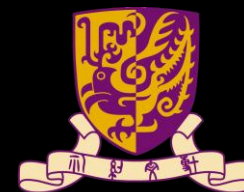


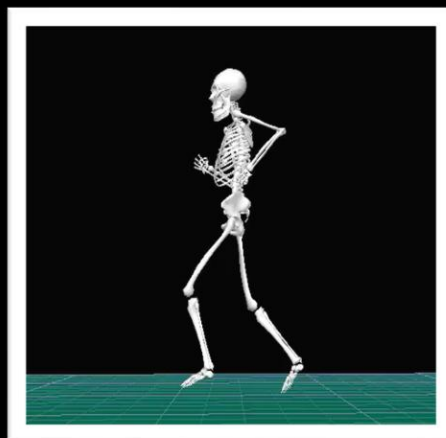


croucher summer courses



香港中文大學
The Chinese University of Hong Kong

Super shoe and the recreational runner – Who benefits?



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PLAN

1

My background

2

Super shoe study 1 (economy, biomechanics, and performance)

3

Super shoe study 2 (biomechanics and comfort)

4

Super shoe study 3 (potential for placebo)

5

Super shoe study 4 (calf muscle fatigue)

6

Q&A



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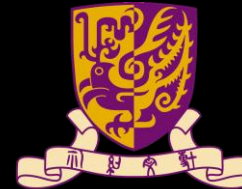
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WHERE ARE WE?



14,000 students
(2,500 international)



MOU
Student exchange



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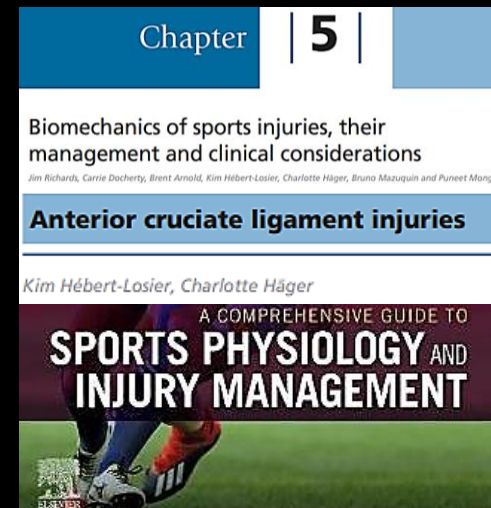
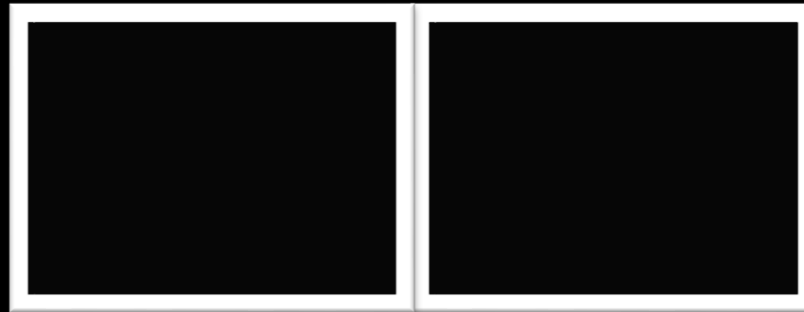
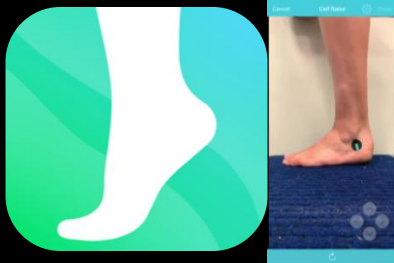
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Research – Overview

Human movement researcher in **lower-limb** and **sports biomechanics** with impact in 3 key areas:

1. Calf muscle function and testing
2. Injury risk screening to prevent sport injuries (ACL)
3. Running biomechanics and footwear



