National-standard middle-distance runners maintain maximal 1500 m running performance on successive days

Dr Laurence Birdsey, Dan Evans, Dr Adam Runacres, Dr Thomas Dos'Santos, Dr Matthew Weston and Dr Adam Field

A.Field@mmu.ac.uk

@acfield1992

ECSS GLASGOW 2024

DAY 1 Heat → DAY 2 Semi-final → DAY 3 Rest → DAY 4 Final

BACKGROUND

- 3 rounds of competition, separated by 24 & 48 h
- Winners adopt championship pacing strategies (Hanley and Hettinga, 2018)
  - Running sub-maximal speeds & Qualifying (doing “enough”)
  - Progressing times to produce fastest time in the final
- Yet, some athletes slow in the final (Hanley and Hettinga, 2018)
  - Attributed to running more maximally in earlier rounds and accumulating fatigue
- Performance margins are small

WC Budapest 2023	Difference (s)	Difference (%)
Top 8	1.40	0.67
Top 3	0.30	0.14
Medal vs. Non-medal	0.21	0.10

- Large performance impact of enhancing performance through rounds of competition
- However, why performance changes between rounds is unclear

PURPOSE & AIM

PURPOSE: To investigate why performance changes through successive 1500 m time-trials

AIM: To examine the impact of successive 1500 m maximal self-paced time-trials on running performance, physiology and biomechanics

METHODS

Overview

- National-standard middle-distance specialists (tier 3)
- Familiarisation 1500 m TT
- 2 x 1500m TT separated by 24 h

Protocol

- Standardised warm-up
- Self-paced TT(Gaitway 3D, h/p/cosmos)
- No structured recovery or training

Measures

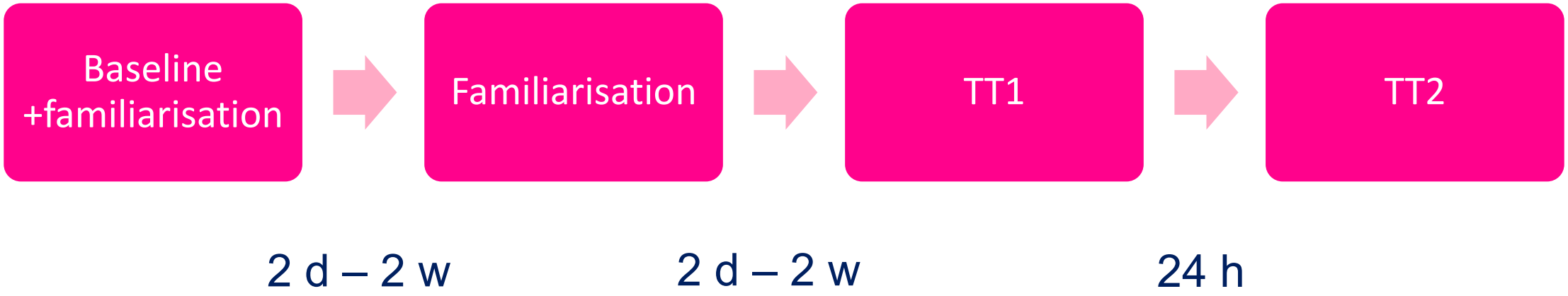
- Internal (HR, [BLA], dRPE, expired gas analysis)
- External (speed)
- Time

N = 12 (10♂ 2♀)	Mean ± SD
Age (y)	27 ± 7
Height (m)	1.8 ± 0.1
Mass (kg)	66 ± 8
1500m SB (s)	244.1 ± 18.8
1500 m SB (%)	86.5 ± 3.9
Weekly mileage (km)	85 ± 24
Running experience (y)	14 ± 8
LT ($km \cdot h^{-1}$)	14.7 ± 1.1
LTP ($km \cdot h^{-1}$)	16.7 ± 1.1
$V\dot{V}O_2peak$ ($km \cdot h^{-1}$)	20.6 ± 1.3
$\dot{V}O_2peak$ ($ml \cdot kg \cdot min^{-1}$)	58.3 ± 3.6

METHODS

Data analysis

- Matt to write a summary as I've no idea!



