10-11 Nov 2022

A (FORCE)-VELOCITY APPROACH TO RESISTED SPRINTING

Matt Cross

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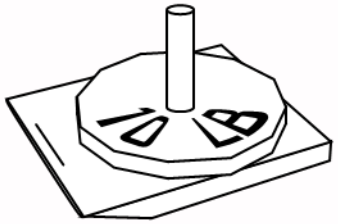
THE WAR OF RESISTED SPRINTING

‘LIGHT’

10%BM

10%vDec

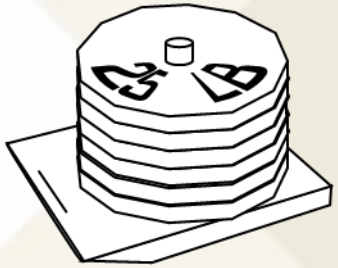


vs

‘HEAVY’

80%BM

50%vDec



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WHAT IS RESISTED SPRINTING?

Sprinting, with typically <u>horizontal</u> resistance

Magnitude of resistance used to target stimulus and adapt transfer

- Increase friction (+ increase inertia)
- Impede acceleration → reduce velocity

SELECTING RESISTANCE

‘Specificity’ has been central to arguments

HISTORICAL PERSPECTIVE

Avoid being too ‘dissimilar’ to a free-sprint
(eg. limit to 20% BM, Alcaraz 2018*)

Result → Few research at high resistance
(eg. Alcaraz 2018* N=3 >20%BM)

DIRECTION OF TALK

Address "Is heavy resisted sprinting specific?"

To answer, need to address what is 'specific':

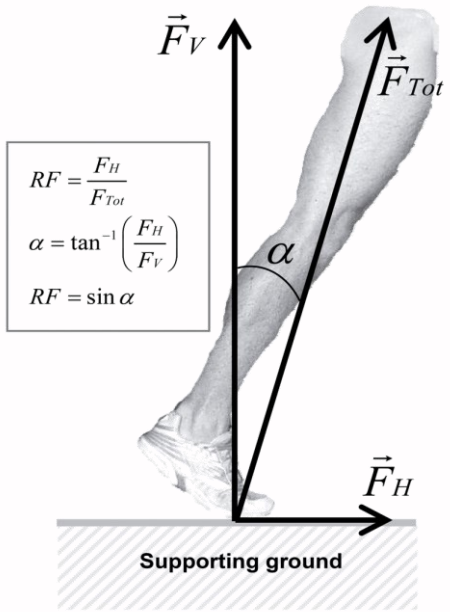
1. What determines acceleration?
2. What parts of acceleration are we targeting?
3. How is resistance relevant?

