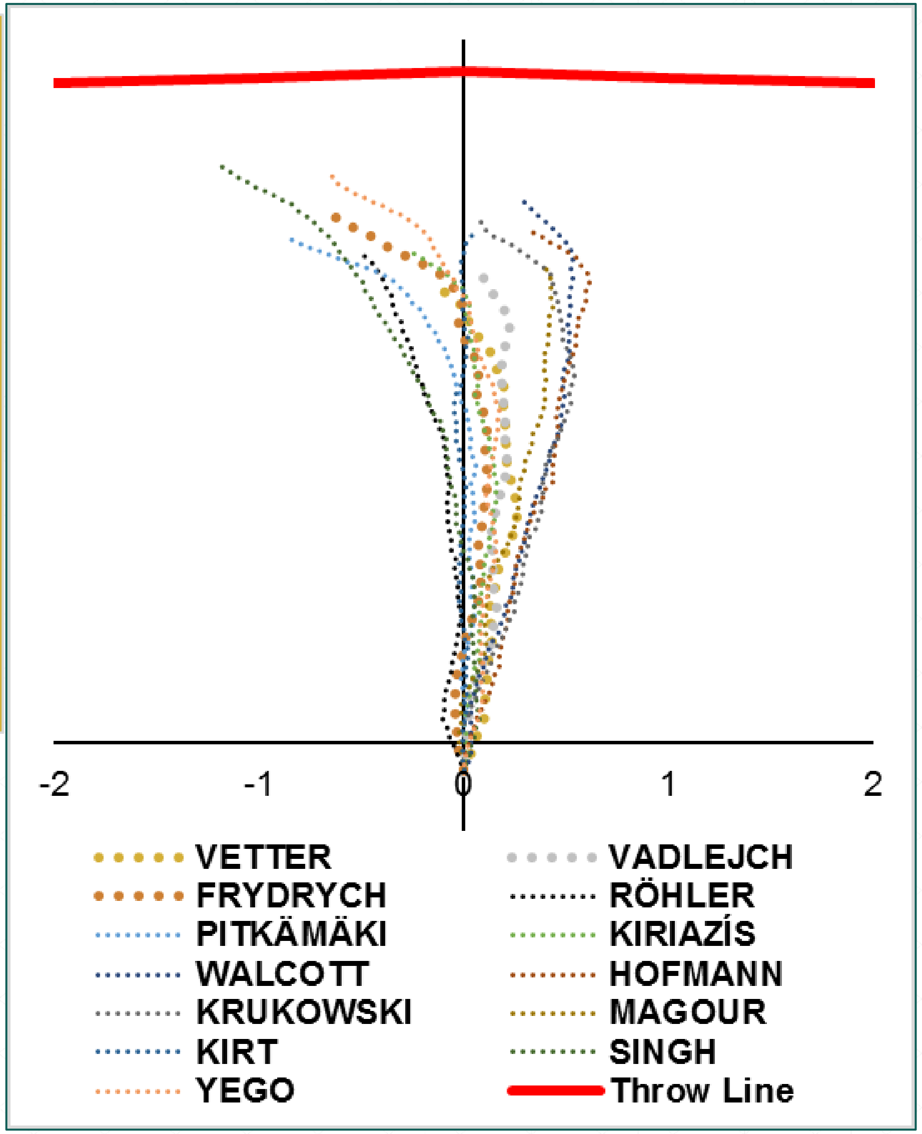
HAMMER THROW …

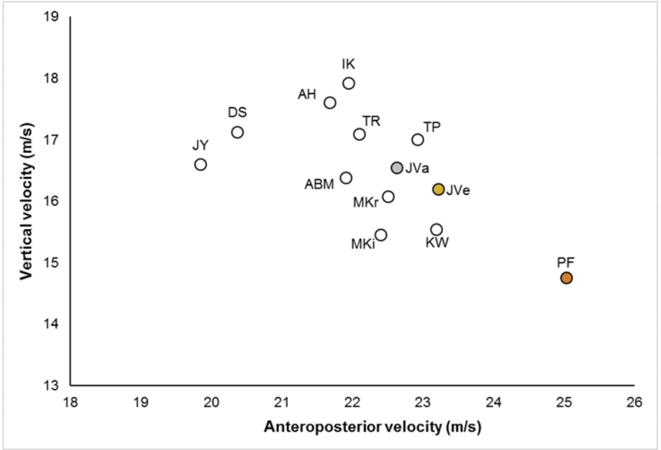


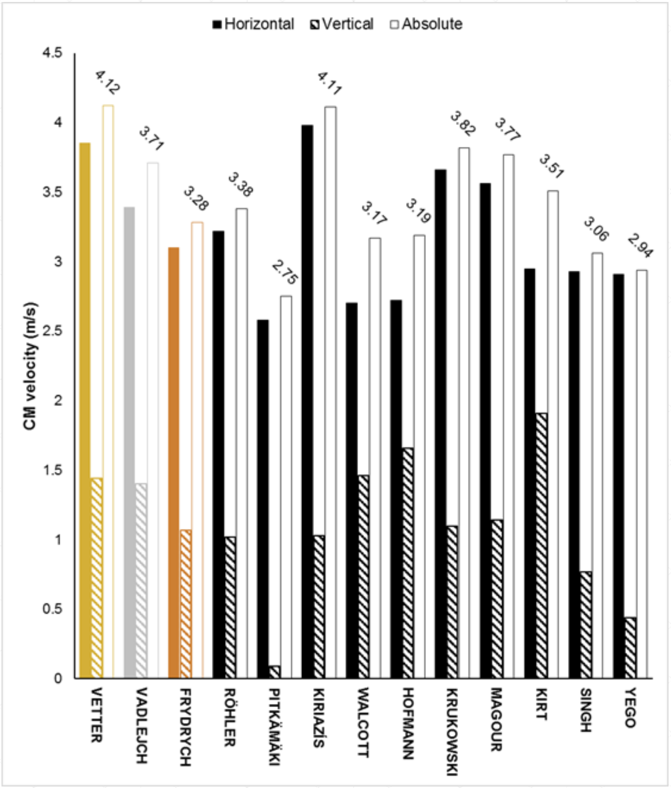


JAVELIN …


16
14
12
10
8
6
4
2
0
-2
-2
0
2

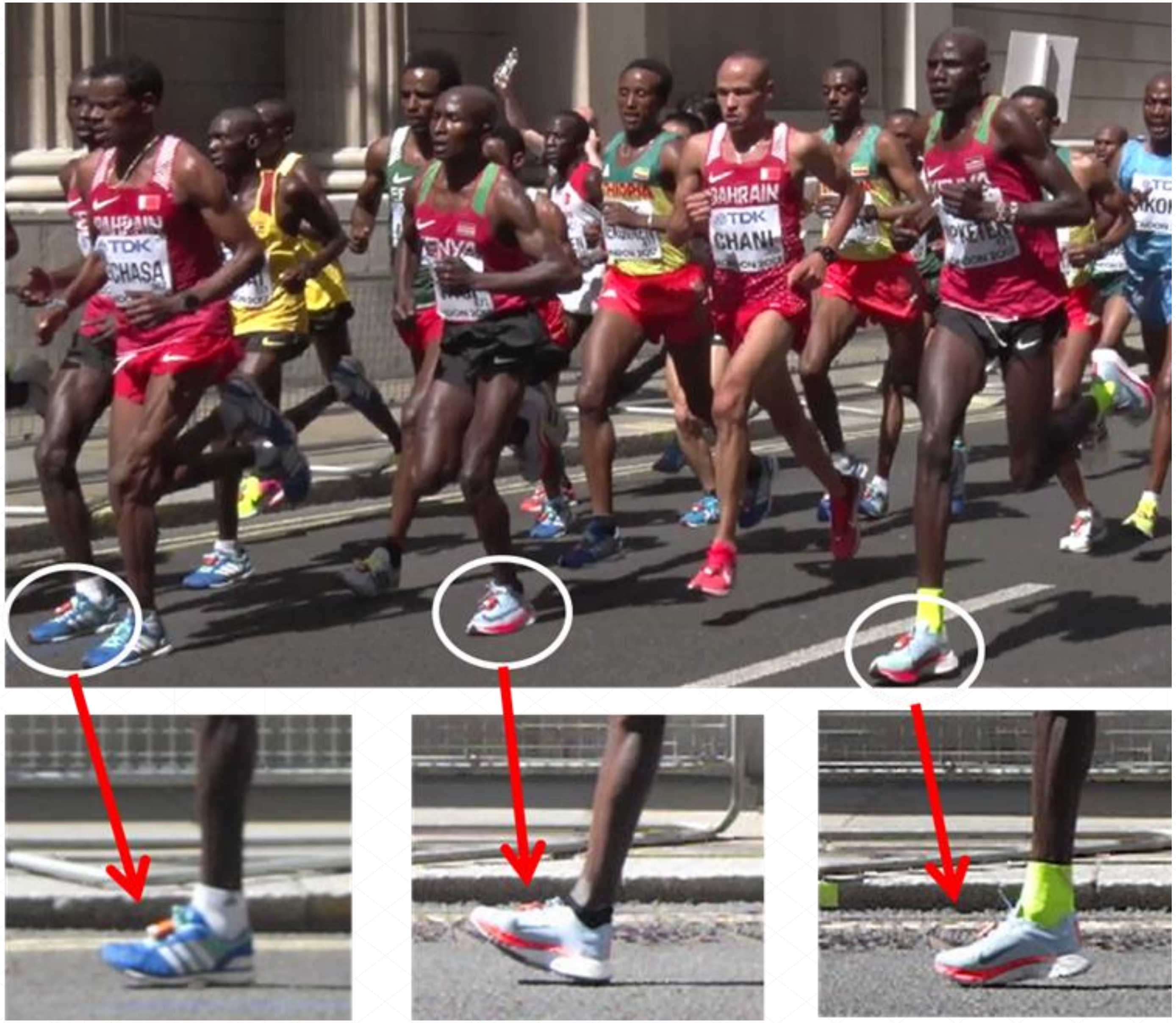

-2
-1
0
1
2
VETTER
VADLEJCH
FRYDRYCH
RÖHLER
PITKÄMÄKI
KIRIAZÍS
WALCOTT
HOFMANN
KRUKOWSKI
MAGOUR
KIRT
SINGH
YEGO
Throw Line


Vertical velocity (m/s)
Anteroposterior velocity (m/s)
IK
AH
DS
TR
TP
JY
JVa
JVe
ABM
MKr
MKi
KW
PF


Horizontal
Vertical
Absolute
CM velocity (m/s)
4.12
3.71
3.28
3.38
2.75
4.11
3.17
3.19
3.82
3.77
3.51
3.06
2.94
VETTER
VADLEJCH
FRYDRYCH
RÖHLER
PITKÄMÄKI
KIRIAZIS
WALCOTT
HOFMANN
KRUKOWSKI
MAGOUR
KIRT
SINGH
YEGO

MEN’S 4 x 100 METRE RELAY …

NATION	TOTAL TIME	RUN TIME	TRANSITION TIME	FINAL RANKING
Great Britain & N.I.	37.47 s	31.885 s	**5.585 s**	**1st**
United States	37.52 s	31.885 s	**5.635 s**	**2nd**



Contents lists available at ScienceDirect

Journal of Biomechanics

journal homepage: www.elsevier.com/locate/jbiomech
www.JBiomech.com

Most marathon runners at the 2017 IAAF World Championships were rearfoot strikers, and most did not change footstrike pattern

Brian Hanley [a,*], Athanassios Bissas [a], Stéphane Merlino [b], Allison H. Gruber [c]