TIME

- Fixed effects of time-trial on running time was -0.6% (95%CI -1.6, 0.3)
- Most of the variance in running time was explained by random effect of athlete
  - ICC=0.98
  - Marginal R2 of 0.002

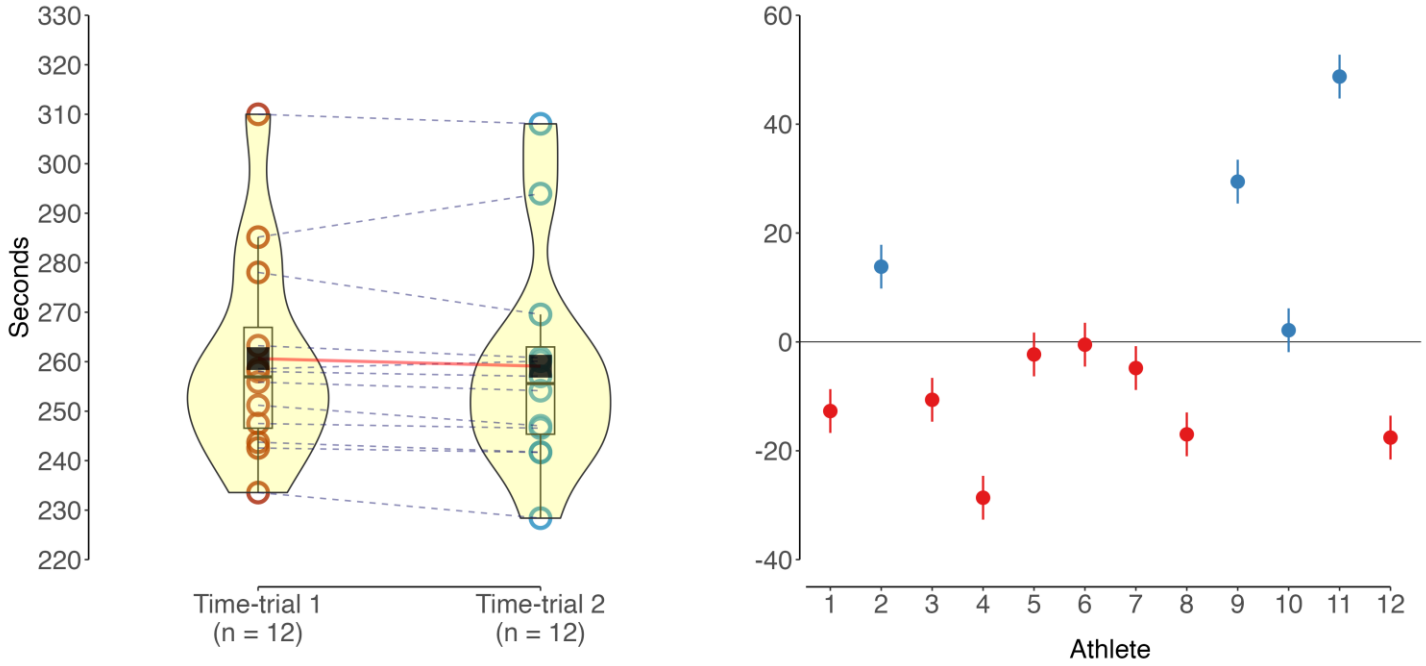


Figure 1. Violin plots, boxplots, mean time-trial 1500 m running time (black square) and individual athlete data points (left panel) along with the random effect estimates and 95% confidence intervals for athlete (right panel).

