EUROPEAN ATHLETICS
COACHING SUMMIT SERIES

Regulation of performance during endurance competition

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EUROPEAN ATHLETICS

ENGLAND ATHLETICS

BRITISH MILERS' CLUB

Thanks to my colleagues

Prof Zig St Clair Gibson (University of Hull)

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Fatigue is the Problem

Origins of fatigue can be central or peripheral in origin.

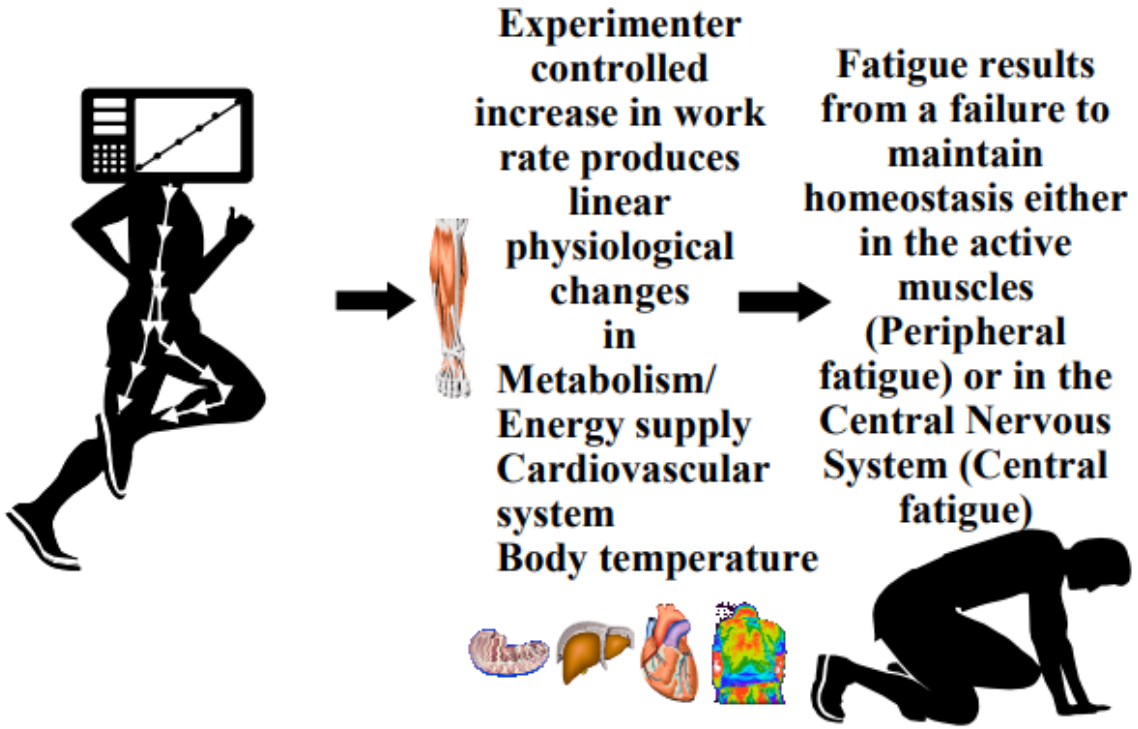
However, a useful **functional** definition is “the inability to maintain a desired or expected power output” (Edwards 1983)

Some of the things that can ‘go wrong’:

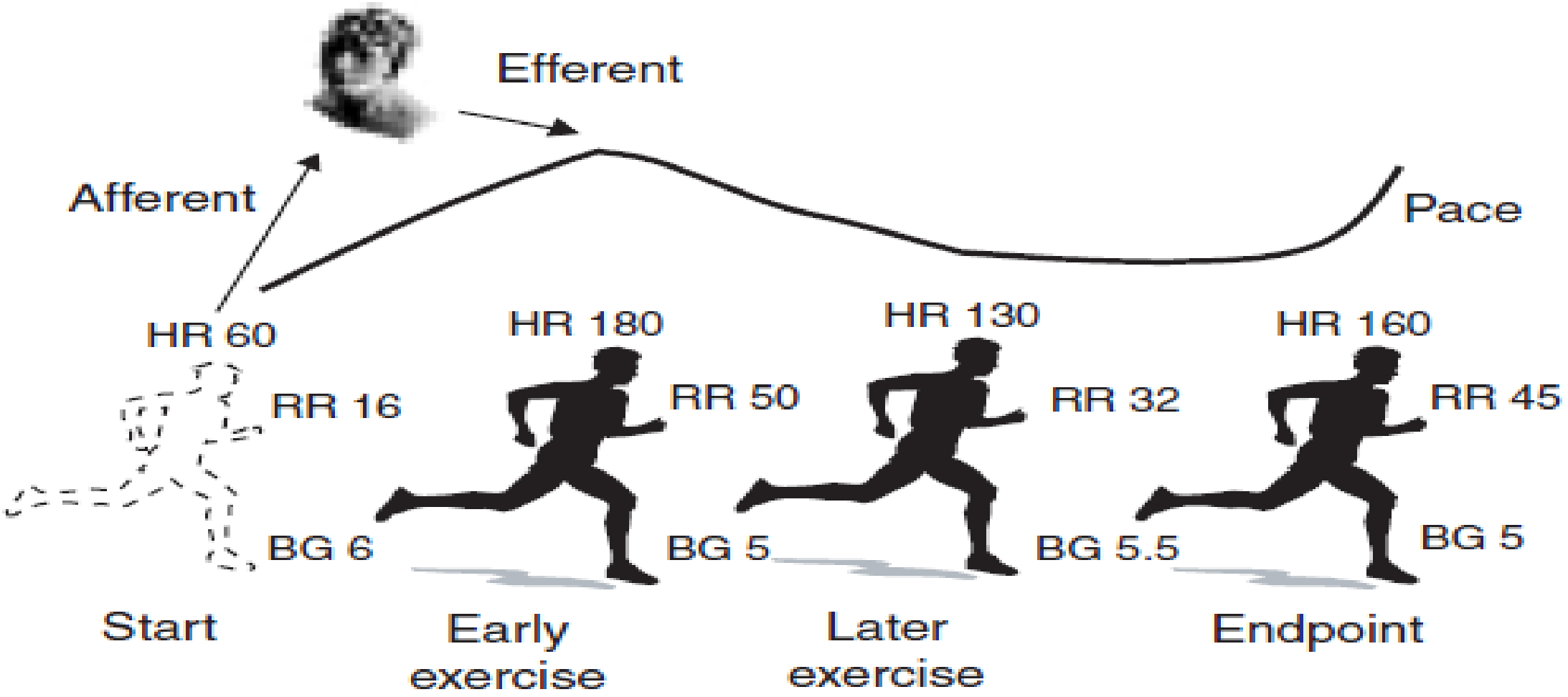
Low pH, glycogen depletion, dehydration, hyperthermia, ion fluxes, mechanical damage, reduced motivation etc etc…

British Journal of
Sports Medicine

Testing for maximum oxygen consumption has produced a brainless model of human exercise performance