[a] Carnegie School of Sport, Leeds Beckett University, United Kingdom

SPORTS BIOMECHANICS
https://doi.org/10.1080/14763141.2020.1856916

Routledge Taylor & Francis Group

Check for updates

Footstrike patterns and race performance in the 2017 IAAF World Championship men's 10,000 m final

Brian Hanley [a], Catherine B. Tucker [a], Athanassios Bissas [a,b], Stéphane Merlino [c] and Allison H. Gruber [d]

frontiers in Sports and Active Living

ORIGINAL RESEARCH
published: 06 August 2020
doi: 10.3389/fspor.2020.00102

Men's and Women's World Championship Marathon Performances and Changes With Fatigue Are Not Explained by Kinematic Differences Between Footstrike Patterns

Brian Hanley [1], Athanassios Bissas [1,2] and Stéphane Merlino [3]*

[1] Carnegie School of Sport, Leeds Beckett University, Leeds, United Kingdom, [2] School of Sport and Exercise, University of Gloucestershire, Gloucester, United Kingdom, [3] Development Department, World Athletics, Monte Carlo, Monaco

Men

Clearance height

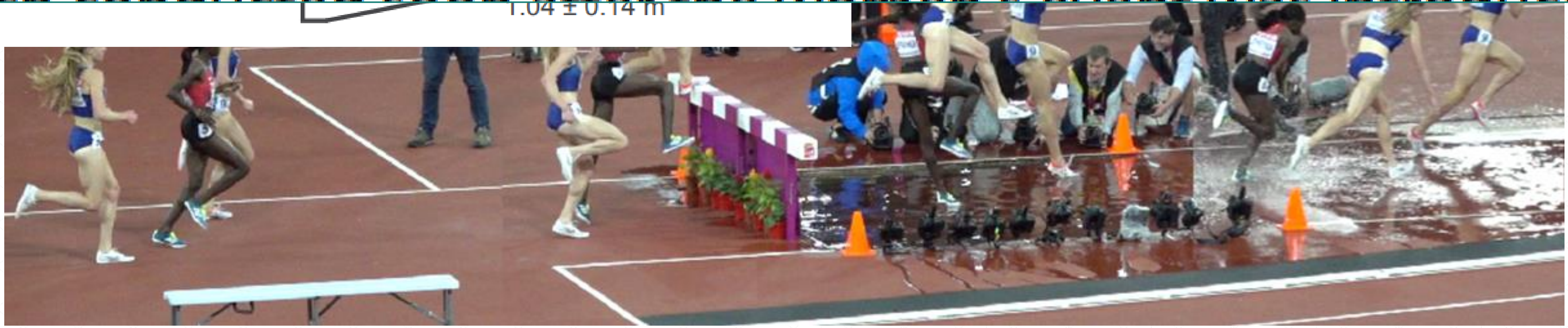
0.67 ± 0.06 m

…ump phase in World Championship men and women steeplechasers. Coefficient of variation …cts (sex-based comparisons) that were significant at $P < 0.05$ are shown in bold with their

Women	P	d
1.96 ± 0.19 (9.6%)	**0.035**	**0.88**
18.41 ± 1.34 (7.3%)	**0.002**	**1.36**

a change in the depth or dimensions of the water jump pit. For women to experience similar foot-water and uphill resistances as men and improve performances and times more in line with the sex-based differences in flat races, a device that changes the pit's dimensions for women could be considered by the IAAF. Previous