PEAK PHYSIOLOGICAL RESPONSES

- Fixed effects of TT were:
  - Peak HR: -0.5% (-1.4, 0.4)
  - Peak VO_2: -0.4% (-1.8, 1.1)
  - Peak BLA: 0.8% (-6.0, 8.1)
  - Peak RER: 1.2% (-1.6, 4.1)
- Mostly accounted for by athlete random effect
  - ICCs from 0.62 to 0.96
  - Low marginal R2 (0.0009 to 0.016)

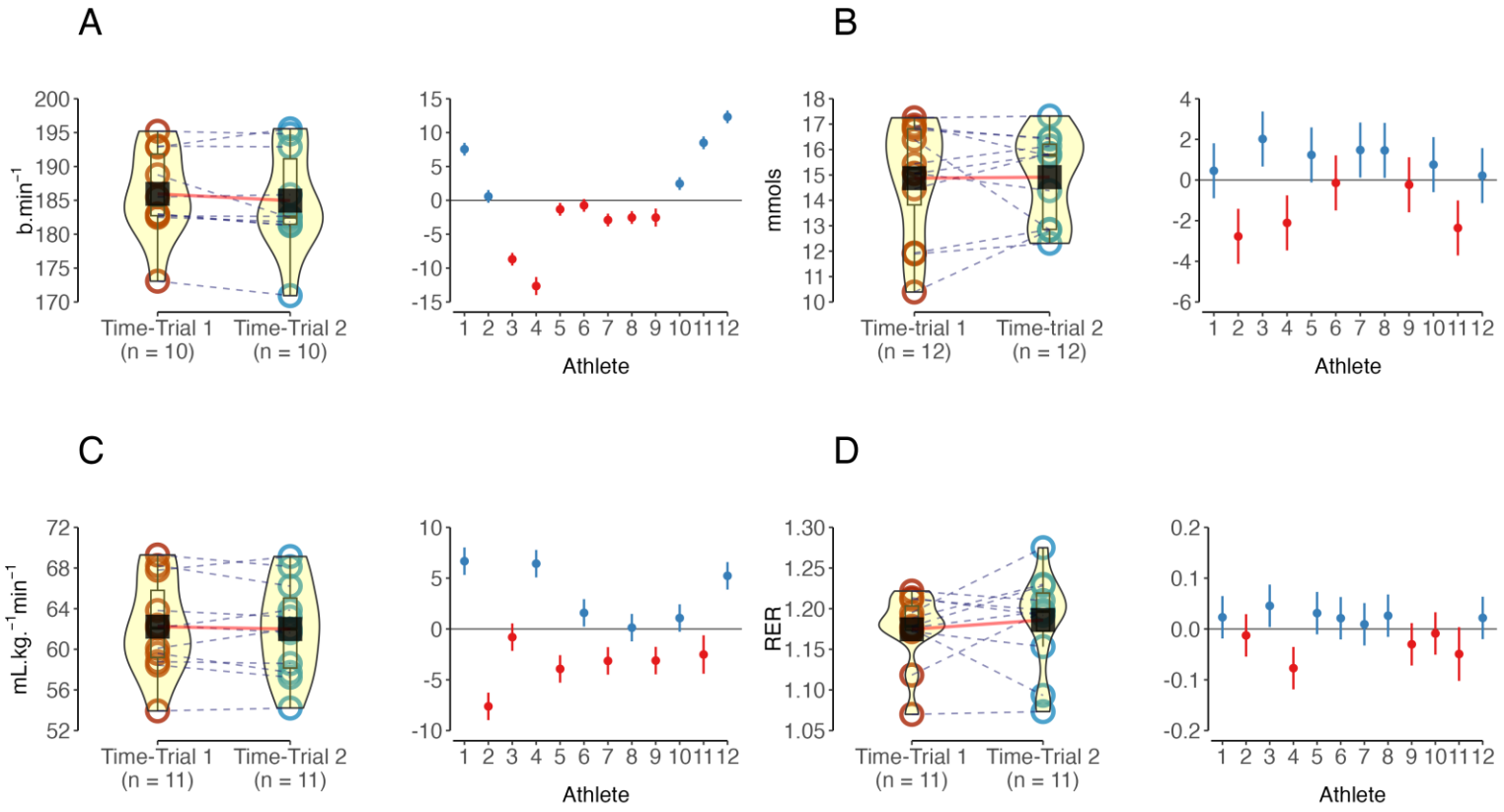


Figure 2. Violin plots, boxplots, mean time-trial response (black square) and individual athlete data points (left panel) along with the random effect estimates and 95% confidence intervals for athlete (right panel) for peak heart rate (A), blood lactate (B), peak VO_2 (C), and peak RER (D)