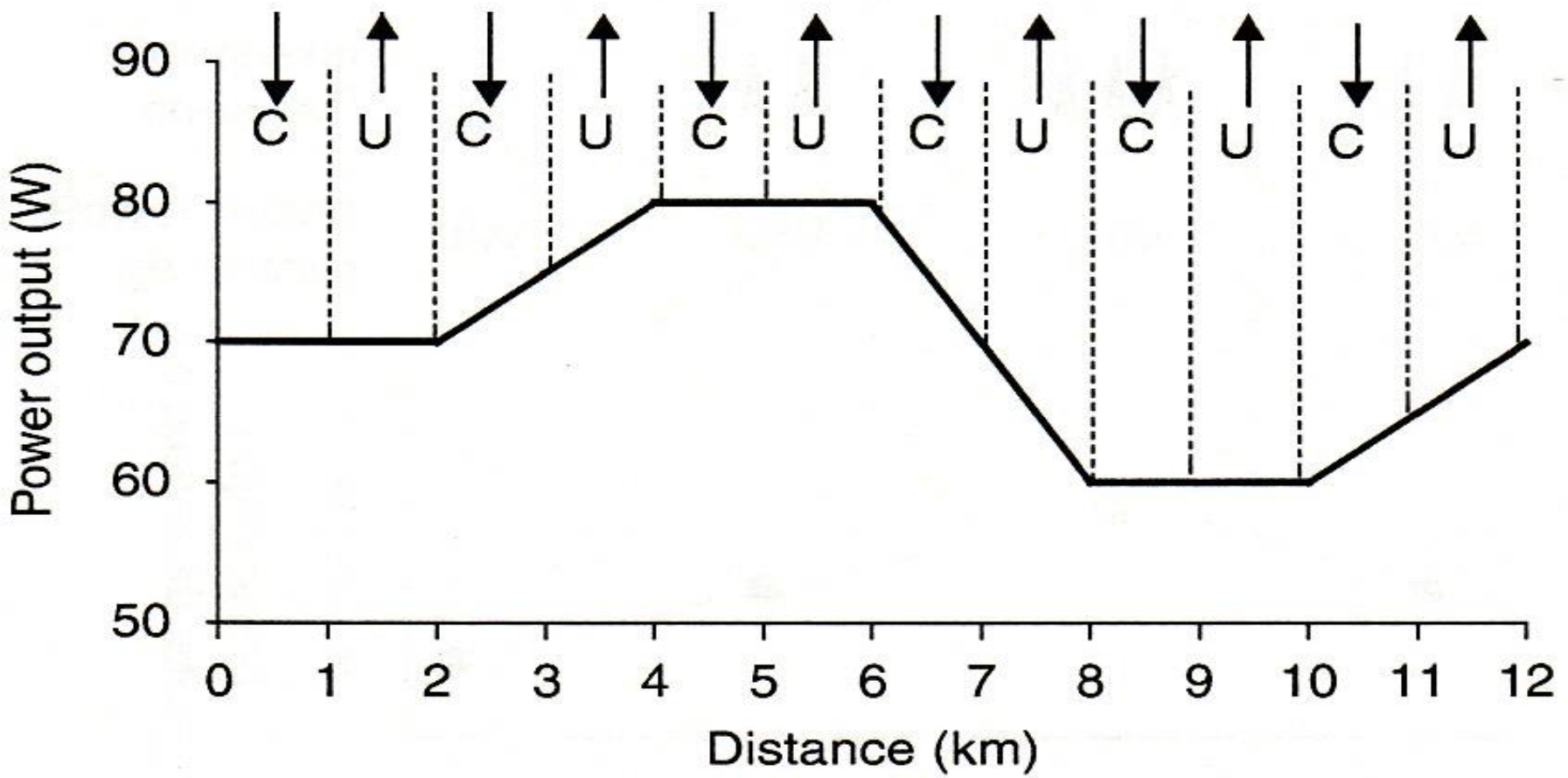


Teleoanticipation



- St Clair Gibson et al. 2006

Teleoanticipation



- St Clair Gibson et al. 2006

Regulation is required to address tension between the ‘mind’ and the ‘body’

- Goal achievement

Avoidance of catastrophic physiological failure

St Clair Gibson et al. 2018

Prevent catastrophic physiological failure

Goal setting is a necessity

Goal achievement is facilitated through identification of a strategy

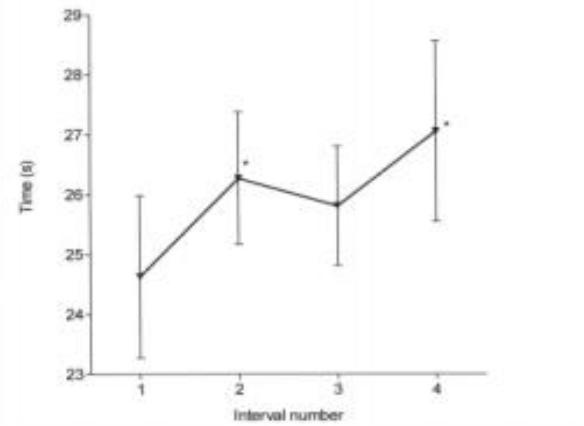


Figure 2 — 200-m interval times from 12 world-record performances in the 800-m. Values are mean ± SD for 12 performances. *Significantly different from intervals 1 and 3 ($P < .05$).

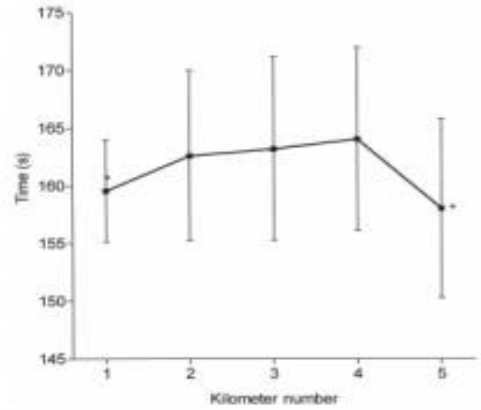


Figure 3 — Kilometer times from 32 world-record performances in the 5000-m event. Values are mean ± SD for 32 performances. *Significantly different from kilometers 2, 3, and 4 ($P < .005$).

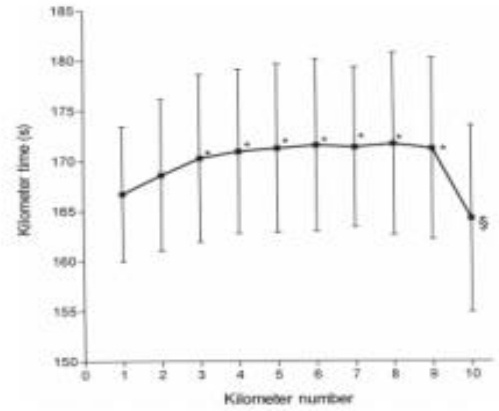


Figure 4 — Kilometer times from 34 world-record performances in the 10,000-m event. Values are mean ± SD for 34 performances. *Significantly slower than kilometers 1, 2, and 10 ($P < .05$). §Significantly faster than the preceding 9 km ($P < .005$).

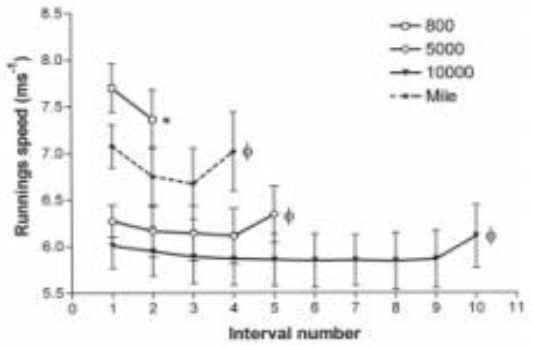
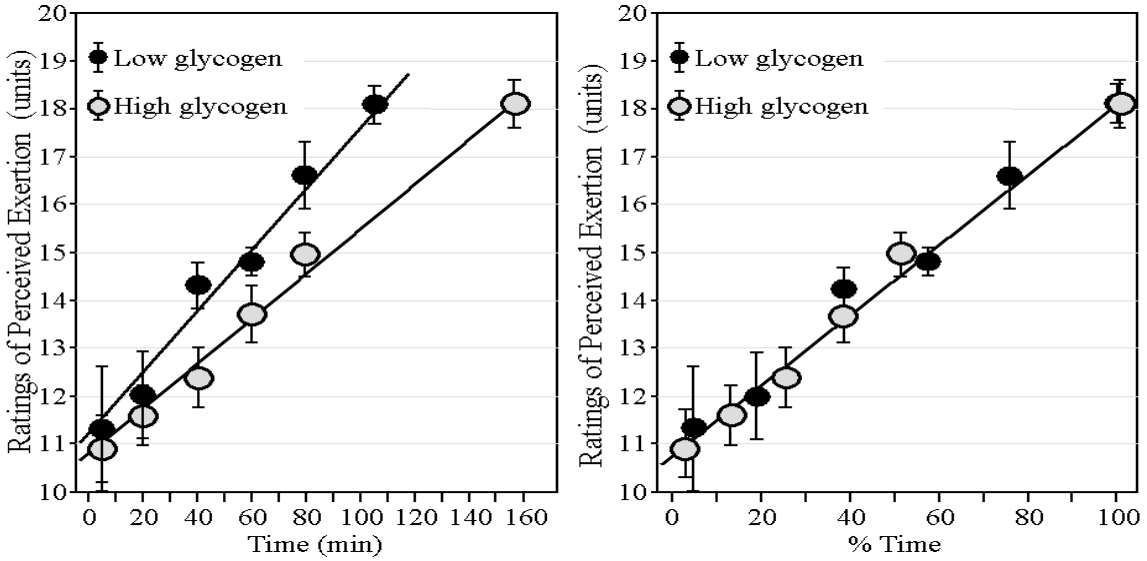


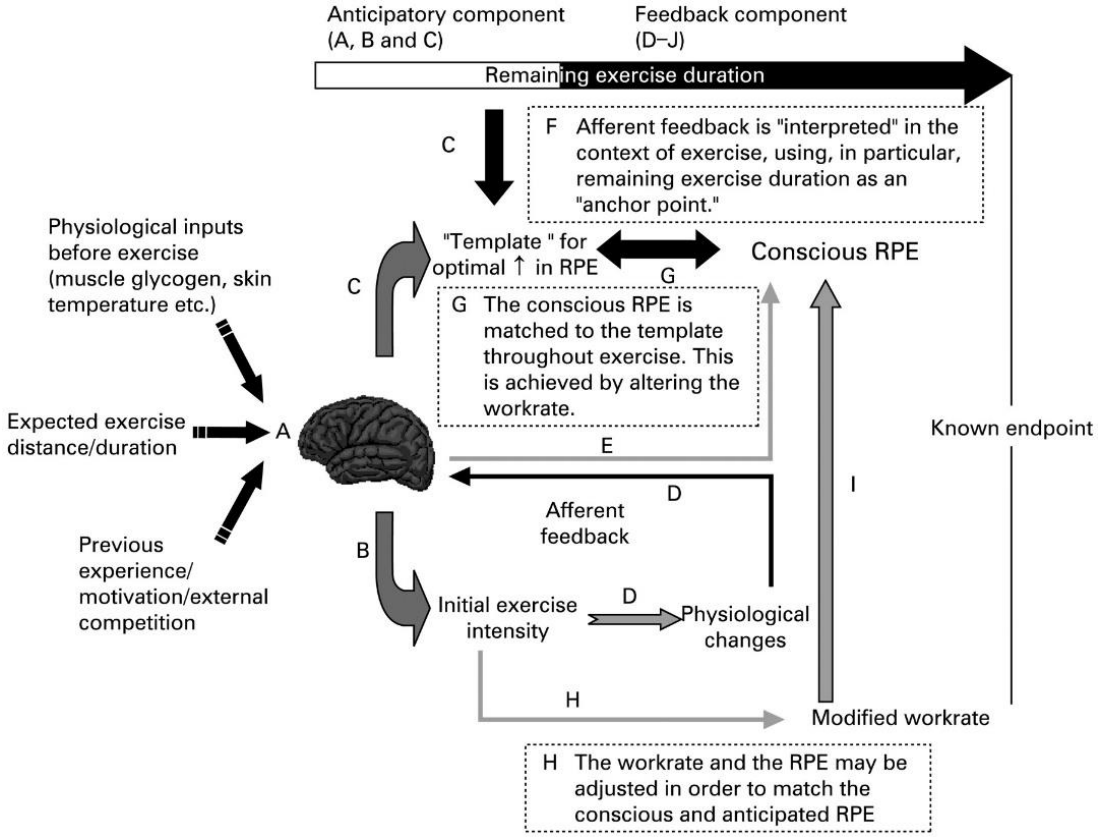
Figure 5 — Average running speed for each interval during world-record performances in 800-m, 1-mile, 5000-m, and 10,000-m events. The running speeds for the mile event are shown with a dashed line (from Noakes and Lambert, in review). *Significantly slower than the first lap ($P < .005$). ΦSignificantly faster than preceding intervals.