1.04 ± 0.14 m

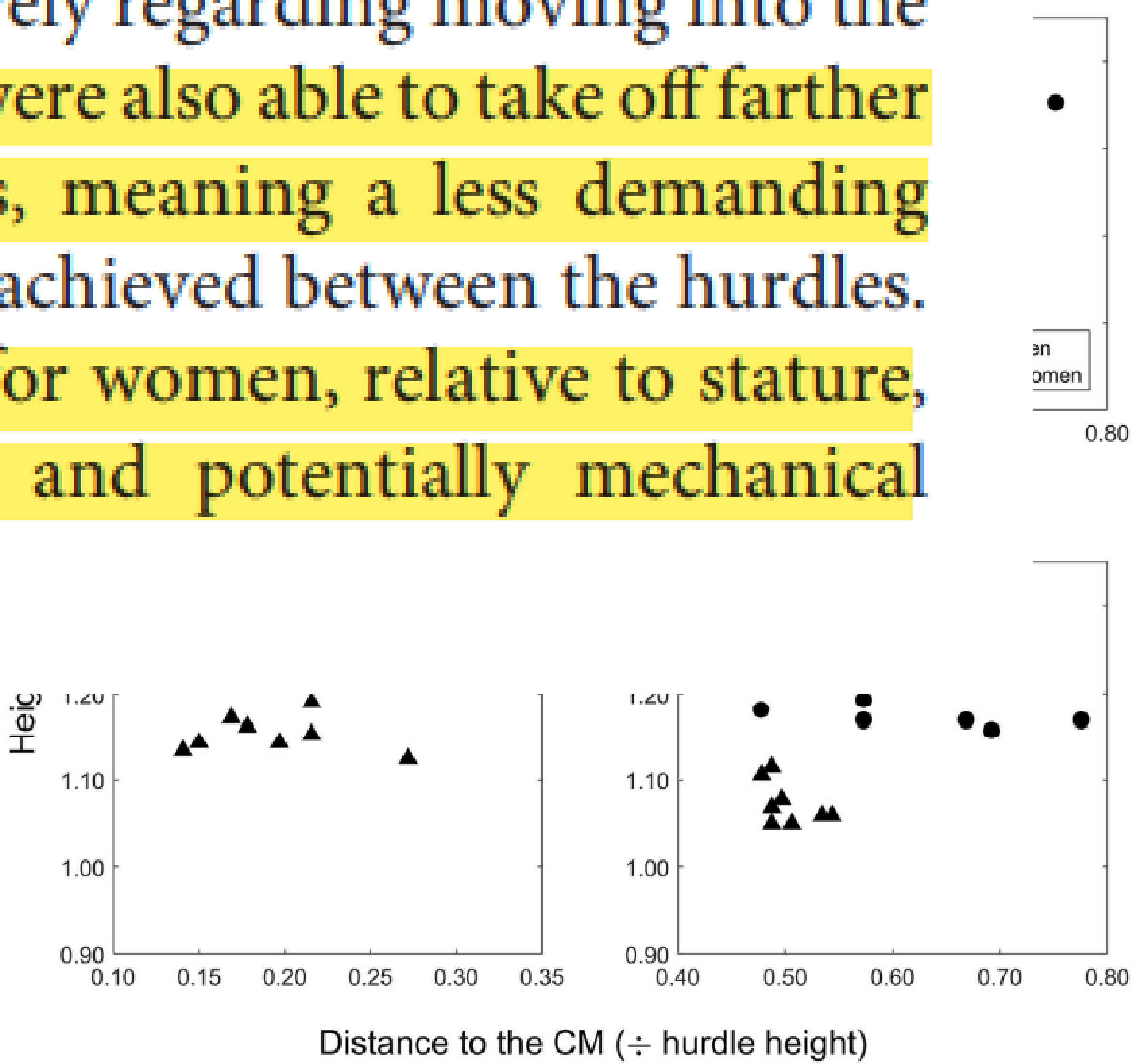


role in supporting the body effectively regarding moving into the subsequent landing step. Women were also able to take off farther from the hurdle in relative terms, meaning a less demanding task and affecting the step lengths achieved between the hurdles. Overall, the lower hurdle heights for women, relative to stature, provide them with a kinematic and potentially mechanical advantage over the men.

Kinematic and temporal differences between world-class men's and women's hurdling techniques

Athanassios Bissas[1,2,3*], Giorgos P. Paradisis[4], Brian Hanley[1], Stéphane Merlino[5], Josh Walker[1]

[1] Carnegie School of Sport, Leeds Beckett University, Leeds, United Kingdom
[2] Athletics Biomechanics, Leeds, United Kingdom
[3] School of Sport and Exercise, University of Gloucestershire, Gloucester, United Kingdom
[4] School of Physical Education & Sport Science, National & Kapodistrian University of Athens, Athens, Greece
[5] Development Department, World Athletics, Monte Carlo, Monaco