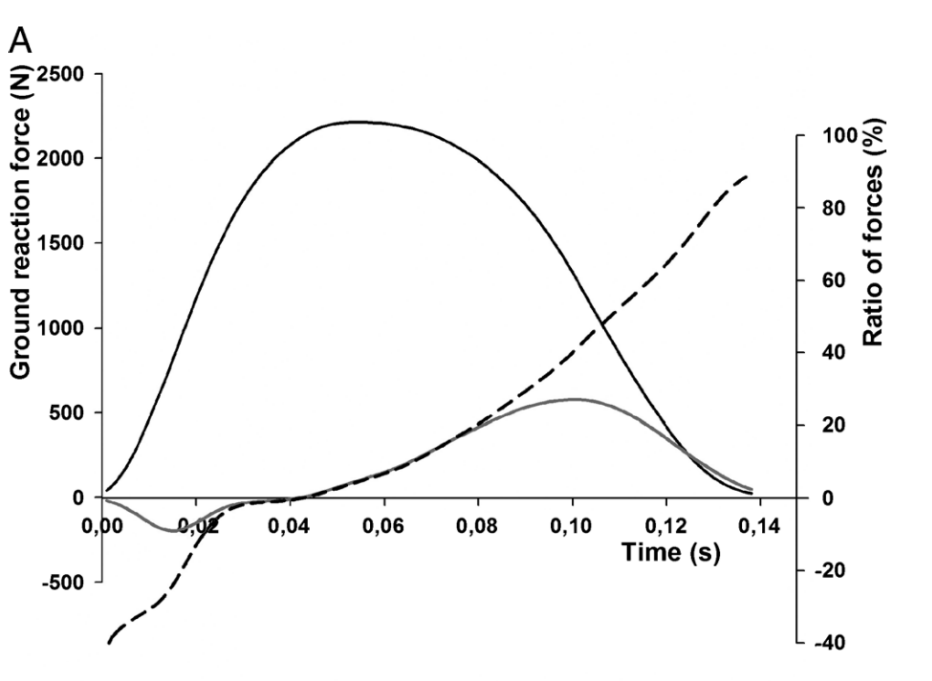
SPRINTING ACCELERATION DETERMINANTS

RESISTED SPRINTING

ACCELERATION DETERMINANTS

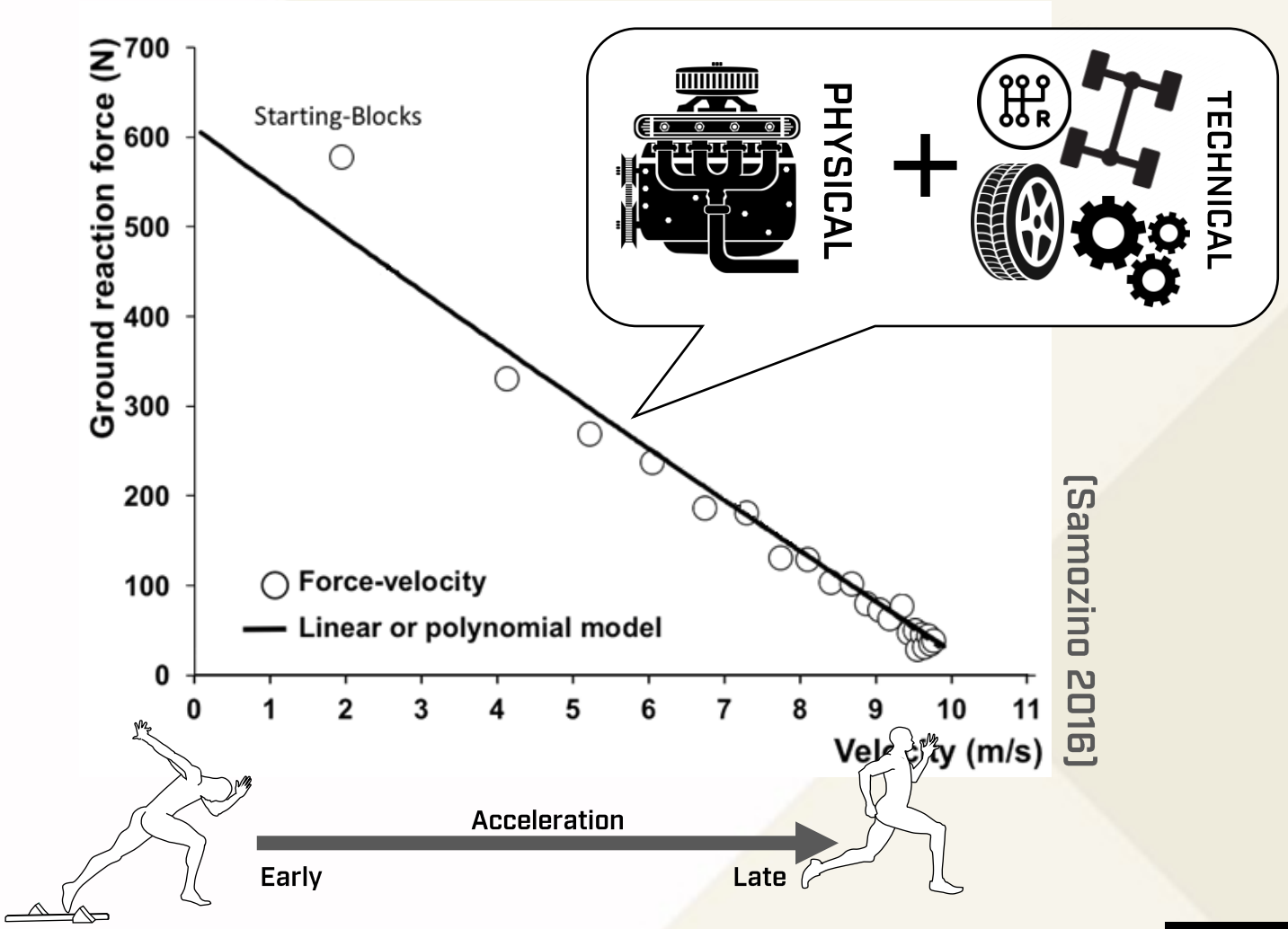
- Requires larges force applied to the ground
- Orientation (ie. Fh) associated with acceleration (R^2=.56, p<.05; Morin 2011; R^2=.67, p<.001; Rabita 2016)