(Tucker 2006)

Plans rarely work out as intended

RPE has been suggested to be the ‘controller’

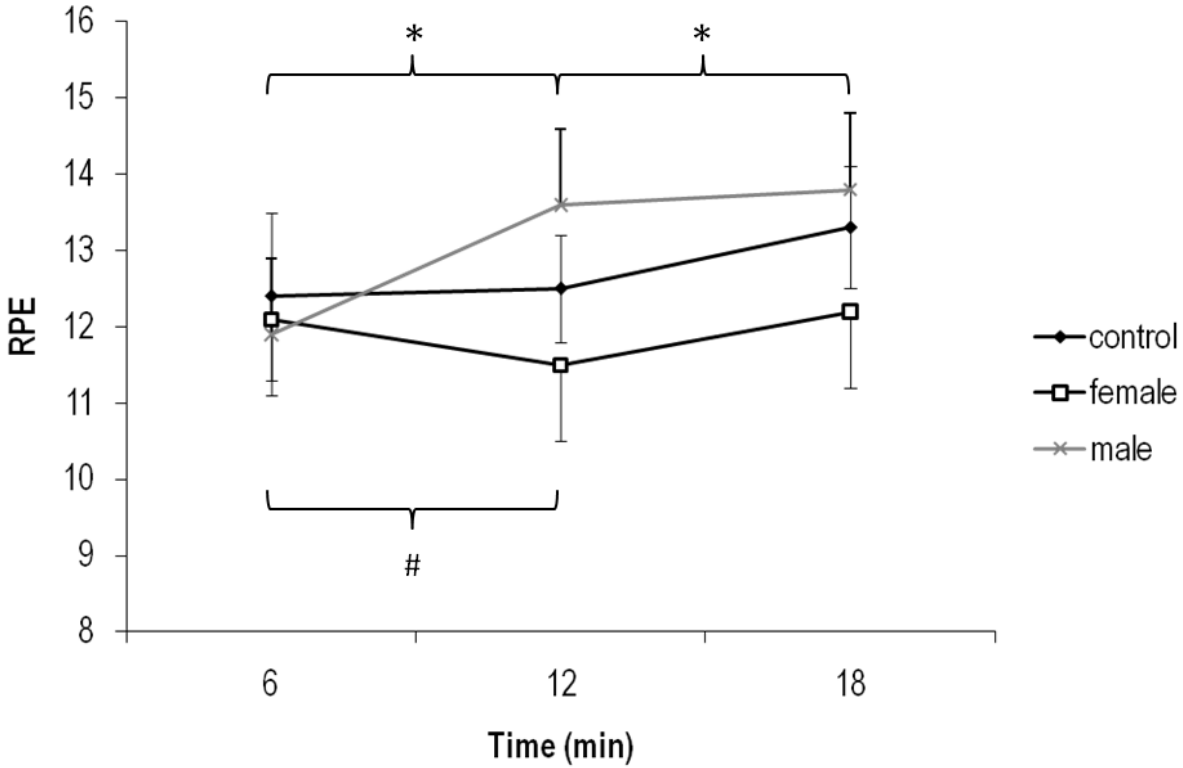


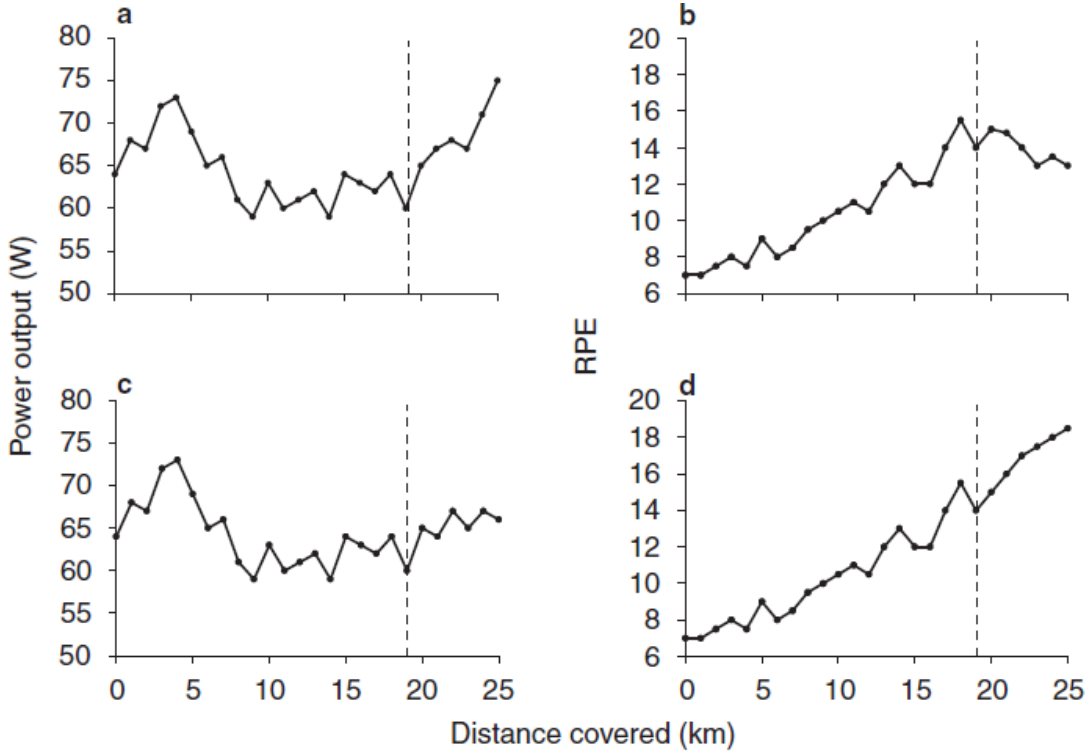


- Noakes 2004

Tucker 2009

But RPE is easily dissociated from physiological variables





- Winchester et al. 2010

St Clair Gibson et al. 2006

Decision-making is the process of making a choice from a set of options where the consequences of that choice are crucial (Bar Eli et al 2001).

Rational Decision Making (Simon 1955) requires certain criteria to be met:

- the individual must be faced with a set of behaviour alternatives.
- the individual must have access information relating to all possible outcomes of the choices made.

Such decision-making behaviour place severe demands on cognitive processing abilities. As such, effective rational decision making can only occur in 'Small World' environments where the decision maker has perfect knowledge of all relevant behaviour alternatives, consequences, and probabilities

Heuristic decision-making considers only a limited fraction of available information.

Heuristics may be the preferred method of decision-making in situations where the outcome of actions cannot be calculated with confidence (Gigerenzer & Gaissmaier 2011). Heuristics therefore place lesser demands on individuals.