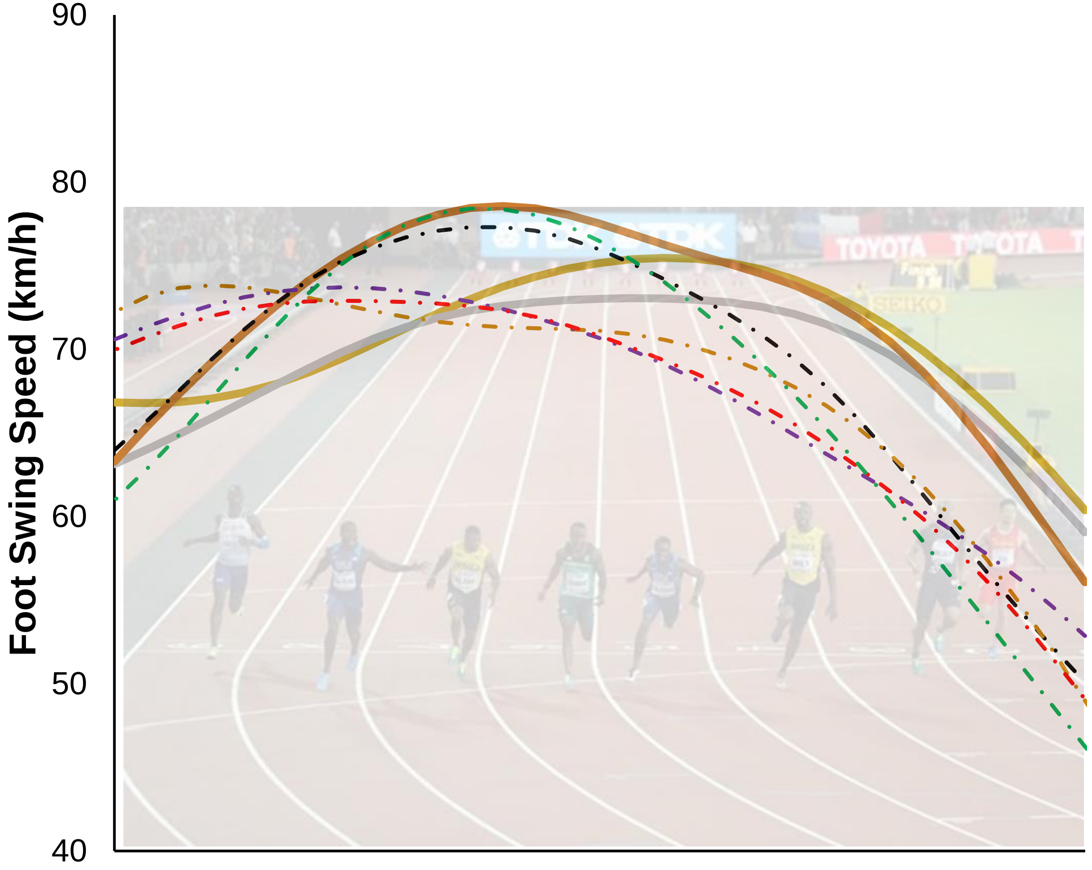


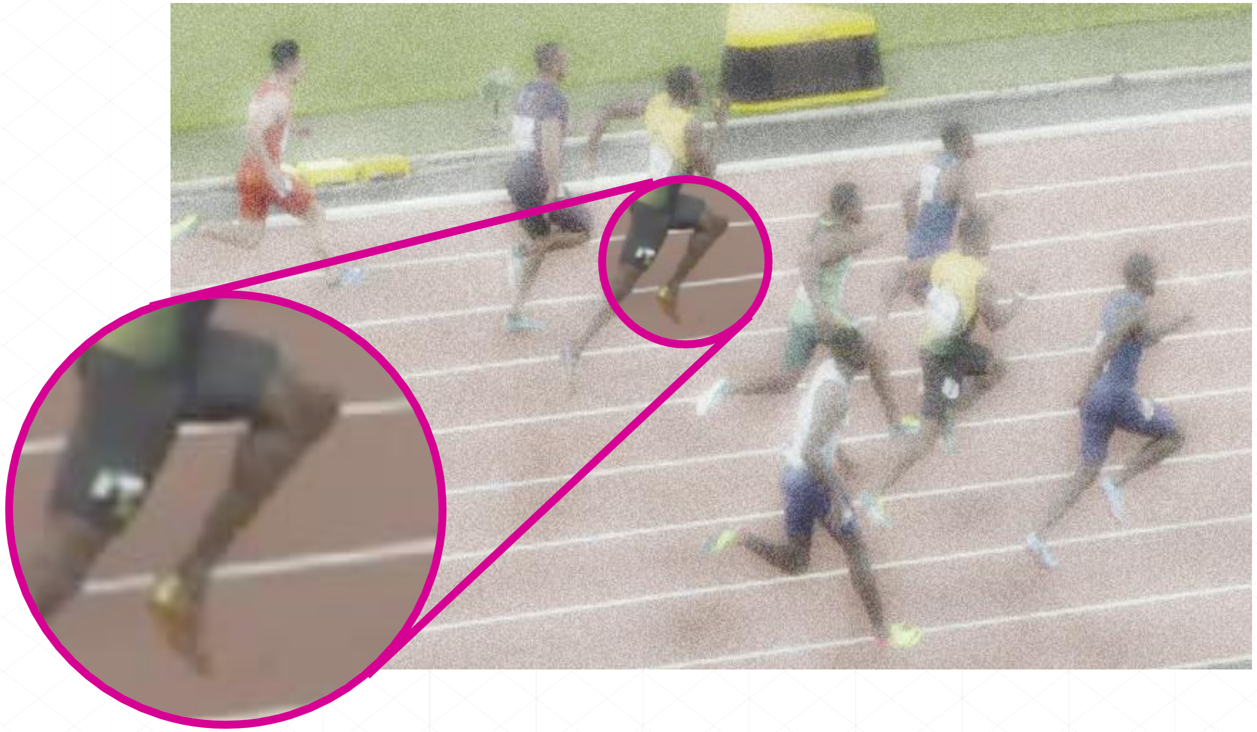

TOYOTA TOYOTA TOYOTA
TDK TDK TDK

TDK TDK

5.0
SEIKO

SEIKO





BOLT = 78.6 km/h

GATLIN = 75.5 km/h

COLEMAN = 73.0 km/h

Received: 9 June 2021 | Revised: 8 September 2021 | A
DOI: 10.1111/sms.14068

ORIGINAL ARTICLE

Asymmetry in sprint
men and women spri

Athanassios Bissas[1] | Josh W
Catherine B. Tucker[1] | Nils Jo
Pierre-Jean Vazel[4] | Olivier Gi

[1]Carnegie School of Sport, Leeds Beckett University, Leeds, UK
[2]Athletics Sector, School of Physical Education & Sport Science, National & Kapodistrian University of Athens, Athens, Greece
[3]International Relations & Development Department, World Athletics, Monte Carlo, Monaco
[4]Athlétisme Metz Métropole, Metz, France
[5]School of Human Sciences (Exercise and Sport Science), University of Western Australia, Crawley, Perth, WA, Australia

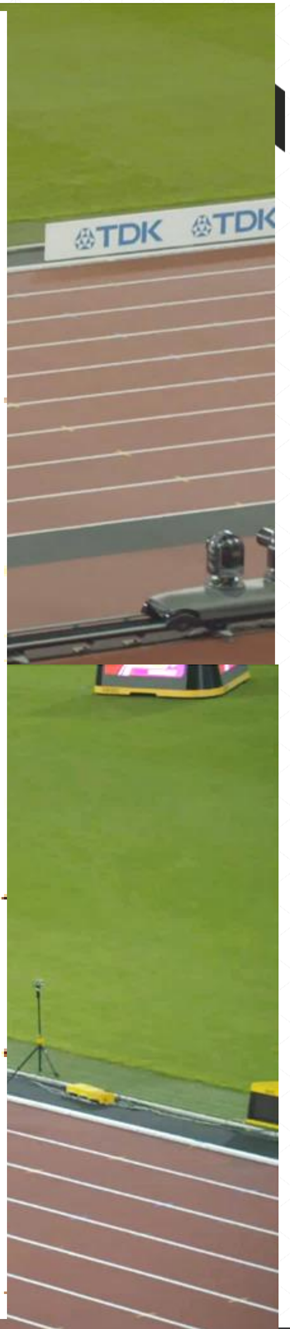
Correspondence
Olivier Girard, School of Human Sciences, Exercise and Sport Science, University of Western Australia, Perth, WA, Australia.
Email: oliv.girard@gmail.com

Present address
Athanassios Bissas, School of Sport and Exercise, University of Gloucestershire, Gloucester, UK
Nils Jongerius, European School of Physiotherapy, Amsterdam University of Applied Sciences, Amsterdam, The Netherlands

Funding information
The data collection and initial data

5 | CONCLUSION

Low to moderate asymmetry is a natural phenomenon in elite sprinting and overall sprinters' performance is generally not related to their asymmetry magnitudes. However, SA scores in biomechanical parameters of sprinting varied with the parameter, and at times with the phase, of interest, reinforcing the individual nature of asymmetry. Furthermore, sprinting mechanical asymmetries were largely unaffected by sex as it was evidenced in some of the fastest male and female sprinters in the world. Our results offer a novel benchmark for the expected magnitude of asymmetry in world-class sprinters during maximum velocity sprinting and provide a basis of comparison for future studies.