[Morin 2011]

$F_h v$ PROFILE OF ACCELERATION



[Samozino 2016]

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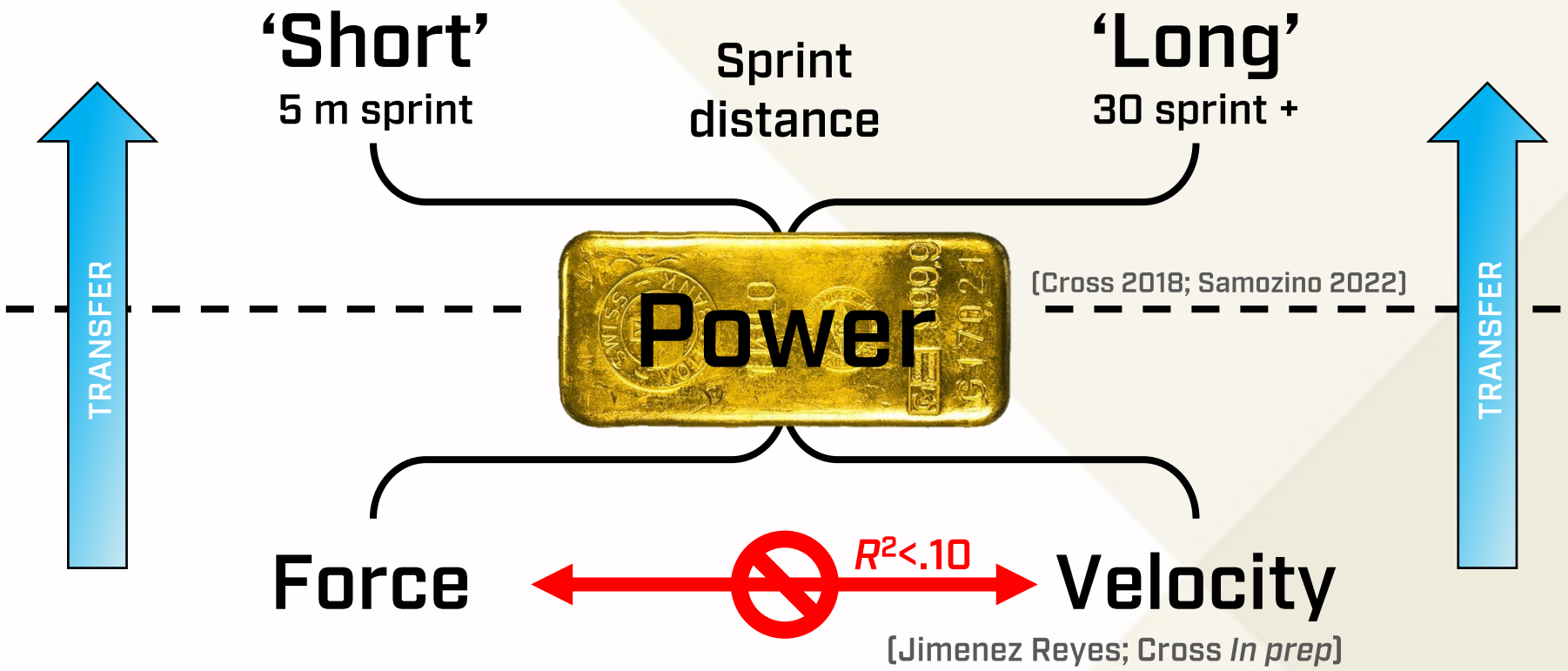
F_hV PER SPRINT DISTANCE