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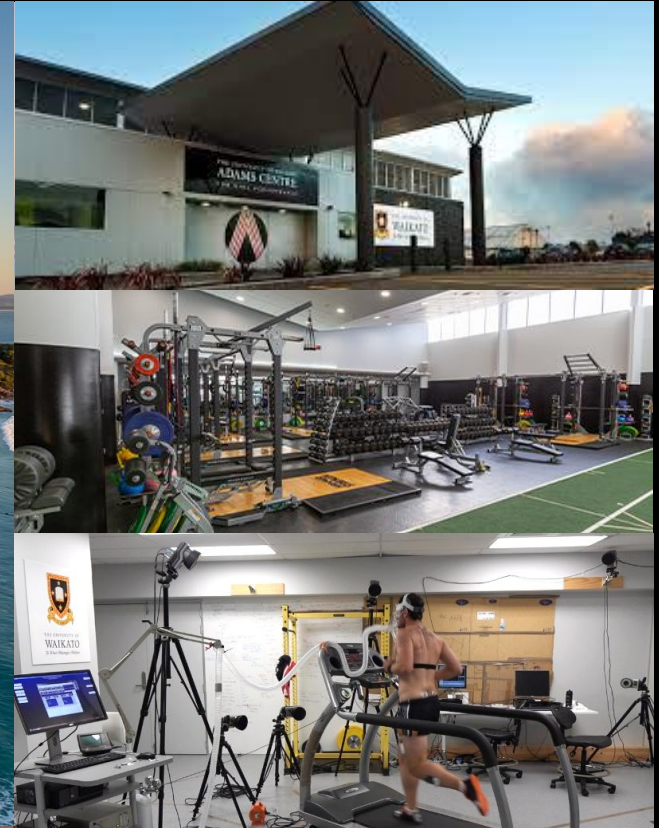
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University of Waikato Adams Centre for High Performance



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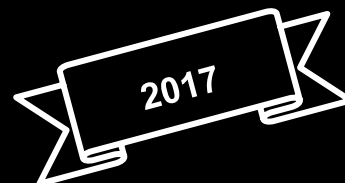
**A NOT SO LONG
TIME AGO IN A
GALAXY NOT SO
FAR, FAR AWAY...**

**...THE SUPER SHOE
WAS INVENTED...**

THE “SUPER SHOE” (HISTORY)

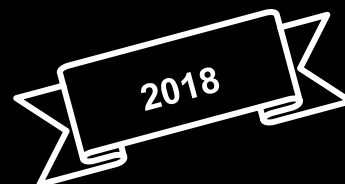
« **Breaking2** » **Monza, Italy**

May 6, 2017 (2:00:25) Nike Vaporfly Elite



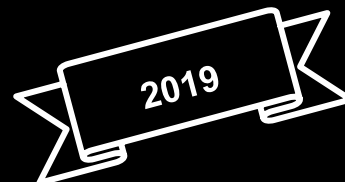
« **World Record Marathon** » **Berlin, Germany**

Sep 16, 2018 (2:01:39) Nike Zoom Vaporfly 4%



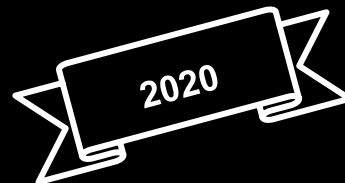
« **Ineos 1:59 Challenge** » **Vienna, Austria**

Octobre 12, 2019 (1:59:40) Nike Vaporfly Next%



« **World Athletics** » **Regulation Change**

January 21, 2020, Restrictions imposed



Eliud Kipchoge (KEN)



Vaporfly 4% (VP4)



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THE “SUPER SHOE” (HISTORY)

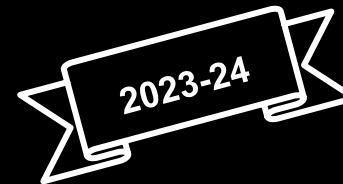
« **World Record Marathon** » **Chicago, United States**

October 8, 2023 (2:00:35) Nike Alphafly 3 (Prototype Dev 163)

« **World Record Marathon** » **Chicago, United States**

October 13, 2024 (2:09:56) Nike Alphafly 3

285 Euro (620 NZD) – Guaranteed to last 1 marathon



Late Kelvin Kiptum
(KEN)



Ruth Chepngetich
(KEN)



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THE “SUPER SHOE” (HISTORY)

« **World Record Marathon** » **Chicago, United States**

October 8, 2023 (2:00:35) Nike Alphafly 3 (Prototype Dev 163)

« **World Record Marathon** » **Chicago, United States**

October 13, 2024 (2:09:56) Nike Alphafly 3

285 Euro (620 NZD) – Guaranteed to last 1 marathon

2023-24



**Sebastian Sawa
(KEN)**

« **World Record Marathon** » **London, United Kingdom**

April 26, 2026 (1:59:30) Adidas Adizeo Adios Pro Evo 3

440 Euro (865 NZD) – Shoe replaced for photo

2026



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THE “SUPER SHOE” (HISTORY)