MEAN PHYSIOLOGICAL RESPONSES

- Fixed effects of TT were:
  - Mean HR: -0.6% (-1.0, -0.2)
  - Mean RE: 0.1% (-0.9, 1.1)
  - Mean VO_2: 0.2% (-1.4, 1.8)
  - Mean RER: 1.8% (-0.8, 4.4)
- Mostly accounted for by athlete random effect
  - ICCs from 0.68 to 0.99
  - Low marginal R2 (0.0001 to 0.033)

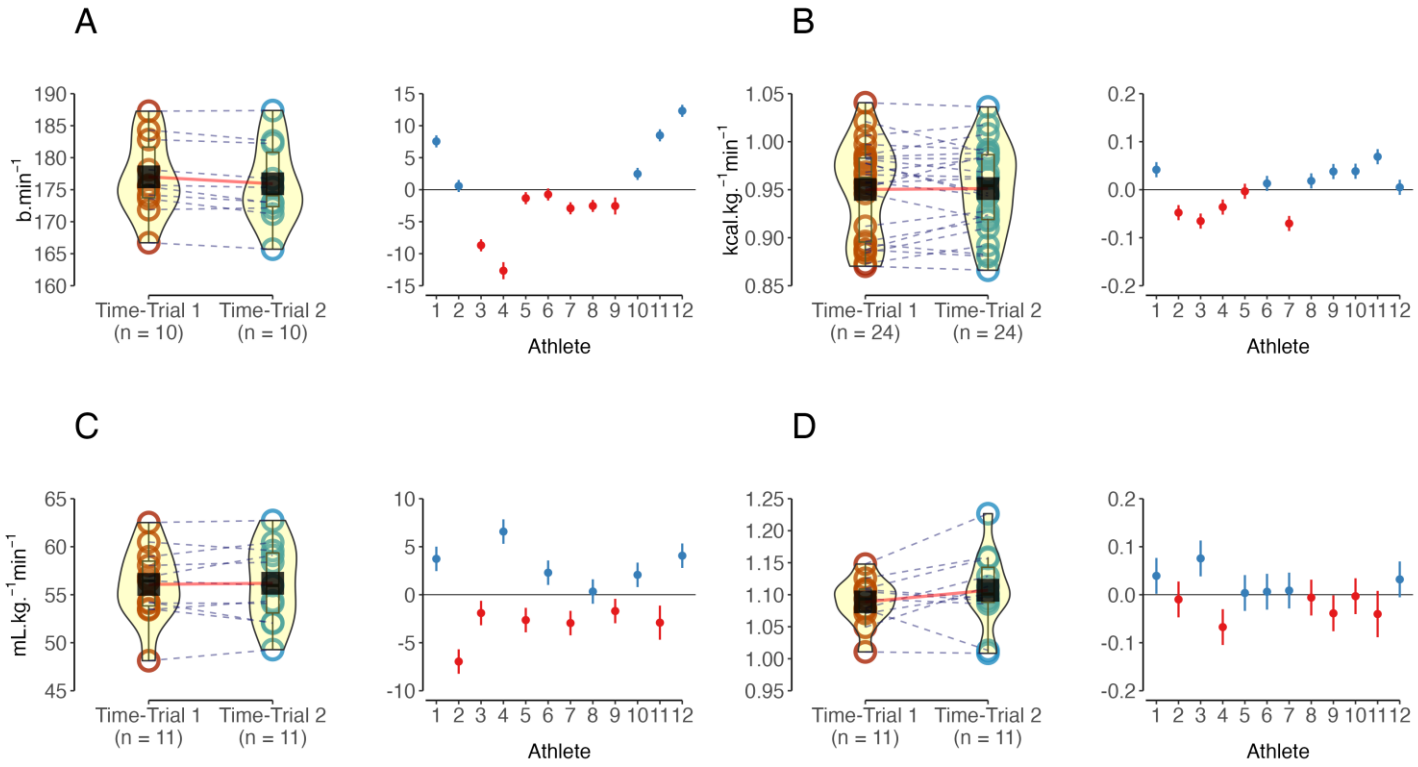


Figure 3. Violin plots, boxplots, mean time-trial response (black square) and individual athlete data points (left panel) along with the random effect estimates and 95% confidence intervals for athlete (right panel) for mean heart rate (A), running economy (B), mean VO_2 (C), and mean RER (D)