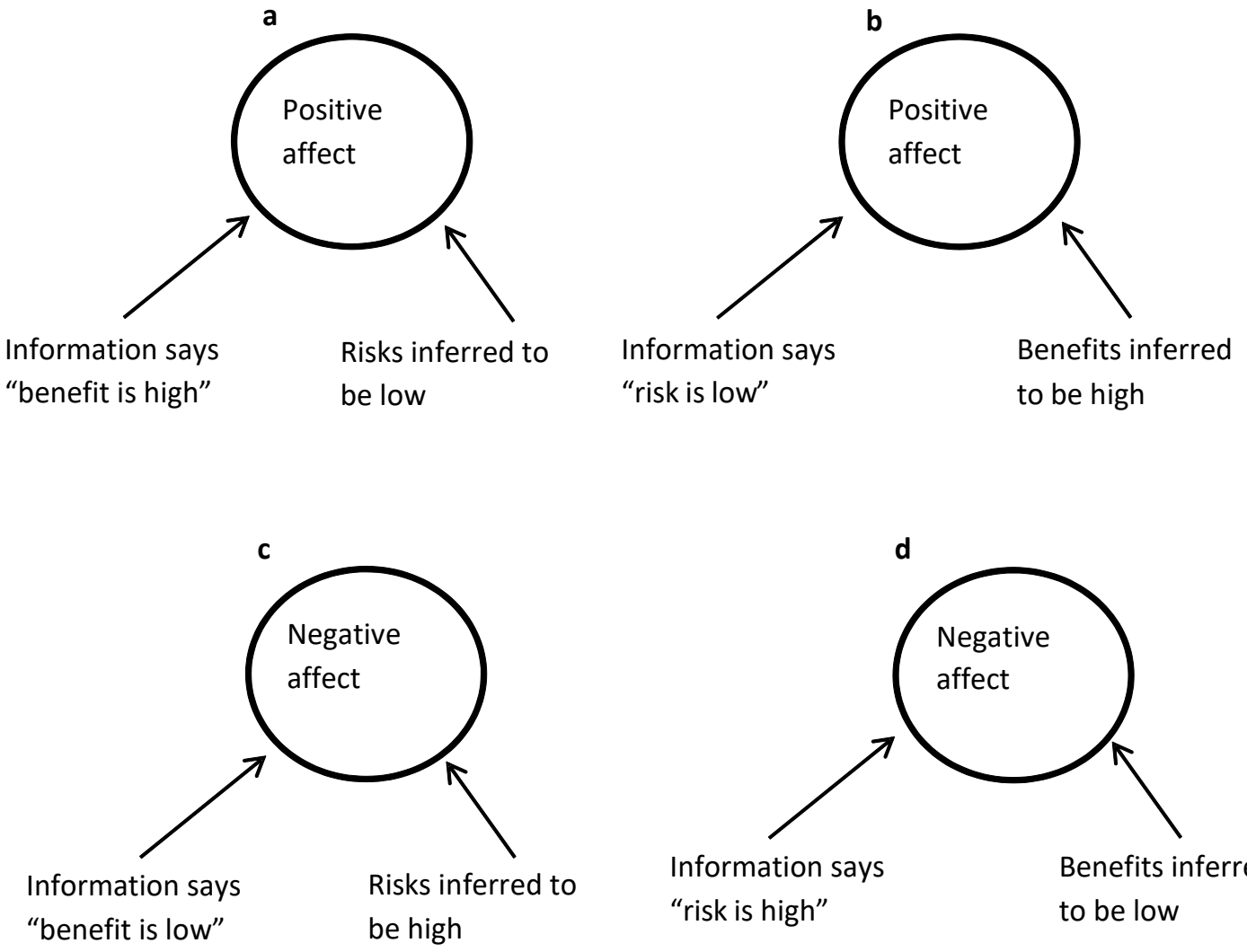
In contrast to the theoretical small world environments described previously, “large worlds” exist where some relevant information is unknown or estimated.

In such environments, rational decision-making is not possible.

Table 1

Rational decision-making	The process of making decisions based upon complete knowledge of the available behaviour options and the statistical probability of specific outcomes occurring. Places high demands on the cognitive processing capacity of an individual.
Heuristic decision-making	A strategy that ignores some available information to make decisions more quickly and or accurately than can be achieved through more complex methods. Heuristics may be considered 'rules of thumb' or 'gut instincts'. Places low demands on the cognitive processing capacity of an individual.
Small world environments	Environments in which the decision maker has perfect knowledge of all behaviour alternatives, consequences, and probabilities
Large world environments	Environments where some relevant information is unknown or estimated

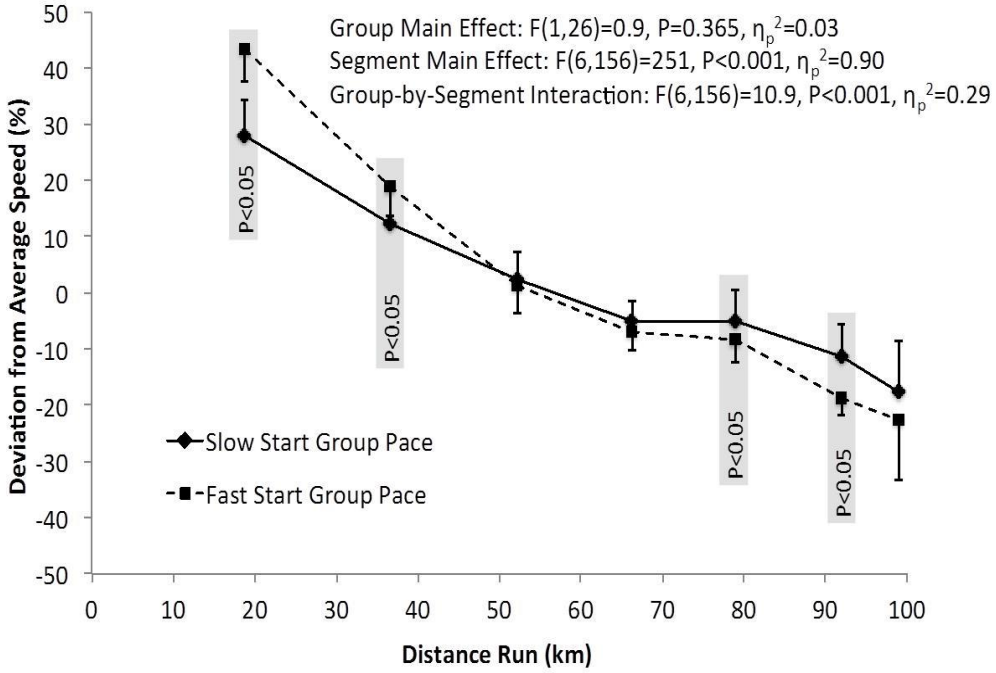
Renfree et al. 2014

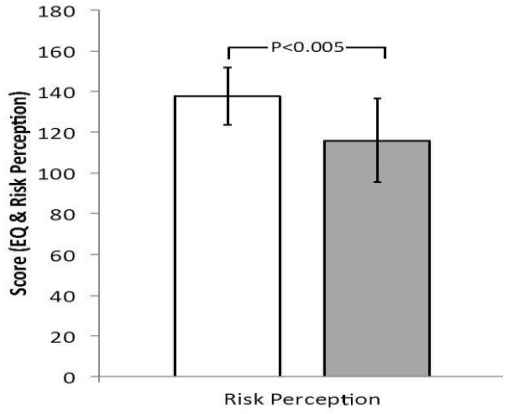


Renfree et al. 2014

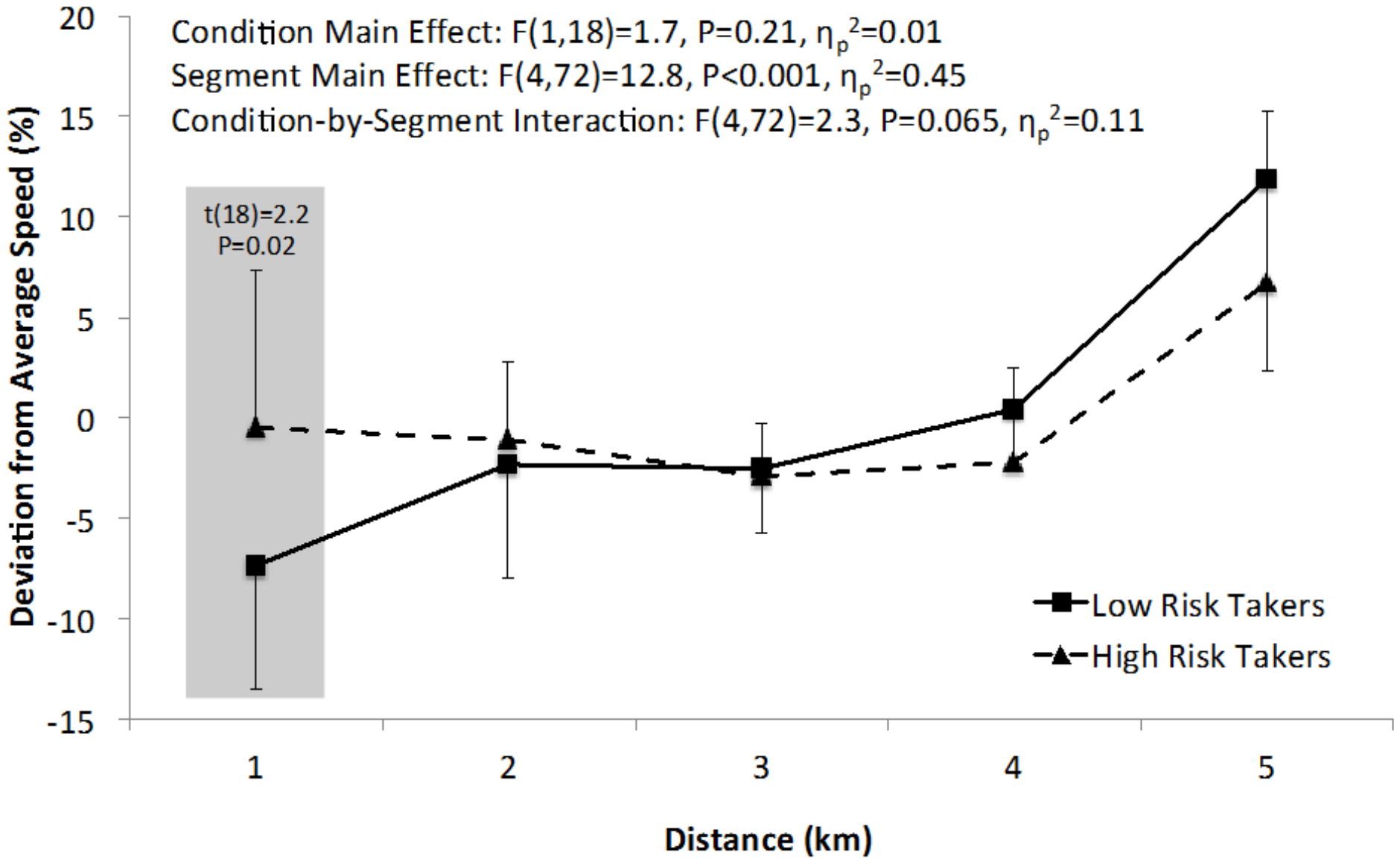
- Use of an overall affective impression is more efficient than rational analysis, especially when the decision to be made is complex or mental resources are limited (Slovic et al 2003)