<https://www.youtube.com/watch?v=gWDyFHCFH7s>



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THE “SUPER SHOE” (REVIEW)



MSc (Loughborough)
Milly Pamment



Hébert-Losier et al. Sports Biomech. 2023;22(3):335-350



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THE “SUPER SHOE” (REVIEW)



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THE “SUPER SHOE” (REVIEW)

Performance-enhancing footwear technology that combines lightweight, resilient midsole foams with rigid moderators and pronounced rocker profiles in the sole



MSc (Loughborough)
Milly Pamment



Hébert-Losier et al. Sports Biomech. 2023;22(3):335-350
Frederick. Footwear Sci. 2022;14(3):131



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THE “SUPER SHOE” (STUDY 1)



MSc (Research)
Steve Finlayson

Original studies found **4%** economy improvements
High calibre runners^{1,2,3}
Nike sponsored¹
Compared to marathon racing shoes and track spikes



We were first to examine ‘**everyday**’ runners, **SUPER**, **OWN**, and **MINIMAL**
(economy, biomechanics, performance)



¹ Hoogkamer et al. Sports Med. 2018;48:1009-19

² Barnes, Kilding. Sports Med. 2019;49:331-42

³ Hunter et al. J Sports Sci. 2019;37:2367-73



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THE “SUPER SHOE” (STUDY 1)

18 male recreational runners (34 ± 12 y)

SUPER



Nike Vaporfly 4%
Original super shoe – 211 g

MINIMAL

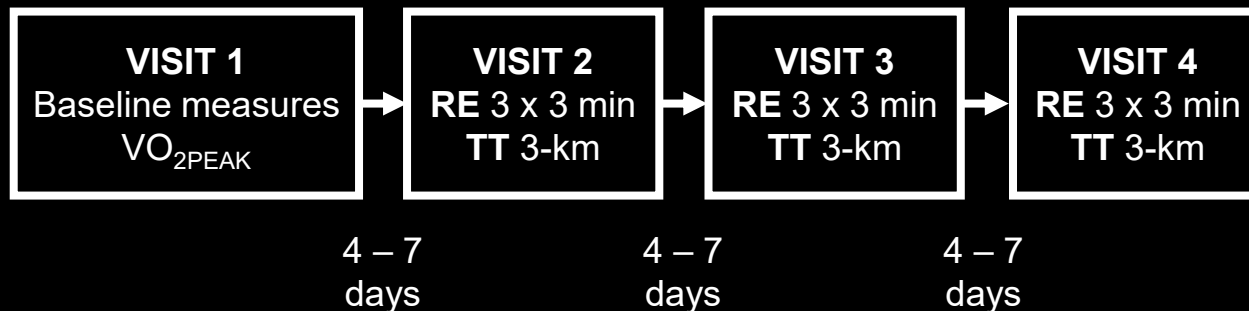


Saucony Endorphin Racer
Minimal racing flat – 153 g

OWN



Habitual shoes – 313 g



THE “SUPER SHOE” (STUDY 1)

RUNNING ECONOMY

SUPER was 4.1% better than own*  

SUPER was 1.3% better than minimal (not sig.)  

TIME TRIAL

SUPER was 2.4% better than own*  

SUPER was 1.3% better than minimal*  

COMFORT

SUPER was less comfortable than own (not sig.)  

SUPER was more comfortable than minimal* (17 mm)  



THE “SUPER SHOE” (STUDY 1)



SUPER was best for economy & performance in 7 runners (41%)



MINIMAL was best for economy & performance in 1 runner (6%)



OWN was best for economy & performance in 0 runner (0%)



MIX was best for economy & performance in 9 runners (53%) ^{1 missing data}



THE “SUPER SHOE” (STUDY 1)



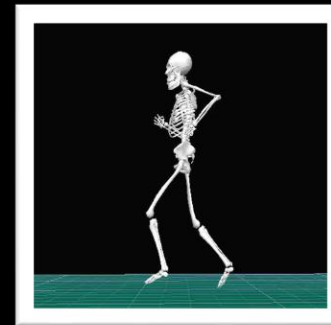
Runners in **SUPER** vs **OWN** had better economy when...

Higher cadence and shorter steps

Less knee and hip range of motion

Less vertical displacement

Smaller peak dorsiflexion



Runners in **MINIMAL** vs **OWN** had better economy when...

Higher cadence and shorter steps

COMFORT did not appear to mediate the responses



THE “SUPER SHOE” (STUDY 1)

“Does this shoe work for me and you?”