Impacts how we view training for acceleration

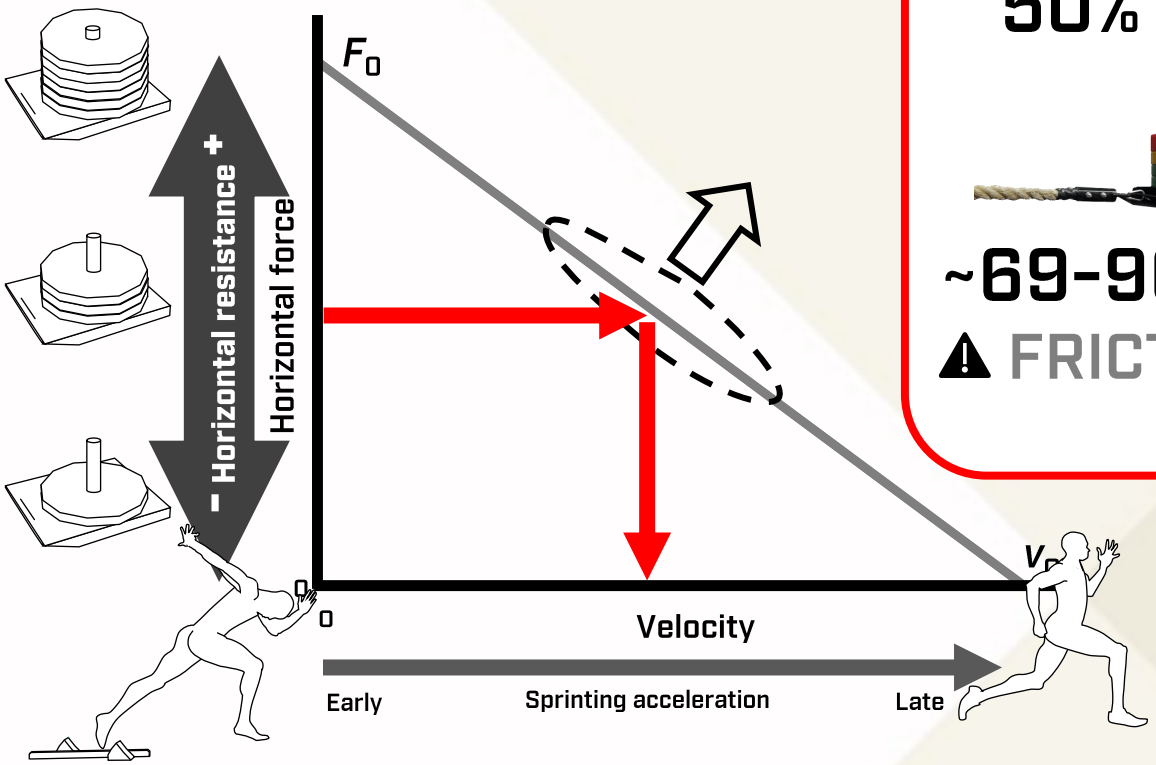
RELEVANCE OF RESISTANCE

Resisted sprinting provides horizontal overload

- Logically targets horizontal force

Varying resistance using a 'velocity-based' approach can target phases and underlying qualities