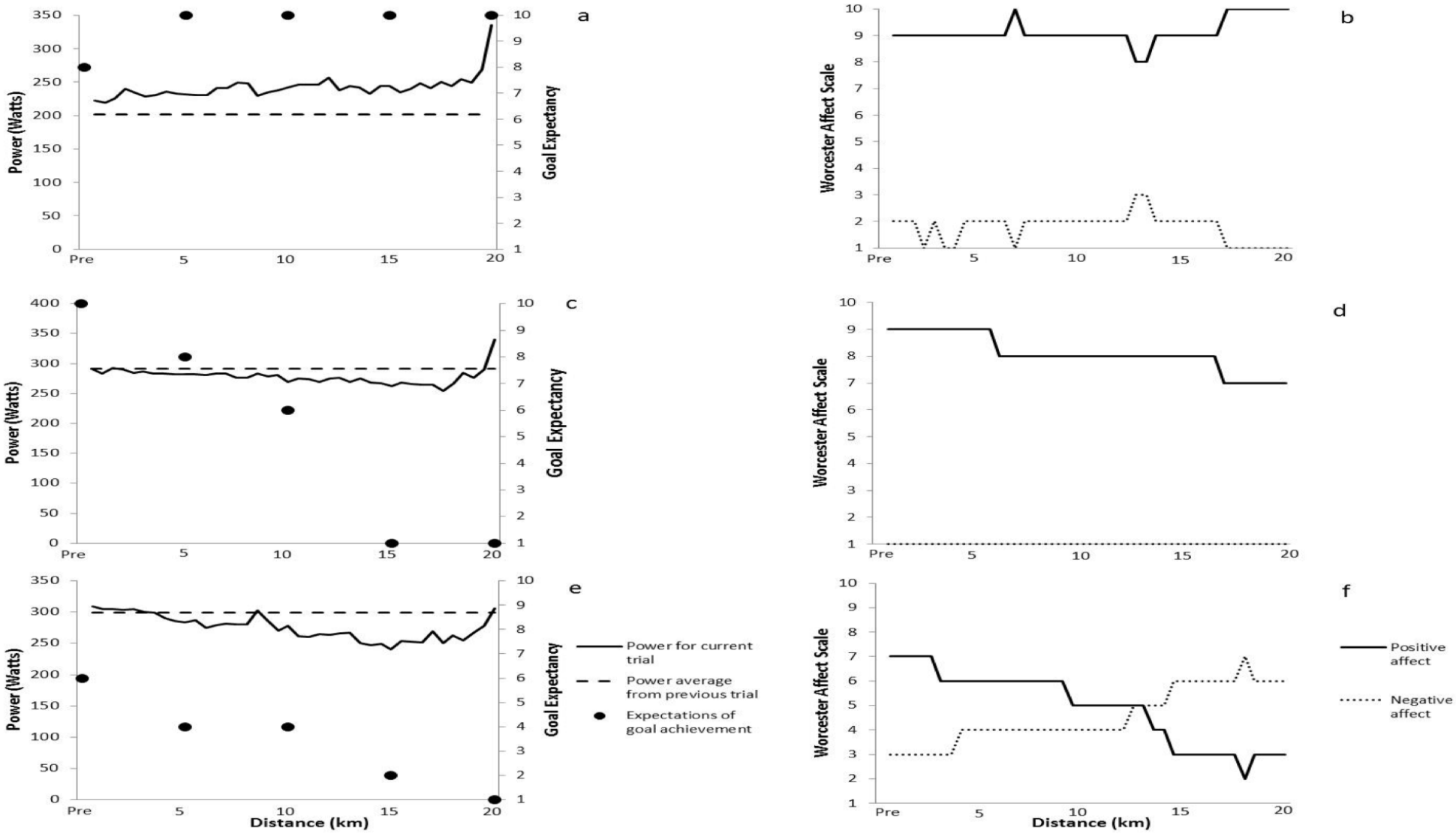
Assessment of risk may be important



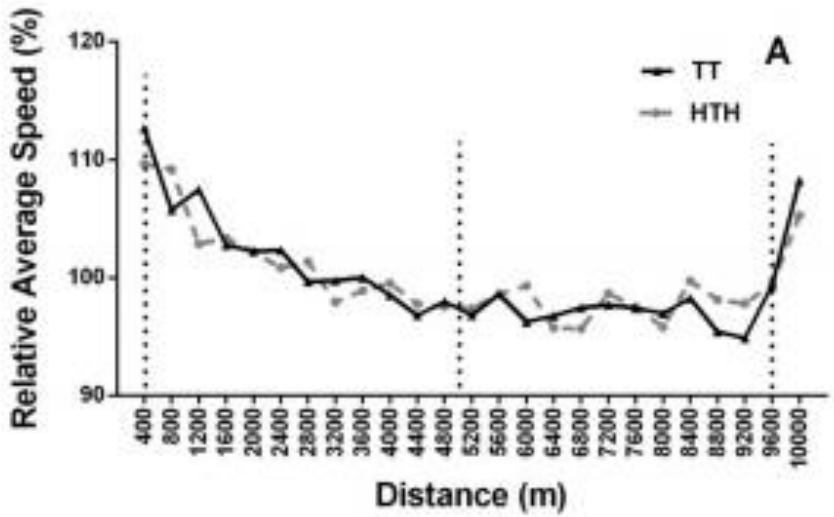


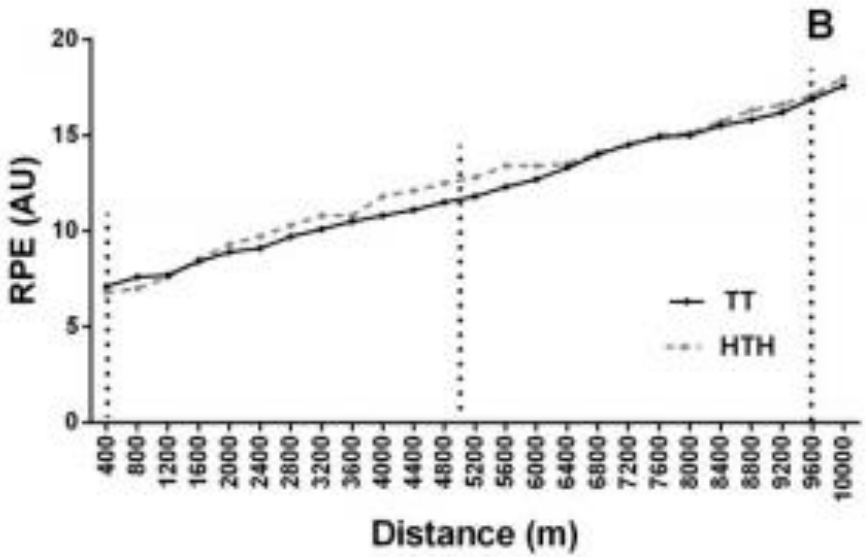
Micklewright et al. 2014

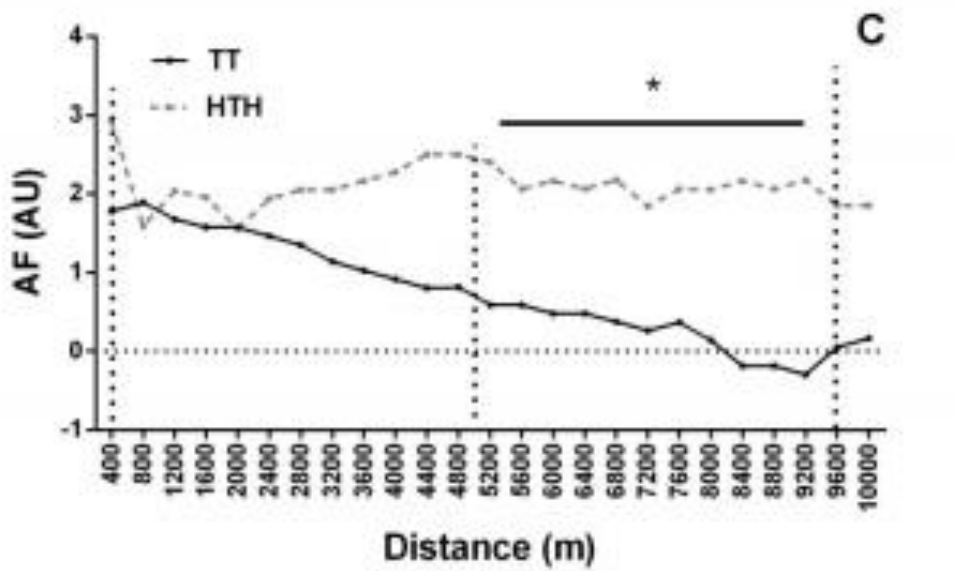

Condition Main Effect: F(1,18)=1.7, P=0.21, η_p^2=0.01
Segment Main Effect: F(4,72)=12.8, P<0.001, η_p^2=0.45
Condition-by-Segment Interaction: F(4,72)=2.3, P=0.065, η_p^2=0.11
t(18)=2.2
P=0.02
Deviation from Average Speed (%)
20
15
10
5
0
-5
-10
-15
1
2
3
4
5
Distance (km)
Low Risk Takers
High Risk Takers