EQUIVALENCES

- Statistical equivalence is observed for 1500 m time, mean and peak heart rates, VO_2, RE, BLA.
- Differences are within measurement error
- All remaining variables are not statistically equivalent to the previously reported measure error

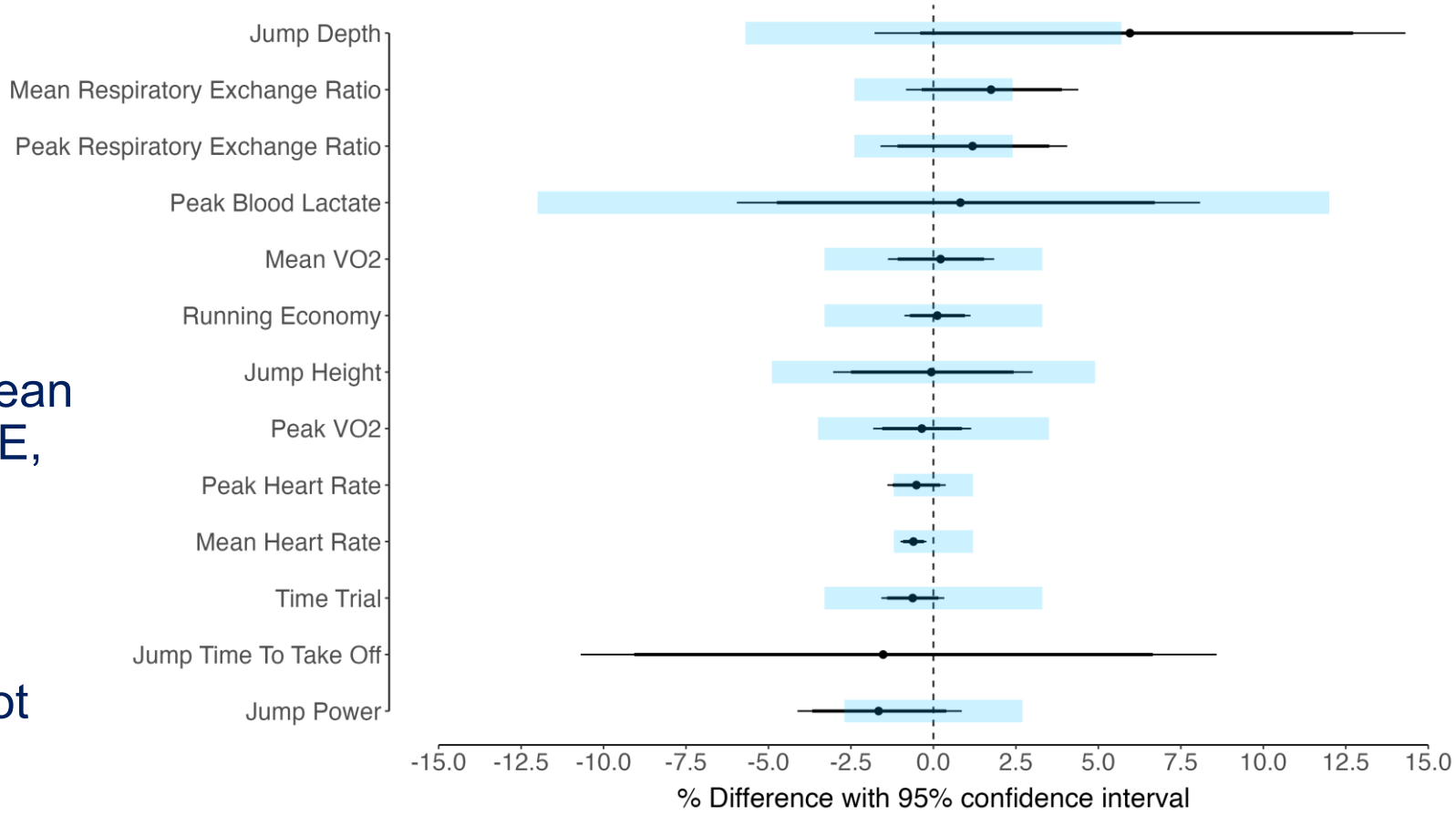


Figure 4. Forest plot of the between-trial difference and 95% confidence intervals, expressed as %'s, for all performance and physiological variables. The previously reported %CV's for each respective variable are displayed via the light blue shaded area.