FV OVERLAID WITH LOAD



50% V_{max}

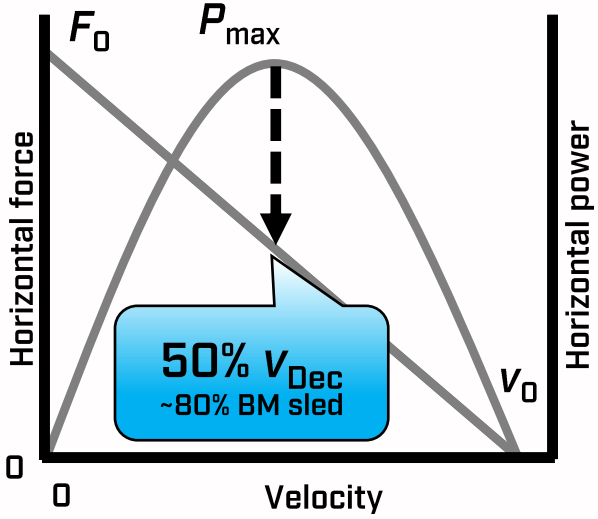
~69-96%BM

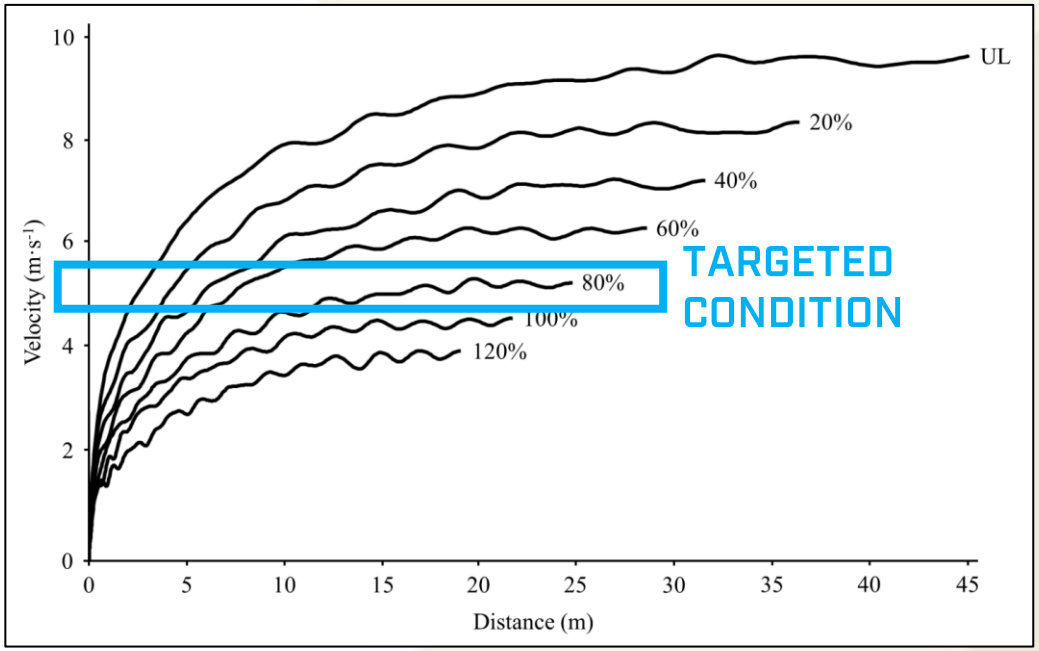
⚠ FRICTION ⚠

[Cahill 2020; Cross 2017; 2018]

VBT FOR RESISTED SPRINTING

- Select loading based on **velocity decrement** to target phases and underlying qualities (physical + technical)
- Accrue work in these conditions





Cross 2017

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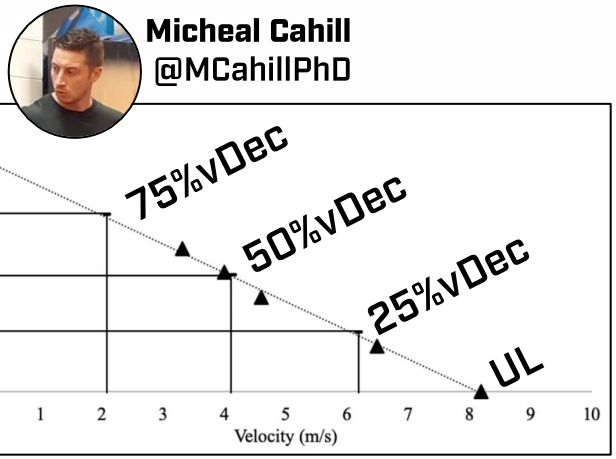
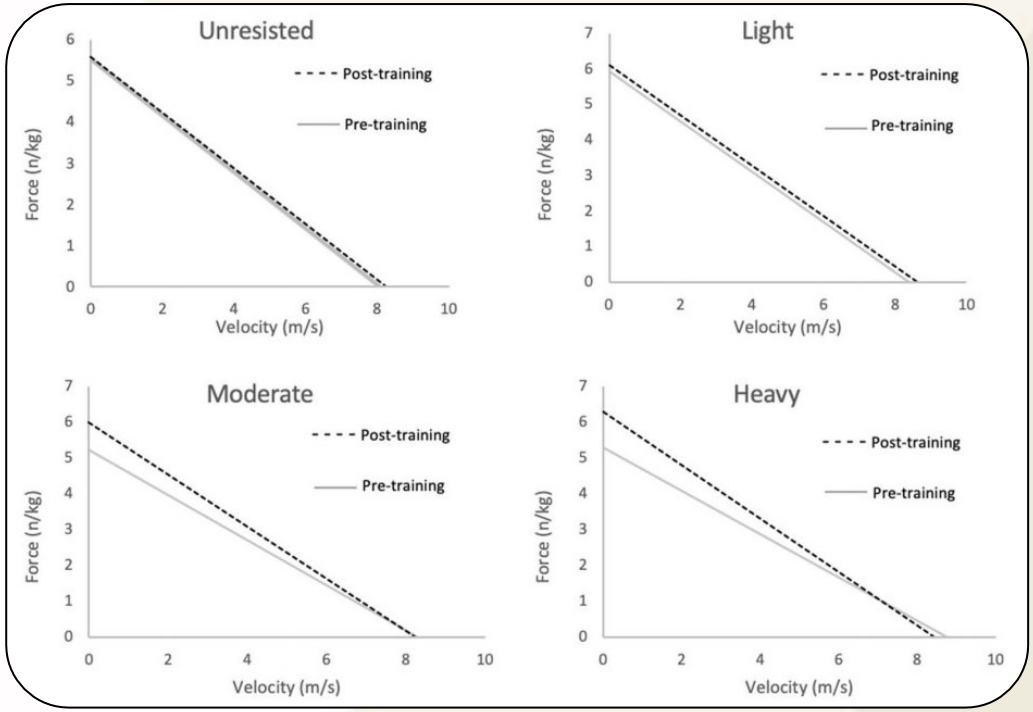
COOL STORY, SHOW ME THE DATA

General support for increased load, increased acc.