Rhoden et al. 2015

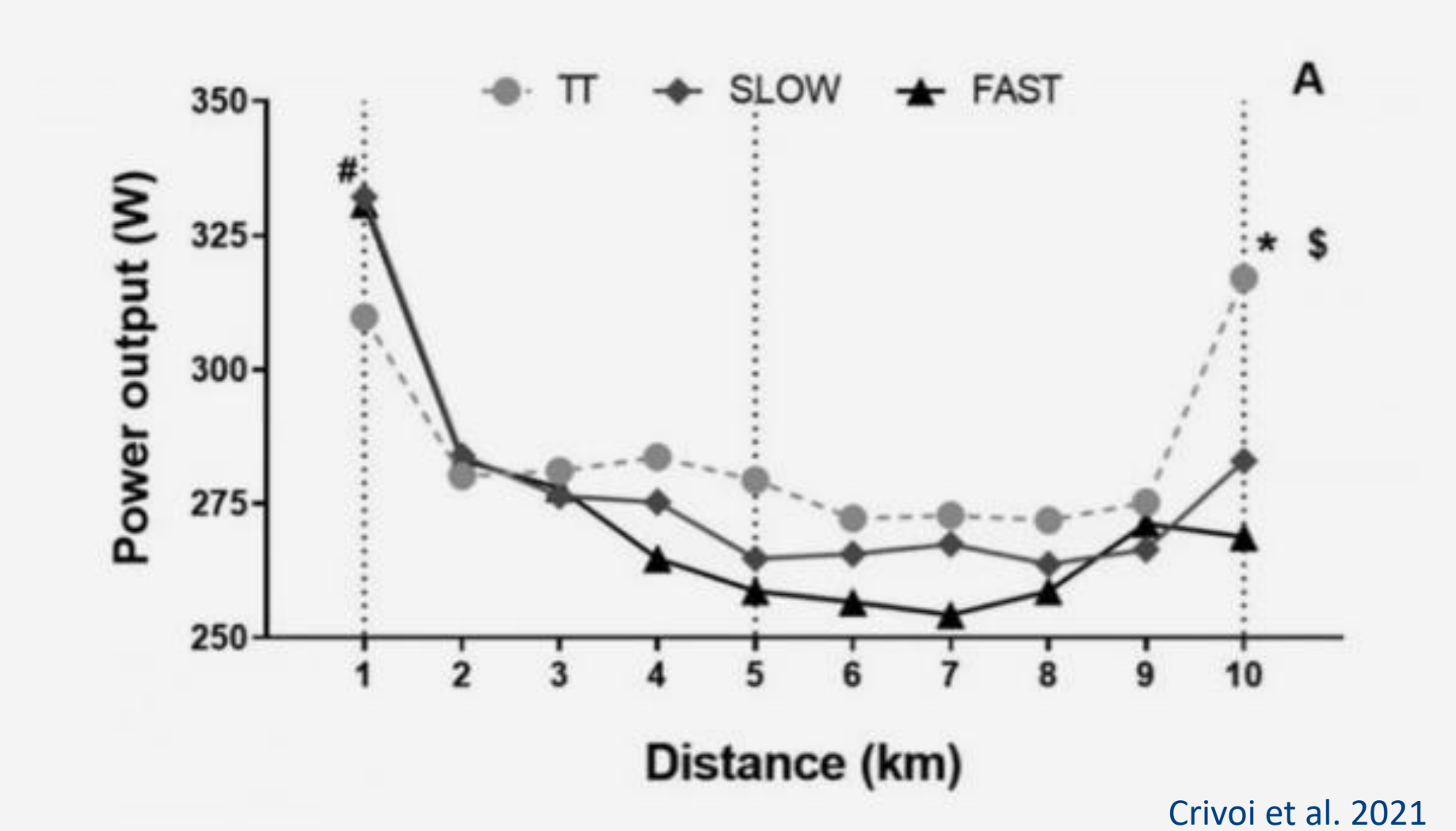




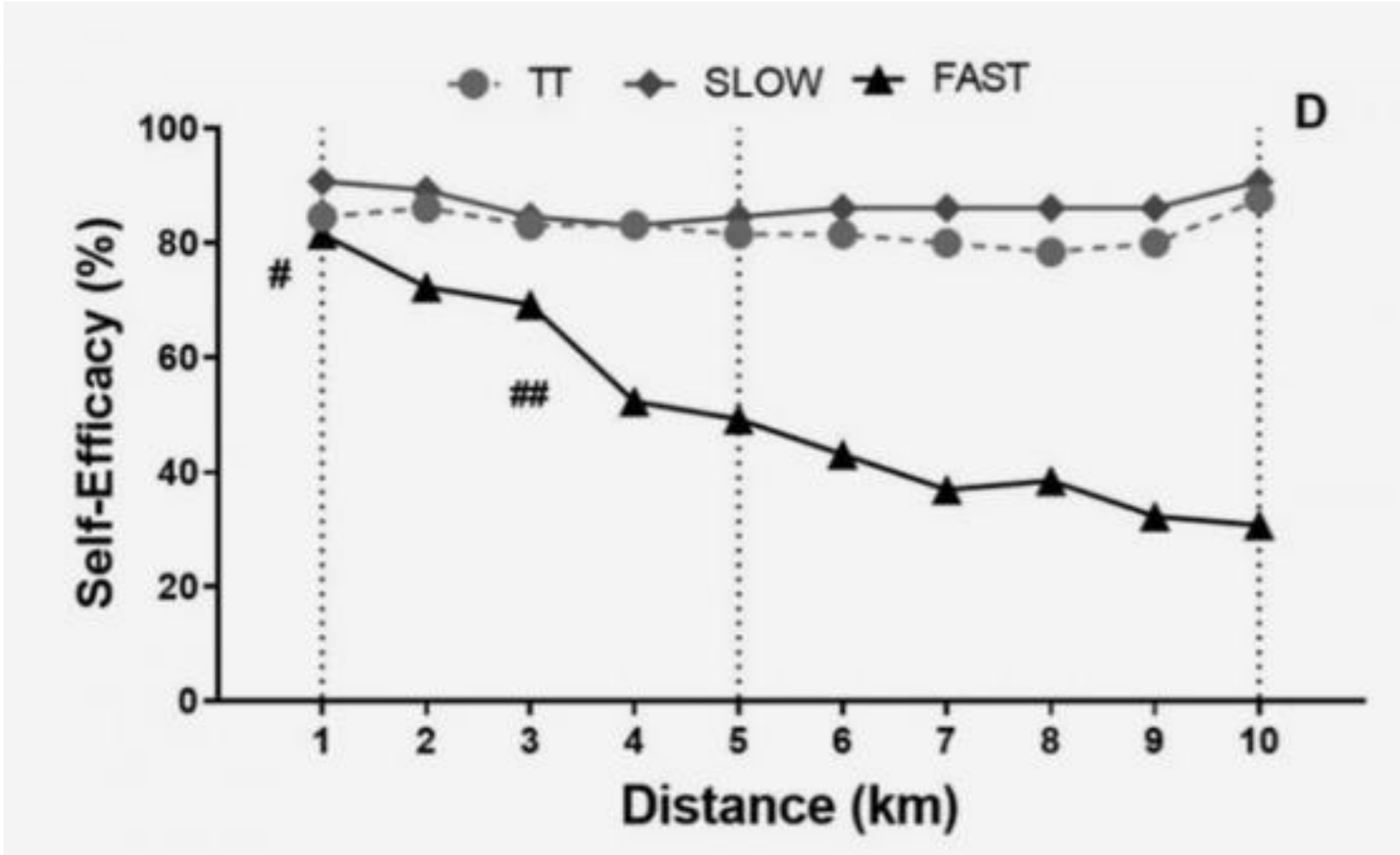


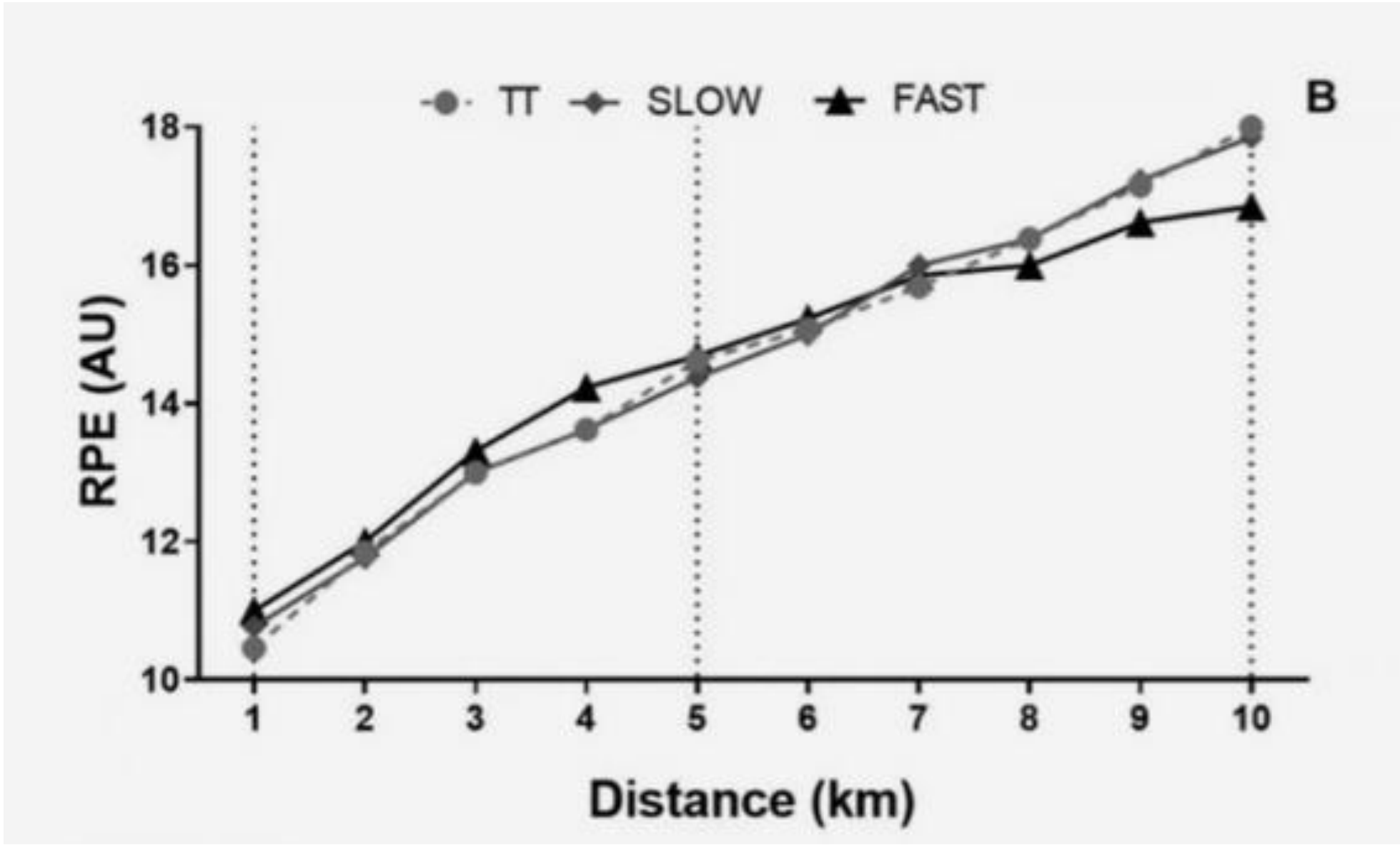
Crivoi et al. 2019

Like knitting with spaghetti!

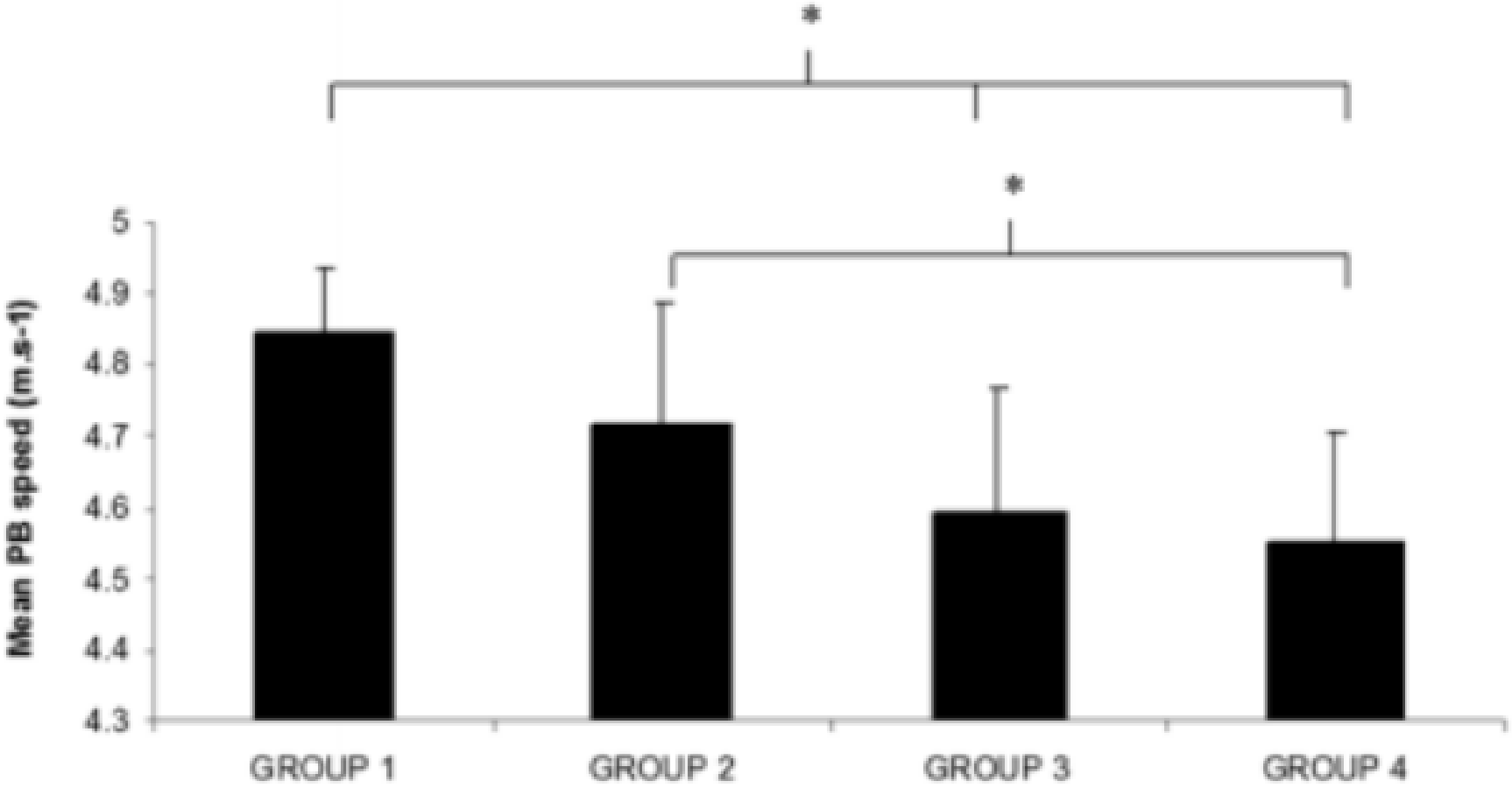


Crivoi et al. 2021


TT
SLOW
FAST
D
100
80
60
40
20
0
Self-Efficacy (%)
#
##
1
2
3
4
5
6
7
8
9
10
Distance (km)


TT
SLOW
FAST
B
RPE (AU)
18
16
14
12
10
1
2
3
4
5
6
7
8
9
10
Distance (km)

Do all competitors do the same?