SUPER enhanced running economy in **most** recreational runners (average 4%)...

...**however**, so did the **MINIMAL** (average 3%)



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Take home message



SUPER improved economy on **AVERAGE**, but so did **MINIMAL**



Large **individual differences** observed – not one-size-fit-all

Difficult to know from biomechanics – cadence appears important

Between-day, single-effort trials (biological and technical noise)



OWN footwear was typically **worse**

Shoe mass effect

Novelty effect

Placebo effect

ARTICLES

Hébert-Losier et al. J Sports Sci. 2022;40(13):1426-1435

Hébert-Losier et al. J Sport Health Sci. 2022;11(3):275-284



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THE “SUPER SHOE” (STUDY 2)



MSc (Research)
Hannah Knighton

Most research on super shoes^{1,2,3}

Conducted in **laboratories**

Do not consider footwear **habits** (OWN)

Do not consider **comfort**



We took our research to the streets to examine the **biomechanics** and subjective **perceptions** of recreational runners **outdoors**



¹Hébert-Losier et al. *J Sport Health Sci.* 2022;11(3):275-284

²Hoogkamer et al. *Sports Med.* 2018;48(4):1009-1019

³Barnes et al. *Sports Med.* 2019;49(2):331-342



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THE “SUPER SHOE”

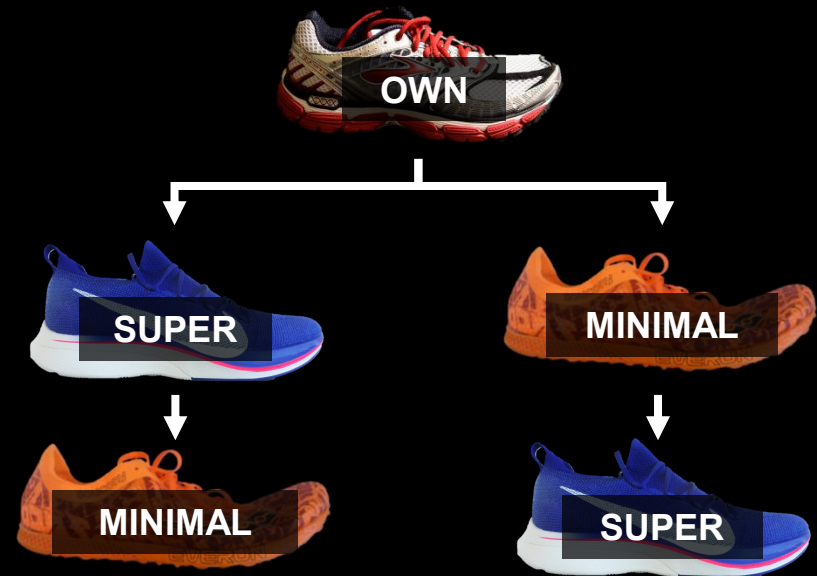
18 male recreational runners (31 ± 10 y, 5 km 23 ± 2 min, 17 rearfoot)

Ran 3 x 1.5 km on asphalt

1.1 km comfortable pace (slower)

30 s rest

400 m race pace (faster)



THE “SUPER SHOE” (STUDY 2)

RUNNING BIOMECHANICS

SUPER less time in propulsion (*moderate to large*)



MINIMAL lower footstrike angles (*moderate to large*)



MINIMAL slow speed ↑ cadence, ↓ contact time, ↑ vertical & leg stiffness (*trivial to small*)



Fast speed no other sig. differences



SUBJECTIVE PERCEPTIONS

OWN most comfortable, most ideal, and least injurious (*moderate to large*)



SUPER too cushioned, too stiff, too technical (*moderate to large*)



MINIMAL least comfortable, least cushioned (*moderate to large*)



No sig. correlations between comfort and biomechanics





Take home message



Biomechanical changes generally **trivial** and **not related** to comfort
MINIMAL – Shift towards forefoot and reduced cushioning may increase distal loads
SUPER – Potentially quicker to adapt to ‘super shoes’ from own (more similar)



Runners most **comfortable** in **OWN**, and more in **SUPER** vs **MINIMAL**
SUPER are more like traditional shoes – habits are important
Runners were mostly rearfoot – footstrike likely important



Running **biomechanics** were not related to footwear **comfort**
Implications in research, selection, and prescription