Few have (well) tested approach (Cahill 2019; 2020)





More research needed...

COMMON CRITICISMS

SPECIFICITY AND ACUTE DIFFERENCES

Q: BUT LOAD ALTERS TECHNIQUE?

Many reports of changes evoked by loading

- Kinetic and kinematic, EMG, energetics, muscle damage…
  (eg. Monahan 2021; Oesterwald 2021; Pareja-Blanco 2022a,b; Zabaloy 2020)

"…a solid body of evidence suggests that heavy or very heavy loads … should be used with caution because of the mechanical, technical, and physiological alterations clearly provoked in different sprint-related parameters"
Zabaloy et al. 2022

Narrative Review on the Use of Sled Training to Improve Sprint Performance in Team Sport Athletes

Santiago Zabaloy, PhD,[1,2] Tomás T. Freitas, PhD,[3,4,5] Fernando Pareja-Blanco, PhD,[3] Pedro E. Alcaraz, PhD,[3,6] and Irineu Loturco, PhD[4,6,7]
[1]Faculty of Physical Activity and Sports, University of Flores, Buenos Aires, Argentina; [2]Faculty of Sports Sciences, Pablo de Olavide University, Seville, Spain; [3]Research Center for High Performance Sport, Catholic University of Murcia (UCAM), Murcia, Spain; [4]Nucleus of High Performance in Sport (NAR), São Paulo, Brazil; [5]Department of Human Movement Sciences, Federal University of Sao Paulo, Sao Paulo, Brazil; [6]Faculty of Sport Sciences, Catholic University of Murcia (UCAM), Murcia, Spain; and [7]University of South Wales, Pontypridd, Wales, United Kingdom

Conclusions rest on two main assumptions…

1) Acute changes are relevant
2) Acute changes lead to long term changes

ASSUMPTION #1

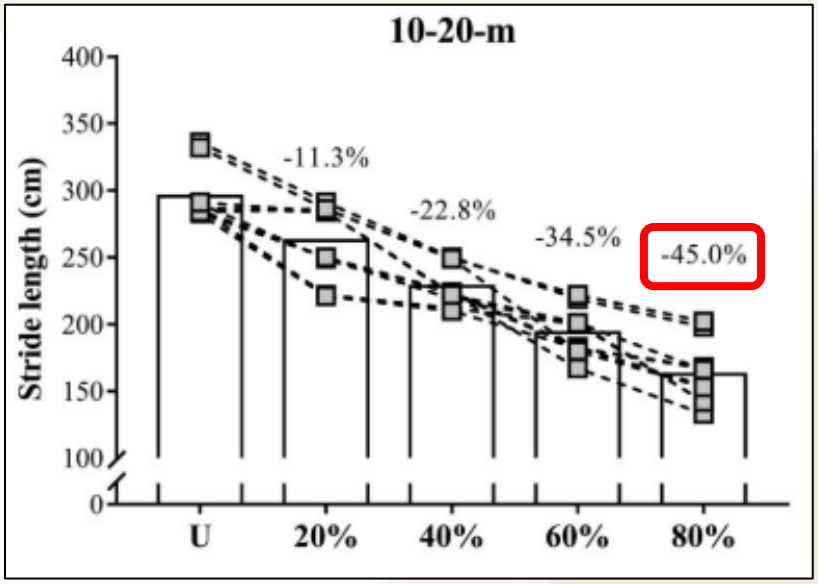
Most studies examine effect of loading by distance

Acute Effects of Progressive Sled Loading on Resisted Sprint Performance and Kinematics

Fernando Pareja-Blanco,[1] Lucas A. Pereira,[2,3] Tomás T. Freitas,[3,4] Pedro E. Alcaraz,[4,5] Valter P. Reis,[2] Aristide Guerriero,[6] Ademir F.S. Arruda,[6] Santiago Zabaloy,[1] Eduardo Sáez De Villarreal,[1] and Irineu Loturco[2,3,7]