IAAF World Indoor Championships™
BIRMINGHAM 2018
1–4 MARCH

frontiers in Sports and Active Living
ORIGINAL RESEARCH
published: 18 September 2019
doi: 10.3389/fspor.2019.00023

Check for updates

World-Class Male Sprinters and High Hurdlers Have Similar Start and Initial Acceleration Techniques

Ian N. Bezodis[1], Adam Brazil[2], Hans C. von Lieres und Wilkau[1], Matthew A. Wood[1], Giorgios P. Paradisis[3], Brian Hanley[4], Catherine B. Tucker[4], Lysander Pollitt[4], Stéphane Merlino[5], Pierre-Jean Vazel[6], Josh Walker[4] and Athanassios Bissas[4*†]

OPEN ACCESS

Journal of Biomechanics 124 (2021) 110554

Contents lists available at ScienceDirect

Journal of Biomechanics

journal homepage: www.elsevier.com/locate/jbiomech

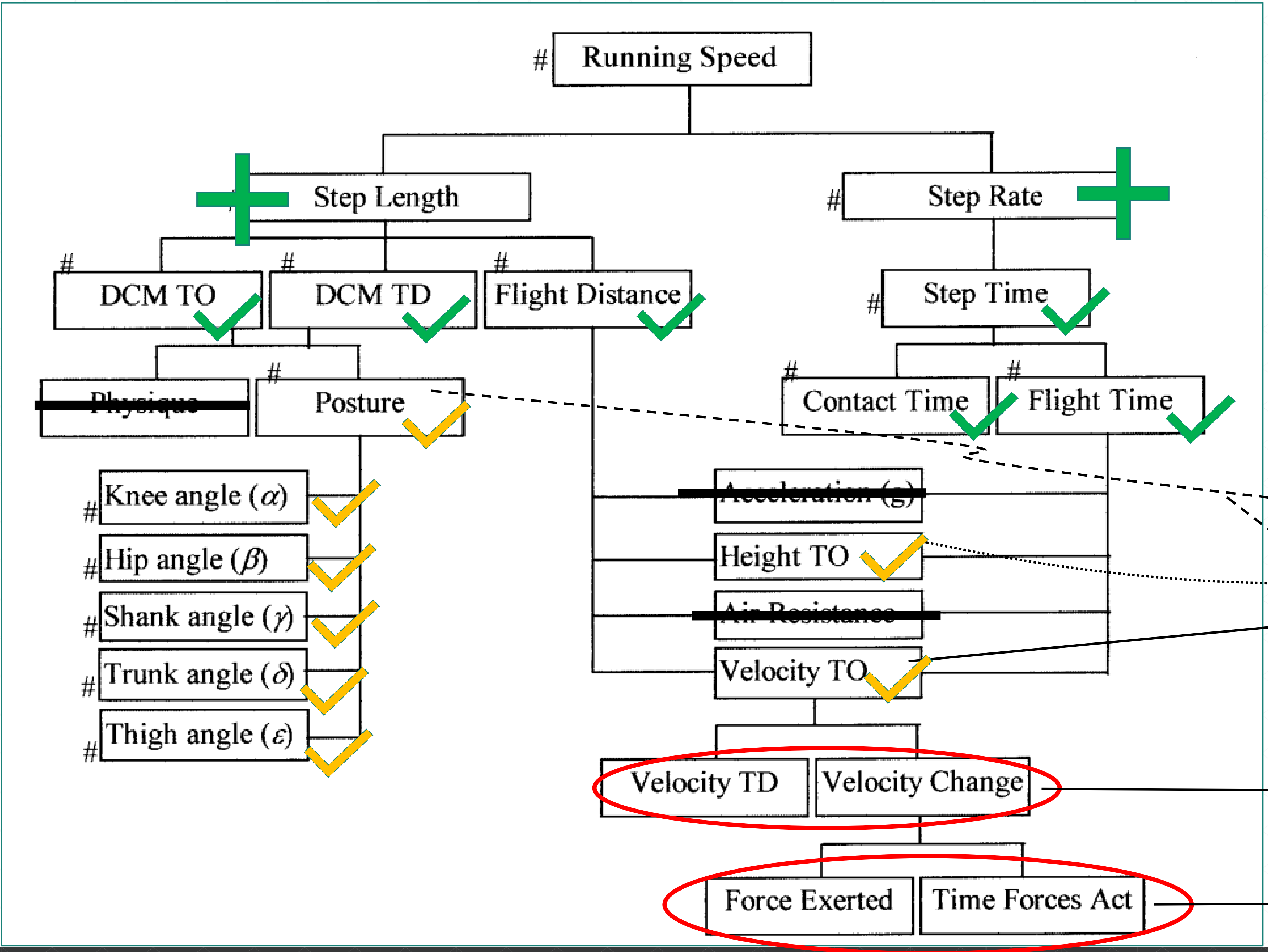
ELSEVIER

Check for updates

Kinematic factors associated with start performance in World-class male sprinters

Josh Walker[a], Athanassios Bissas[a,b,c,*], Giorgos P. Paradisis[d], Brian Hanley[a], Catherine B. Tucker[a], Nils Jongerius[a,e], Aaron Thomas[a], Hans C. von Lieres und Wilkau[f], Adam Brazil[g], Matthew A. Wood[f], Stéphane Merlino[h], Pierre-Jean Vazel[i], Ian N. Bezodis[f]

[a] Carnegie School of Sport, Leeds Beckett University, Leeds, UK
[b] Athletics Biomechanics, Leeds, UK
[c] School of Sport and Exercise, University of Gloucestershire, Gloucester, UK
[d] Athletics Sector, School of Physical Education & Sport Science, National & Kapodistrian University of Athens, Athens, Greece
[e] European School of Physiotherapy, Amsterdam University of Applied Sciences, Amsterdam, the Netherlands
[f] Cardiff School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff, UK
[g] Department for Health, University of Bath, Bath, UK
[h] International Relations & Development Department, World Athletics, Monaco
[i] Athlétisme Metz Métropole, Metz, France