ARTICLE

Hébert-Losier et al. Footwear Sci.
2023;16(1):13-23



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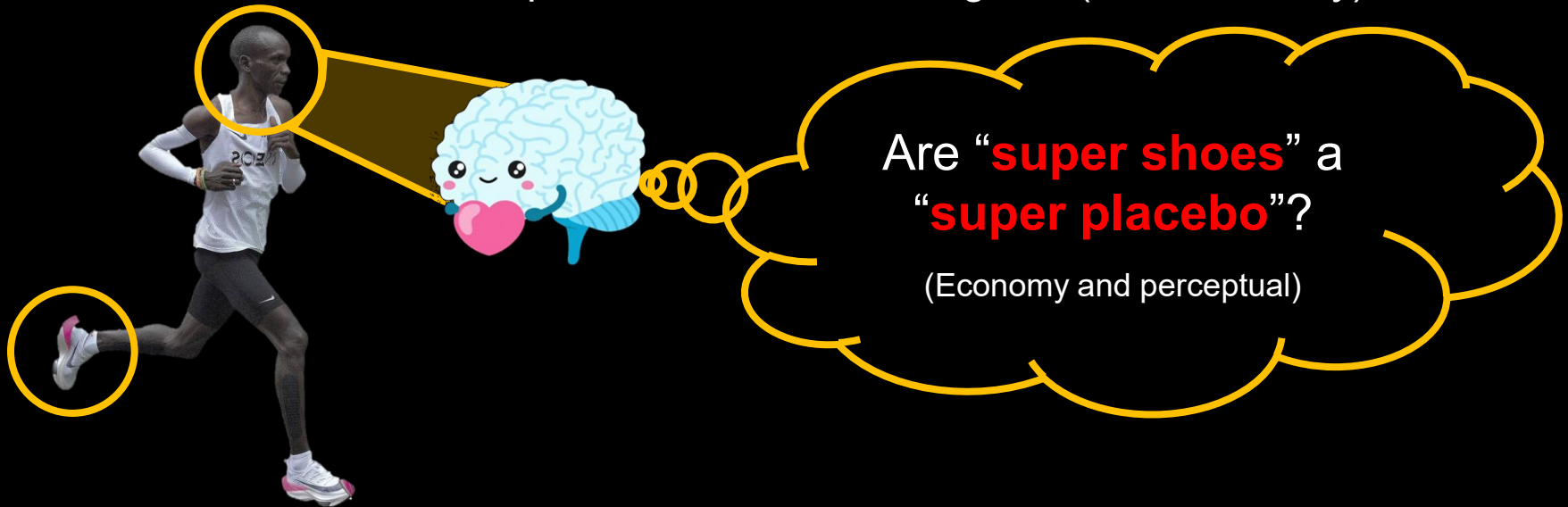


THE “SUPER SHOE” (STUDY 3)



MSc (Research)
Ashlynn Pfister

Placebo effect cited as a potential contributor to gains (and variability)^{1,2,3}



¹ Hoogkamer et al. Sports Med. 2018;48:1009-19

² Hunter et al. J Sports Sci. 2019;37:2367-73

³ Hebert-Losier et al. J Sport Health Sci. 2022;11(3):275-84



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THE “SUPER SHOE” (STUDY 3)

24 female recreational runners (35 ± 10 y)



SUPER SHOE
Nike Vaporfly 2
Advanced technologies
Women's Road Racing Shoes
Maximises performance

Best on the market
Returns energy
Propels you forward
Saves you energy
Breaking world records
Worth \$400



THE “SUPER SHOE” (STUDY 3)

24 female recreational runners (35 ± 10 y)



KNOCK OFF
Nike Vaporfly 2
No advanced technologies
Women's Road Racing Shoes
Regular foam

Elites never wear
Basic shoe
Worth \$100



THE “SUPER SHOE” (STUDY 3)

24 female recreational runners (35 ± 10 y)



Nike Vaporfly 2
Women's Road Racing Shoes



THE “SUPER SHOE” (STUDY 3)

RUNNING ECONOMY DATA



NO significant difference between shoes (0.1%)

PERCEPTUAL DATA



Super shoes were perceived as:

More comfortable (14.6 mm)*

More pleasant (15.8 mm)*

Made running easier (19.2 mm)*

Higher performing (18.5 mm)*

Having a lower risk of injury (9.4 mm)*

0 - 100 mm visual analogue scales



Not comfortable at all

Most comfortable imaginable

Most runners (87.5%) preferred **super shoes** vs **knock-offs**



THE “SUPER SHOE” (STUDY 3)