Renfree & St Clair Gibson 2013

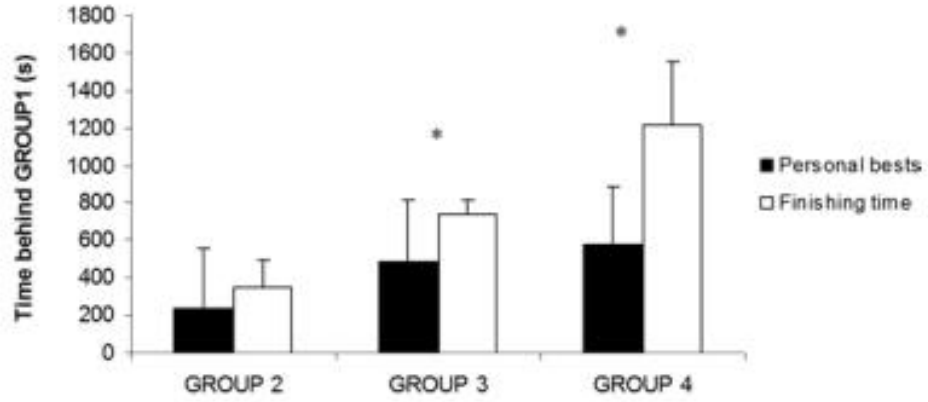


Figure 2 — Time behind personal best and finishing time of group 1 athletes for groups 2–4. *Significant difference between personal best and finishing times behind group 1 ($P < .01$).

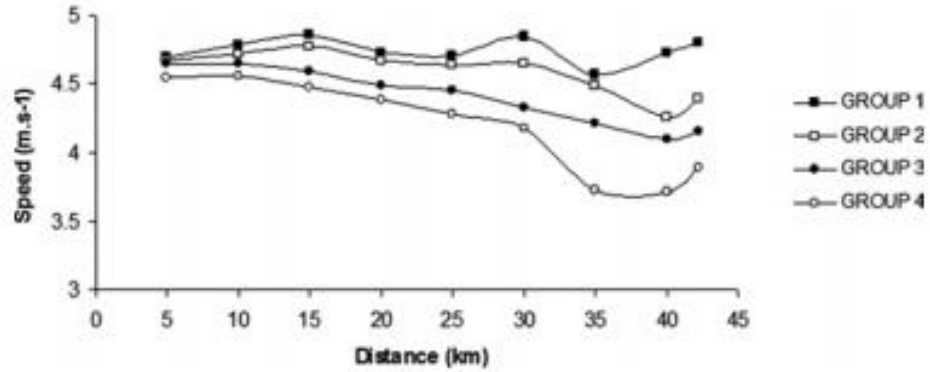


Figure 3 — Mean running speed in each intermediate 5-km segment (error bars and statistical significance removed for clarity).