(*Impulse – Momentum Relationship*)

F = ma

F = m Δv/Δt

FΔt = mΔv

FΔt = m(v_{TO} - v_{TD})

thus

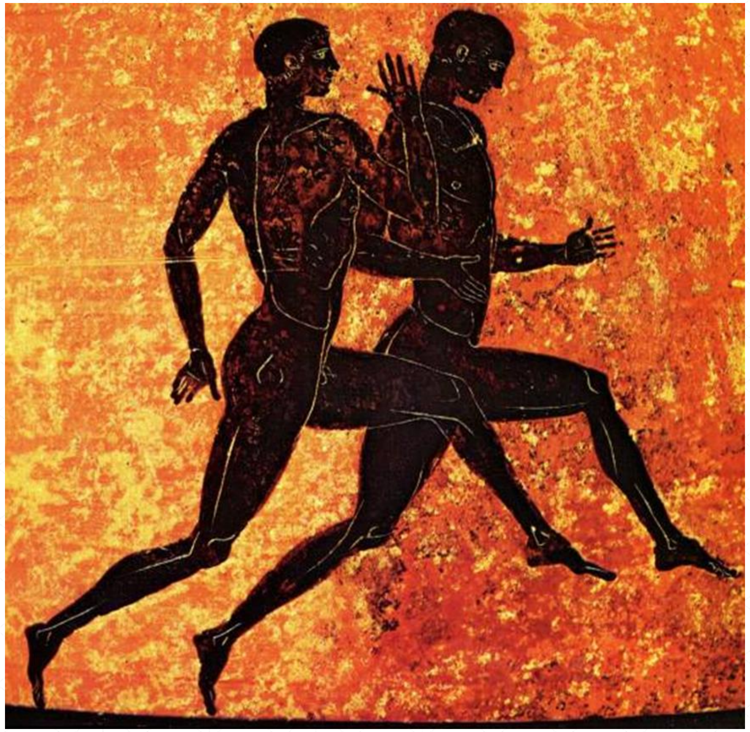
v_{TO} = FΔt/m + v_{TD}

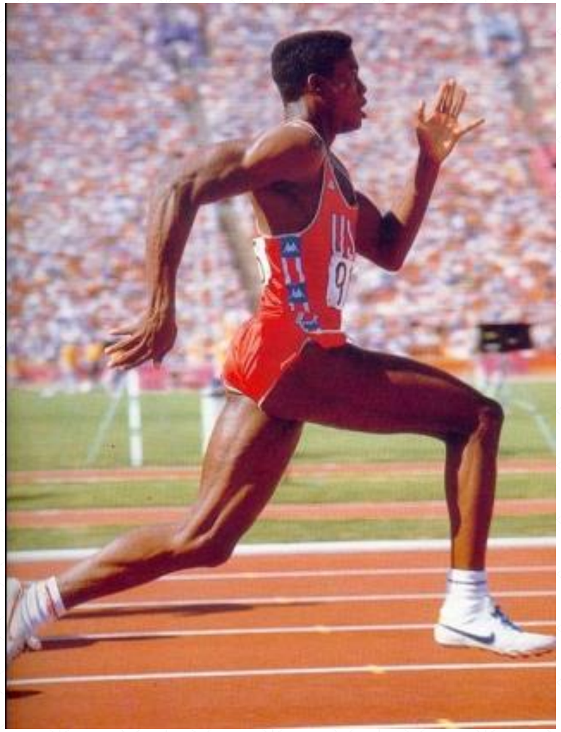
$$R = \frac{v^2 \sin 2\theta}{g}$$

$$R = \frac{v^2 \sin\theta\cos\theta + v\cos\theta\sqrt{(v\sin\theta)^2 + 2gh}}{g}$$