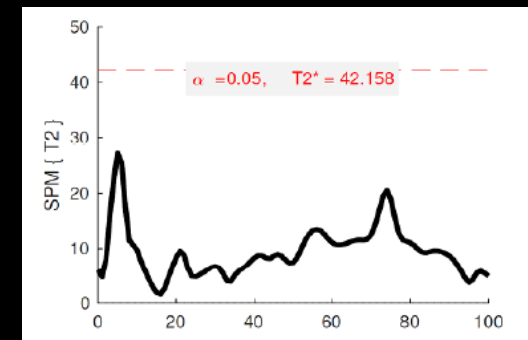
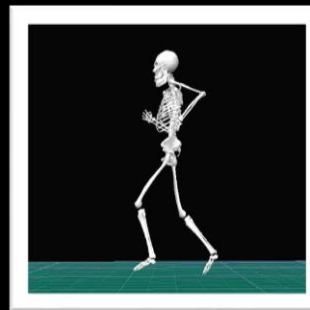
BIOMECHANICS DATA

NO significant differences between shoes:

Discrete biomechanics (contact time, flight time, duty factor, cadence, vertical displacement, tibial acc)

Lower-extremity angular curves (ankle, knee, hip)

Lower-extremity angular velocities (ankle, knee, hip)



Duty factor = ratio of ground contact time to cycle time



THE “SUPER SHOE” (STUDY 3)

“Are super shoes a super placebo?”



Economy and **biomechanics** were similar between “super” and “knock off” shoes despite running **feeling easier**, more **comfortable**, and likely to enhance **performance**



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Take home message



The potential for a placebo effect on economy was **not detected**



Words matter – influence footwear perceptions and comfort



Shoe design does appear to contribute most to economy gains



Future research needed to explain responders / non-responders

ARTICLE

Hébert-Losier et al. Footwear Sci.
2025;17(2):79-88



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THE “SUPER SHOE” (STUDY 4)



MSc (Research)
Ben Bidois

Triceps surae and **Achilles tendon** are vital for running economy and performance

Contribute 25 to 40% total metabolic cost¹

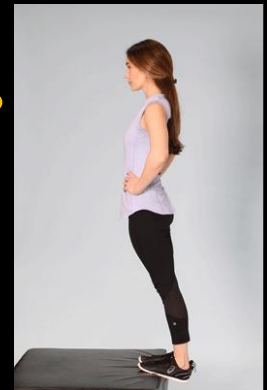
Strength declines 20-30% post 21.1 to 42.2 km^{2,3}

Plantarflexors believed important for ‘super shoe’ response⁴

Lack of strength thought to limit benefits from stiff element^{5,6}

Is plantarflexion
function related to
shoe response?

Does plantarflexion fatigue
affect shoe response?



¹ Fletcher, MacIntosh. Appl Physiol (1985). 2015 Jan 15;118(2):193-9.

² Avela et al. J Appl Physiol (1985). 1999;86(4):1292-300

³ Perrin et al. Med Sci Sports Exerc. 2025;57(4):657-667

⁴ Barrons et al. Sports Med. 2024;54(6):1357-1360

⁵ Willwacher al. Gait Posture. 2014;40(3):386-90

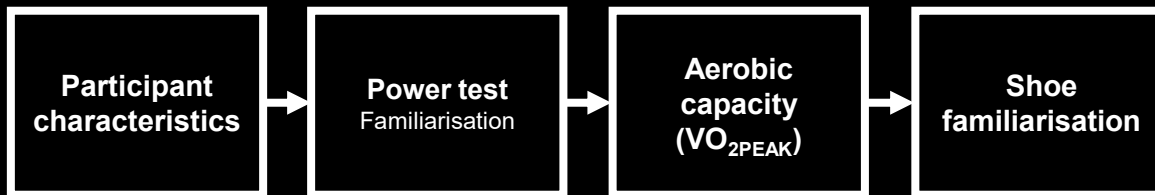
⁶ Ortega et al. Sports Med. 2021;51(5):873-894.