[1]Physical Performance & Sports Research Center, Pablo de Olavide University, Seville, Spain; [2]NAR—Nucleus of High Performance in Sport, São Paulo Brazil; [3]Department of Human Movement Science, Federal University of São Paulo, Santos, São Paulo, Brazil; [4]UCAM Research Center for High Performance Sport - Catholic University of Murcia, Murcia, Spain; [5]Faculty of Sport Sciences, Catholic University of Murcia, Murcia, Spain; [6]CBRu—Brazilian Rugby Confederation, São Paulo, Brazil; and [7]University of South Wales, Pontypridd, Wales, United Kingdom

	Mean ± *SD*†	Δ% ± *SD*
VEL 10–20 m (m·s^{-1})		
Unloaded	7.52 ± 0.22	—
20%	6.05 ± 0.31	−19.5 ± 2.47
40%	5.28 ± 0.40	−29.8 ± 3.82
60%	4.00 ± 0.28	−46.8 ± 2.79
80%	3.10 ± 0.28	−58.8 ± 3.00



Much different velocities… relevant to different phases

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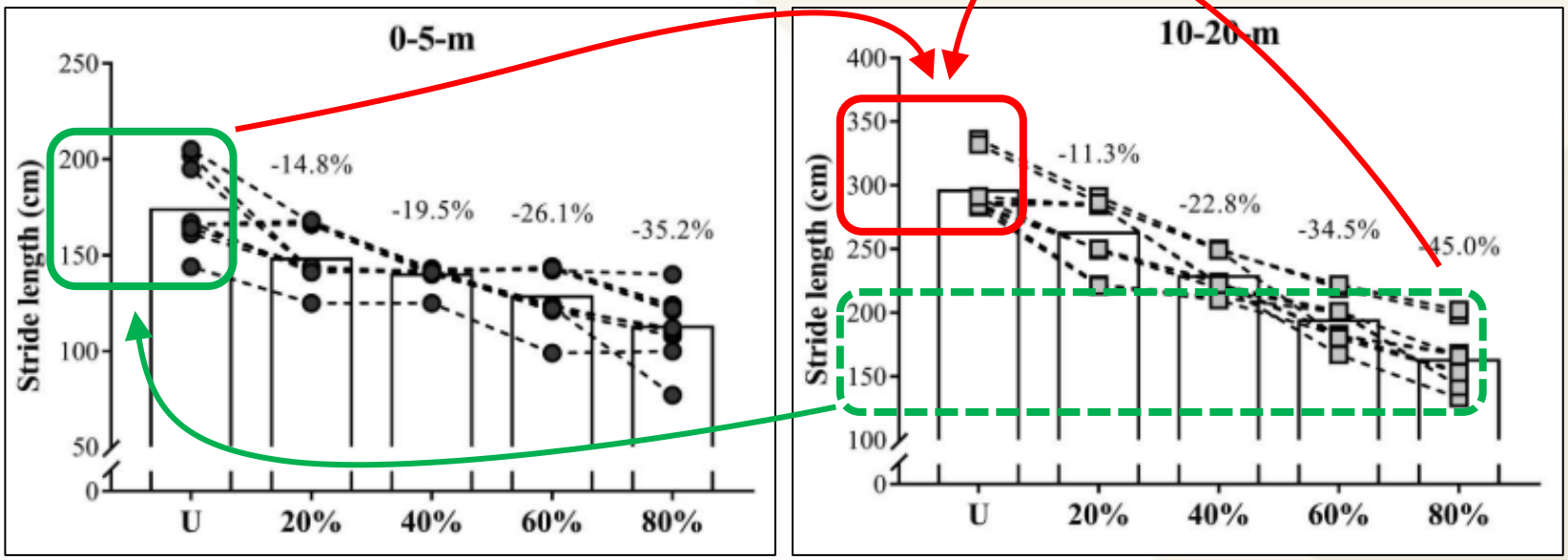
ASSUMPTION #1

Interested is in matched velocities and phases…



Probably wrong comparison, and questionable practical relevance

ASSUMPTION #2 (ACUTE → LONGTERM)

- **No negative training outcomes in technique**
  (Lahti 2020; Alcaraz 2014; Spinks 2007)