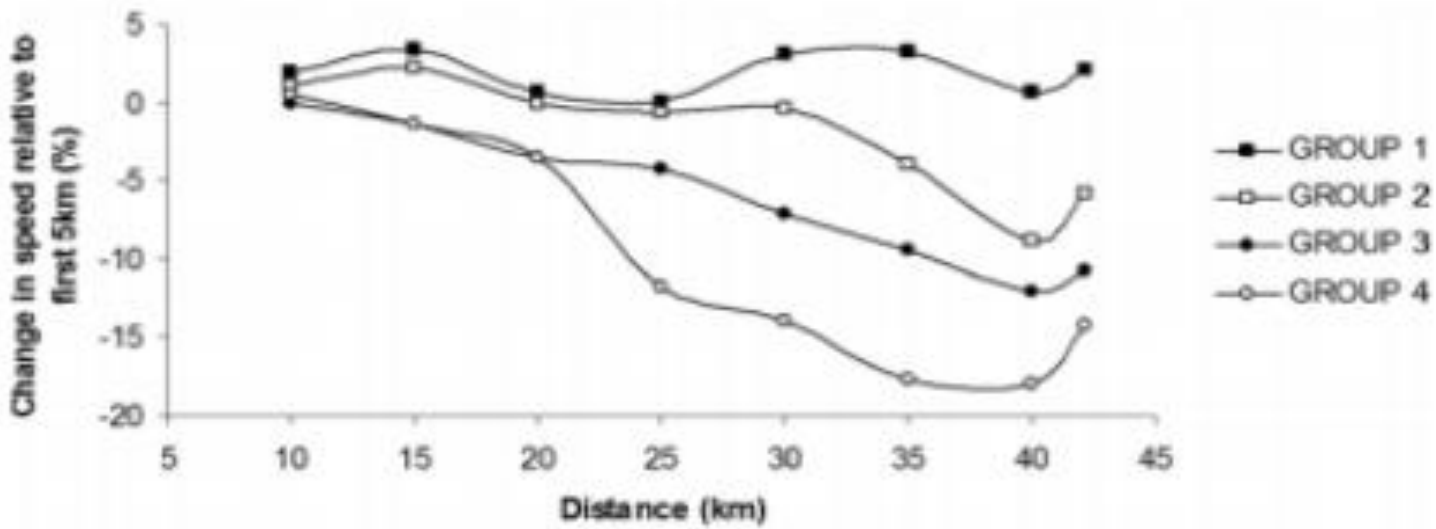


Figure 5 — Changes in speed relative to initial 5 km (error bars and statistical significance removed for clarity).

PERSPECTIVE ARTICLE
Front. Physiol., 09 December 2015 | https://doi.org/10.3389/fphys.2015.00373

The Influence of Collective Behavior on Pacing in Endurance Competitions

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Experimental evidence that opponents influence pacing decisions

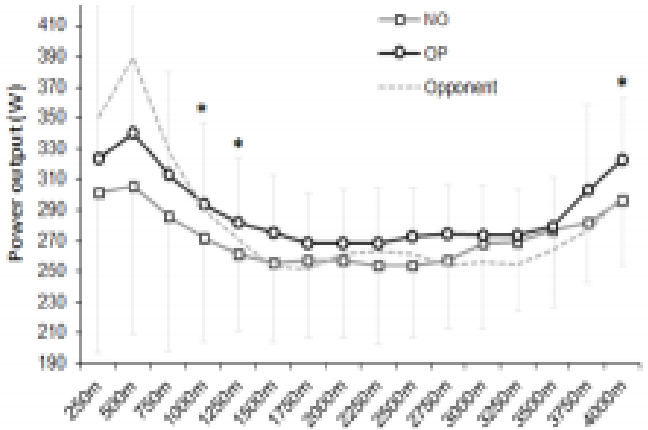

Figure 1. Average power output per 250 m segment for both experimental conditions. In addition, the average power output per 250 segment of the virtual opponent in the experimental condition OP is displayed.
* significant difference between OP and NO (P<0.05)

Table 2. Mean ± SD values for the neuromuscular function of the knee extensors in terms of maximal voluntary contraction force (MVC), potentiated doublet-twitch force (PT) and voluntary activation (VA) before and after both 4 km time trial conditions.

	NO			OP		
	Pre-TT	Post-TT	Decrease%	Pre-TT	Post-TT	Decrease%
MVC [A,B] (N)	715±182	633±169	11.4±10.9	717±199	592±170	17.5±12.4
PT [A,B] (N)	425±70	356±83	16.2±11.4	431±83	331±75	23.1±14.0
VA [A] (%)	80.2±9.8	76.7±8.1	3.4±5.0	83.0±8.8	78.1±11.8	4.9±6.7

[A] main effect for Trial (pre vs post), [B] interaction effect for Trial*Condition

Konings et al. 2018

It’s complex (and that is a good thing!)

Athletic Races Represent Complex Systems, and Pacing Behavior Should Be Viewed as an Emergent Phenomenon

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[1]Institute of Sport & Exercise Science, University of Worcester, Worcester, United Kingdom

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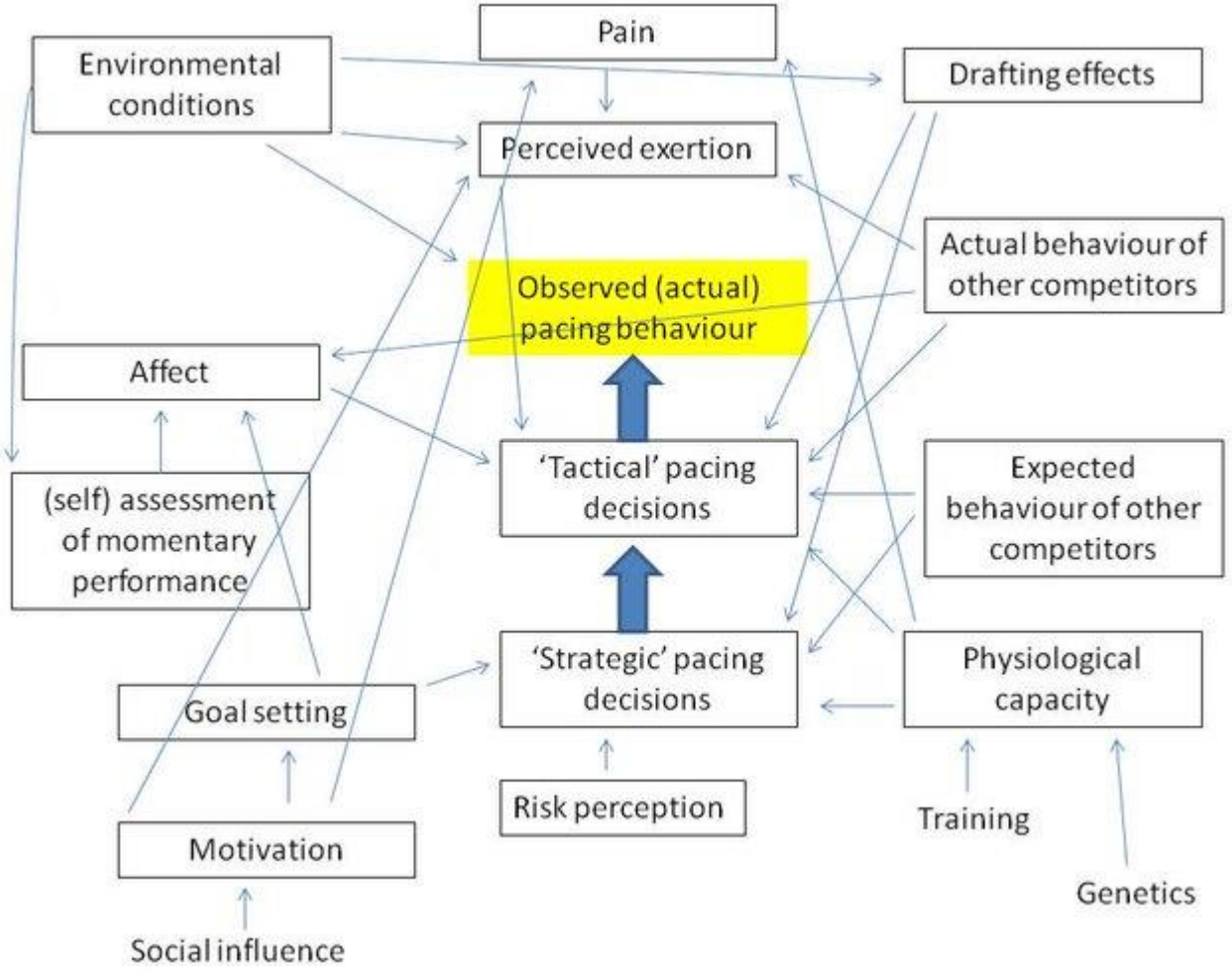

In summary

- Management of exercise intensity is regulated by the brain.
- Exactly how pacing decisions are made is uncertain, although both RPE and affect are implicated.
- Goal setting is of crucial importance.
- Goal achievement requires strategic planning.
- (Perceived) progress towards a goal is important and may result in modifications to strategy.
- Presence of opponents heavily influences pacing decisions.
- It’s complicated

Thank you!

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