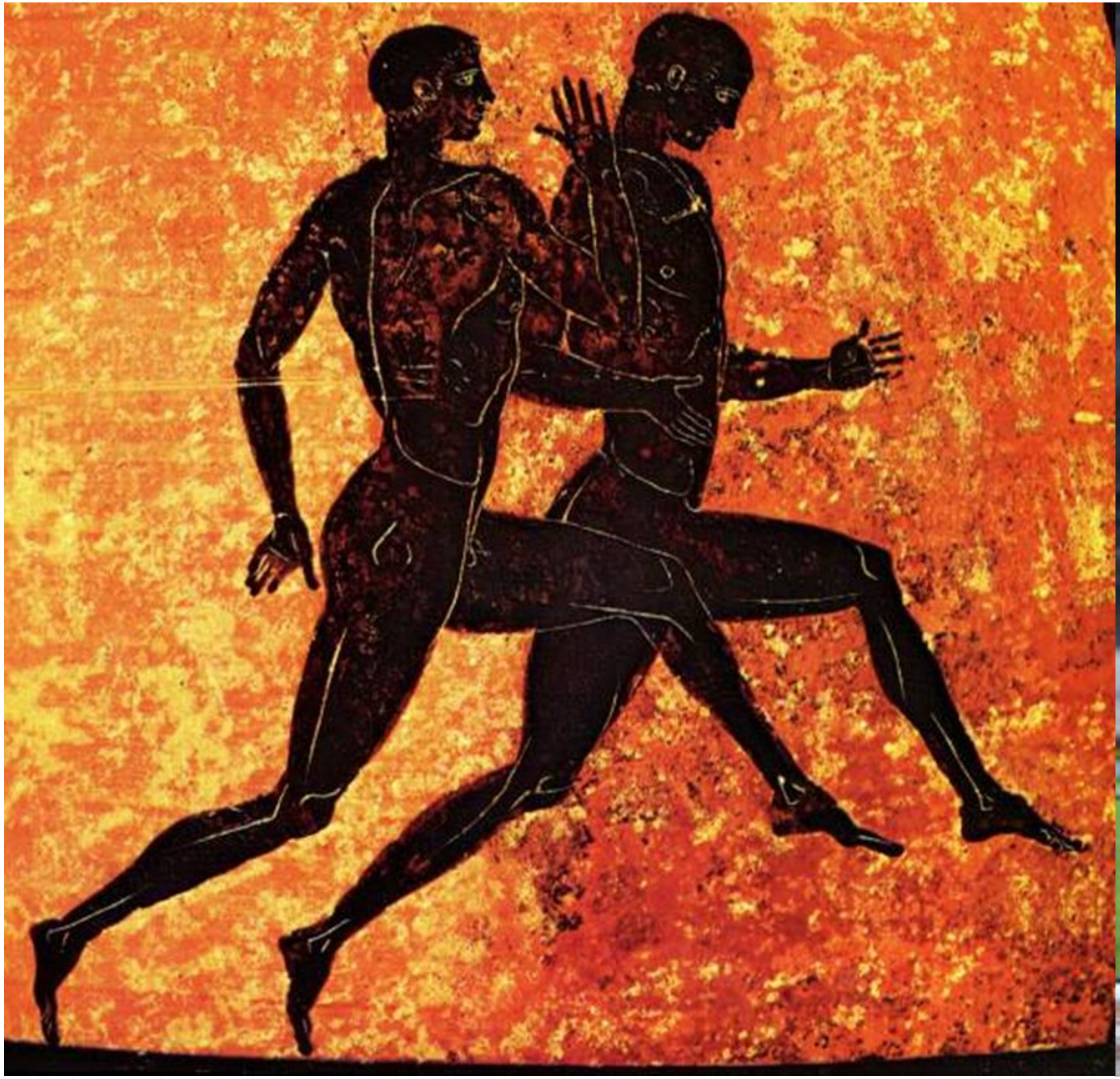
× *mass* = Momentum

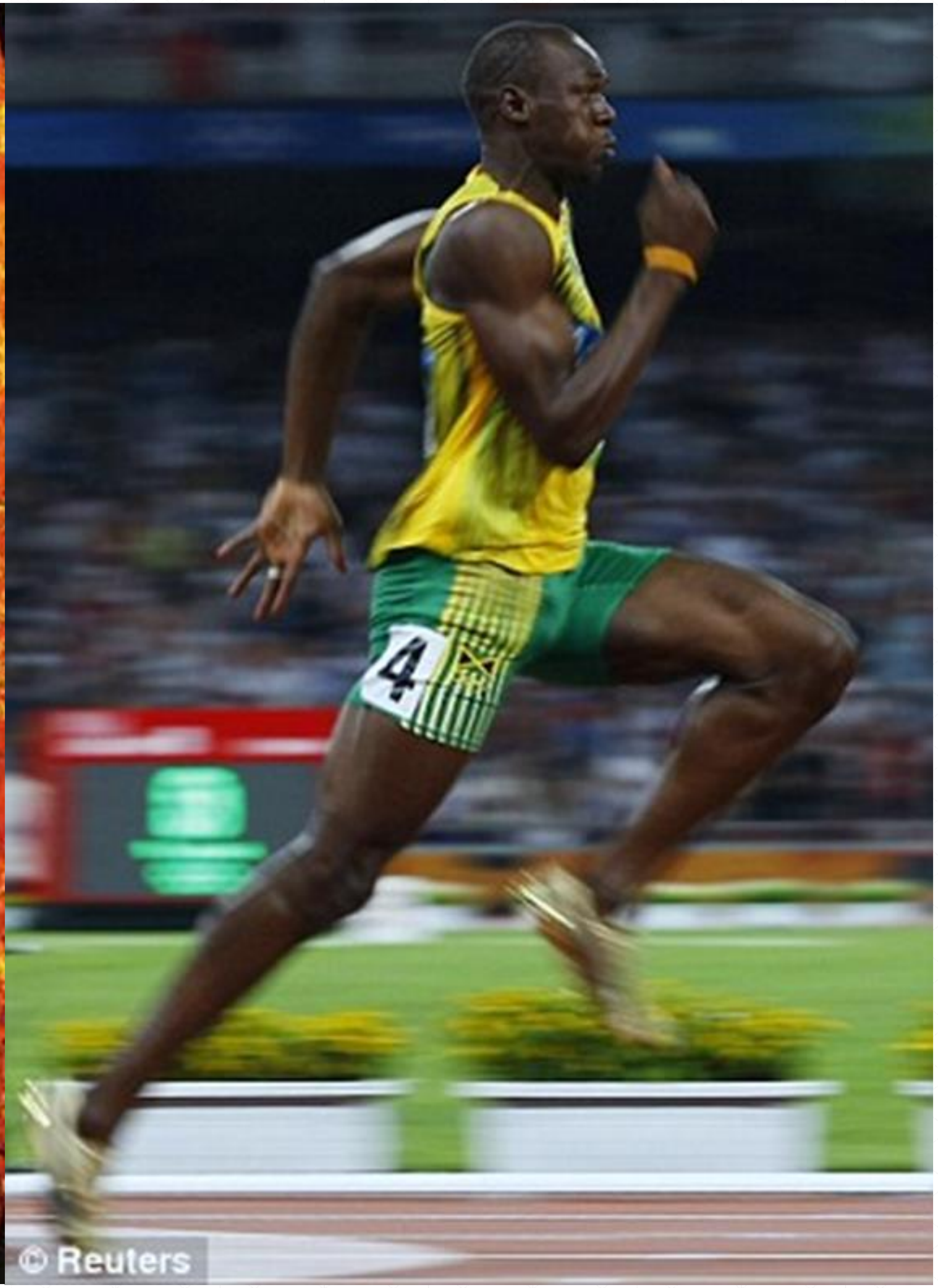
Impulse






© Reuters




© Reuters