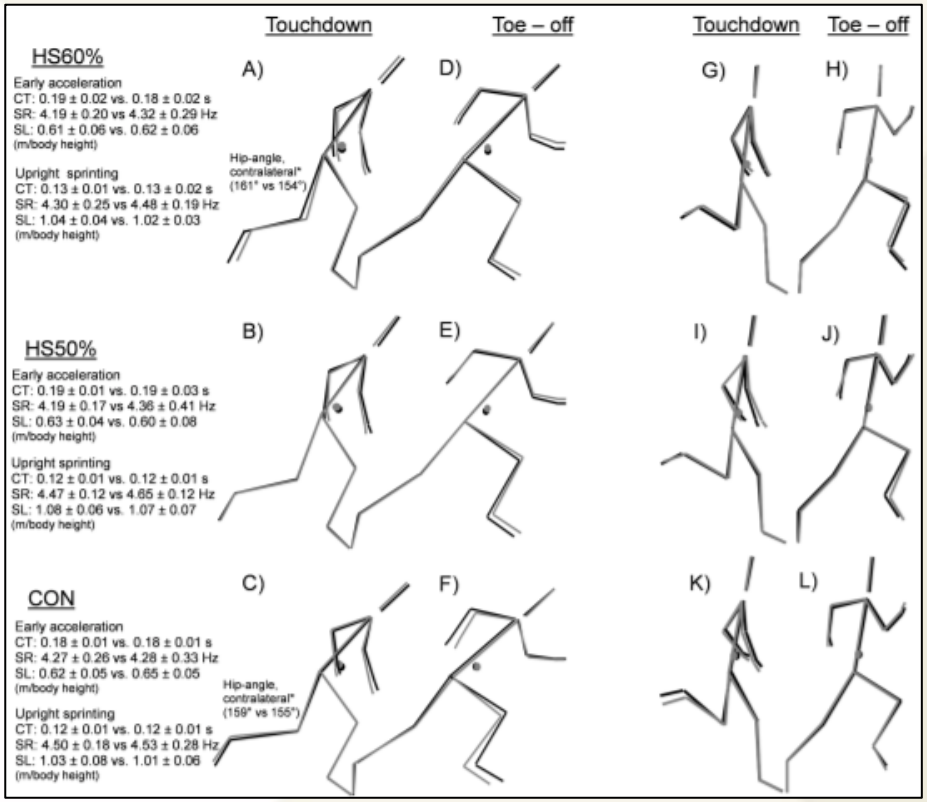
Johan Lahti
@lahti_johan

PeerJ

Changes in sprint performance and sagittal plane kinematics after heavy resisted sprint training in professional soccer players

Johan Lahti[1], Toni Huuhka[2], Valentin Romero[3], Ian Bezodis[4], Jean-Benoit Morin[1,5,6] and Keijo Häkkinen[2]

- **Positive outcomes for performance across all loads**
  (eg. Petrakos 2016)



INJURY EPIDEMIOLOGY

- Inferred from acute differences, with no evidence of ‘risky’ outcomes or injury prevalence
- Reports from the field are generally positive:

JB Morin
@jb_morin

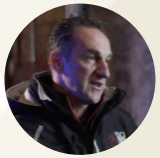
Simond-Cote Benjamin
@bensimondcote14

Patrick Chassaing
@p_chassaing

Cam Josse
@IUCoachJosse

Jonas Dodoo
@EatSleepTrain_

Scott Salwasser
@CoachSSal



Carlo Buzzichelli

- Intelligent programming probably solves a lot

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TO SUM UP

Conflict between high/low resistance misplaced

- Depends on what your goal is (distance/phase)

Velocity-based approach is useful for resisted sprinting

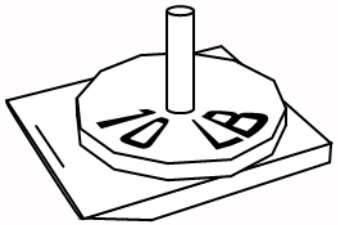
- Helps understand and target acceleration qualities
- Accordingly select resistance, depending on goal

WHAT IS ‘OPTIMAL’

‘LIGHT’

10%BM

10%vDec



Fv

‘HEAVY’

80%BM

50%vDec

Thanks!

Matthew R. Cross, PhD

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assumed zero

$$F = m \cdot a + F_{\text{aero}} + F_{\text{f}}$$

Furusawa 1927

$$\boldsymbol{P} = F \cdot v$$

$$\frac{\mu_{\text{k}} \cdot F_{\text{n}}}{\cos\theta + \mu_{\text{k}} \sin\theta}$$