THE “SUPER SHOE” (STUDY 4)

Heterogenous group of runners ($n = 64$, 34 ± 16 y, 50% female)

SESSION 1



SUPER SHOE

Salomon S/Lab Phantasm 2
230 Euros (NZ\$460)



CONTROL

Salomon Aero Glide 2
105 Euros (NZ\$210)



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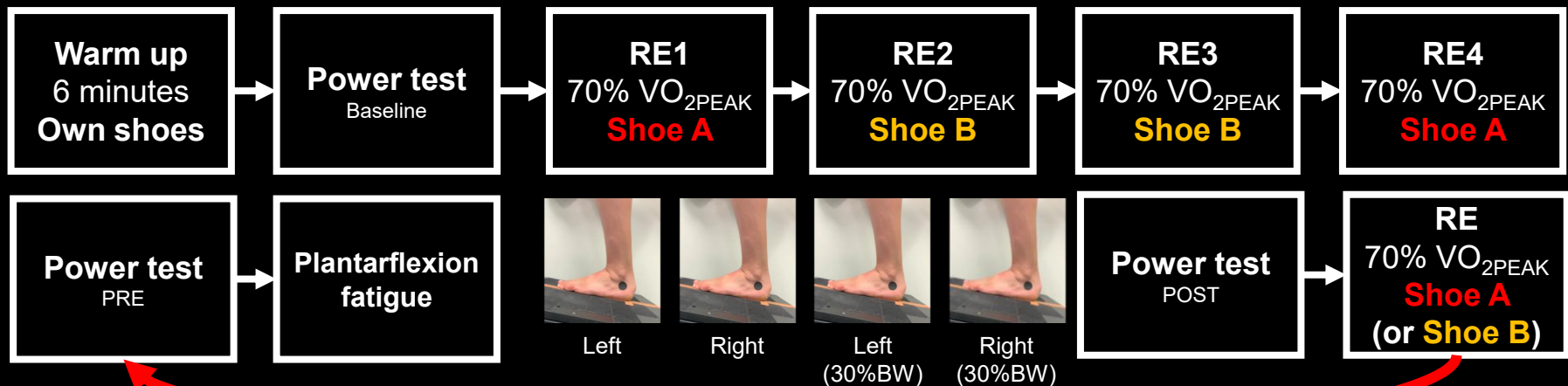
[kim-hebert-losier](#)



THE “SUPER SHOE” (STUDY 4)

Heterogenous group of runners ($n = 64$, 34 ± 16 y, 50% female)

SESSION 2 (2 – 14 days later)



THE “SUPER SHOE” (STUDY 4)

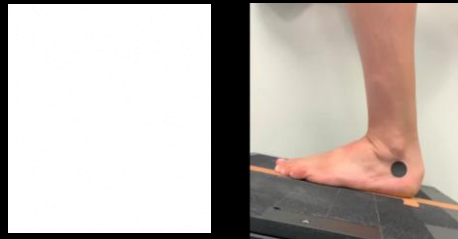
PLANTARFLEXION FATIGUE

Decline in **power** (6.5%, *moderate*)*

Increase in calf **soreness** (69 units, *large*) and **fatigue** (81 units, *large*) *

Impaired running **economy** (1.5 to 2.3%, *large*)*

Quicker **cycle times** (6.5 ms, *large*) and larger **duty factors** (0.25, *small*)*



Duty factor = ratio of ground contact time to cycle time



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THE “SUPER SHOE” (STUDY 4)

SHOE EFFECT

‘Super shoes’ improved running **economy** (4.0 to 4.3%, *large*)

Some **biomechanical** differences (*large*)

Quicker GCT (3.3 ms)

Longer cycle times (5.7 ms)

Smaller FSA (1.5°)

Lower duty factor (0.76)



NO INTERACTION EFFECT

No difference in shoe response with plantarflexion fatigue

No association between Δ response and Δ plantarflexion power



Duty factor = ratio of ground contact time to cycle time



THE “SUPER SHOE” (STUDY 4)

“Does plantarflexion fatigue affect super shoe response?”



Economy benefits and **biomechanical differences** were similar before and after plantarflexion fatigue despite impaired **economy**, impaired **plantarflexion power**, changes in **biomechanics**, and enhanced calf **soreness** and **fatigue**



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Take home message



Running in super shoes improved **running economy** (~4%)

Consistent with existing literature and prior studies



Benefits remained with plantarflexion fatigue and not linked with power

Refutes claims that plantarflexion strength is needed to maximise benefits



Acknowledging **limitations**

Muscle strength and power are related, but distinct qualities

Repeated contractions (**local**) are not the same as running (**central**) fatigue

ARTICLE

Bidois et al. *Eur J Appl Physiol.* 2026;
126:3843-57



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THE “SUPER SHOE” (STUDY 5)



MSc (Research)
Christiaan Cumming

“Super shoes” improve running economy by 4%

In **recreational**³, not only high calibre runners^{1,2}

Variability in responses exists

Placebo not apparent mediators⁴



Responses⁵ potentially linked with...