PERCEPTUAL MEASURES

- Athletes were 1.5-2.4 x more likely to rate exertion and mood higher in TT2
- But with considerable uncertainty surrounding the estimates

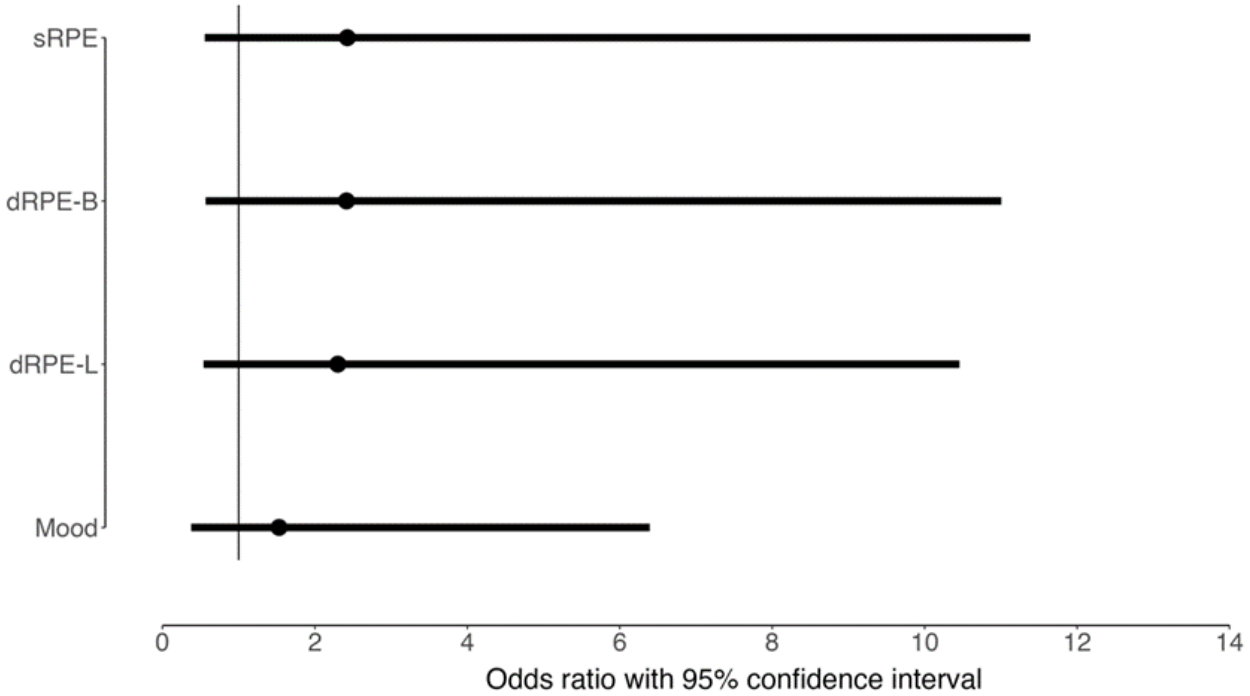


Figure 5: Forest plots showing the odds ratios and 95% confidence interval for the fixed effect of time trial performance on all perceptual measures,

PRACTICAL APPLICATION

1. Highly trained runners, who are highly accustomed to race demands, can maintain performance across successive time-trials
2. Observed increases in performance in championships is likely due to tactical approaches, or minimising effort in prior rounds
3. Those who must perform maximally in heats are unlikely to improve performance in the semi-final

Limitations

Treadmill vs over-ground

Lack of competition/ motivation for “extreme” performance?

Competitions have significantly different demands (e.g., impaired sleep, media commitments, cognitive load etc)

ECSS
GLASGOW
2024