Runner **characteristics** (sex, speed, anthropometrics, etc...)

Neuromuscular function (foot morphology, plantarflexors, etc...)

Running **biomechanics** and **perceptions**



¹ Hebert-Losier et al. J Sport Health Sci. 2022;11(3):275-84

² Hoogkamer et al. Sports Med. 2018;48:1009-19

³ Barnes, Kilding. Sports Med. 2019;49:331-42

⁴ Hebert-Losier et al. Footwear Sci. 2025;17(2):79-88

⁵ Barrons et al. Sports Med. 2024;54(6):1357-1360



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*Metabolic cart + 2D motion + Myotome +
Force Plate + Dynamometer + Calf Raise App*

THE “SUPER SHOE” (**STUDY 5**)

Targeted a heterogenous group of runners ($n = 64$, 34 ± 16 y, 50% female)
to examine variability in running economy responses to two shoes



SUPER SHOE

Salomon S/Lab Phantasm 2
NZ\$460



CONTROL

Salomon Aero Glide 2
NZ\$210



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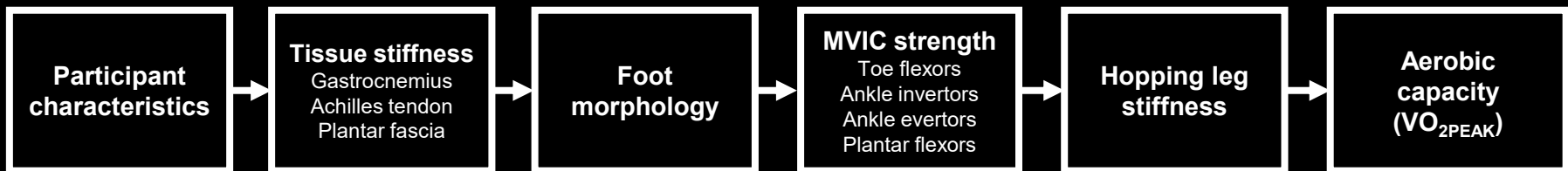


Metabolic cart + 2D motion + Myotome +
Force Plate + Dynamometer + Calf Raise App

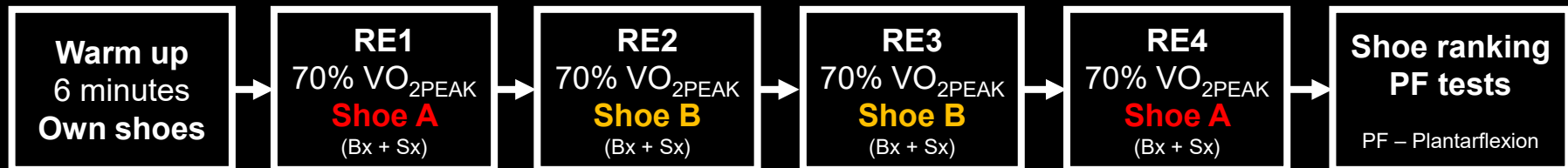
THE “SUPER SHOE” (STUDY 5)

Targeted a heterogenous group of runners ($n = 64$, 34 ± 16 y, 50% female)

SESSION 1



SESSION 2 (2 – 7 days later)



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Metabolic cart + 2D motion + Myotome +
Force Plate + Dynamometer + Calf Raise App

THE “SUPER SHOE” (STUDY 5)

RESPONDERS ($\Delta \geq 2.5\%$) vs **NON-RESPONDERS** ($\Delta < 2.5\%$)

MOST runners were responders (83%, mean improvement 4.1%)

NO significant differences across 70+ measures, except one

Normalised gastrocnemius muscle stiffness 10% greater in responders



CORRELATIONS and REGRESSION

FIVE foot-ankle measures sig. correlated with economy responses

TWO explained **27.5%** of the variance

Normalised gastrocnemius muscle stiffness ($r = 0.35$)

Navicular drop ($r = 0.31$)



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Take home message



Most metrics were **unable** to distinguish responder status



No sig. difference between **sexes** and running **levels** (all can benefit)



Muscle-tendon stiffness of ankle-foot complex may be important



Large proportion of variability remains **unexplained**

ARTICLE

Hebert-Losier et al. *Under review.*



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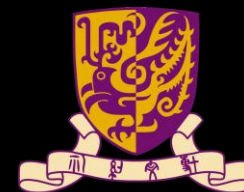


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Thank you
多謝



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