Middlesex University
London Sport Institute

Principles and Practice of **Strength and Power Training**

Prof. Anthony Turner

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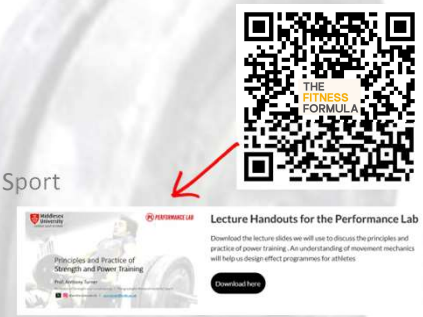
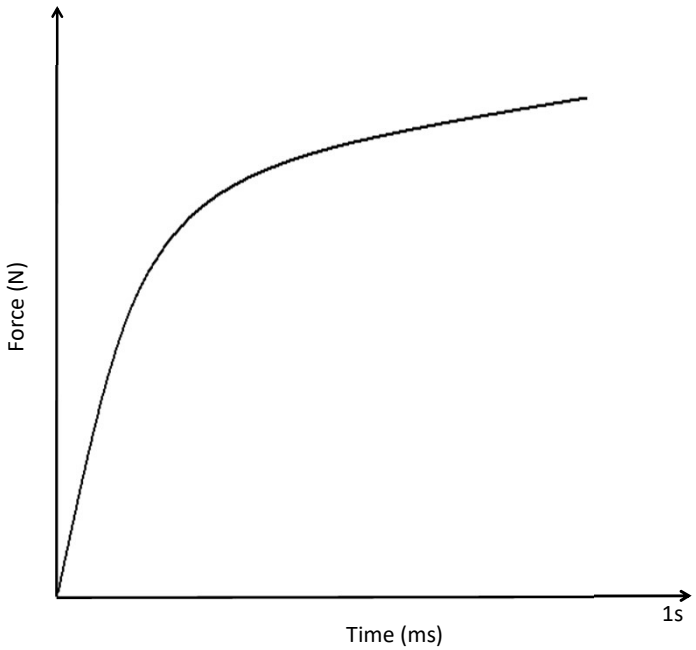
https://thefitnessformula.training/workshop-resources



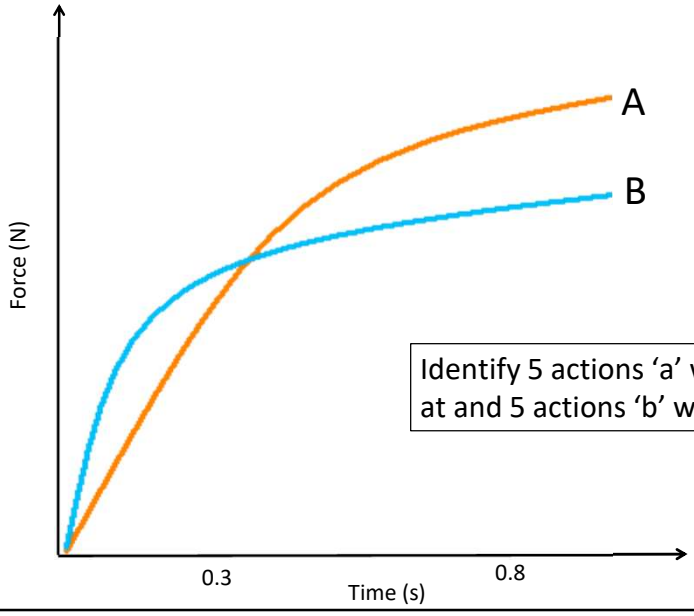
Lecture Outline and Objectives

- ***F-t*** and ***F-v*** curves
- RFD
- ***F***, *P* and ***J***
- Training prescription

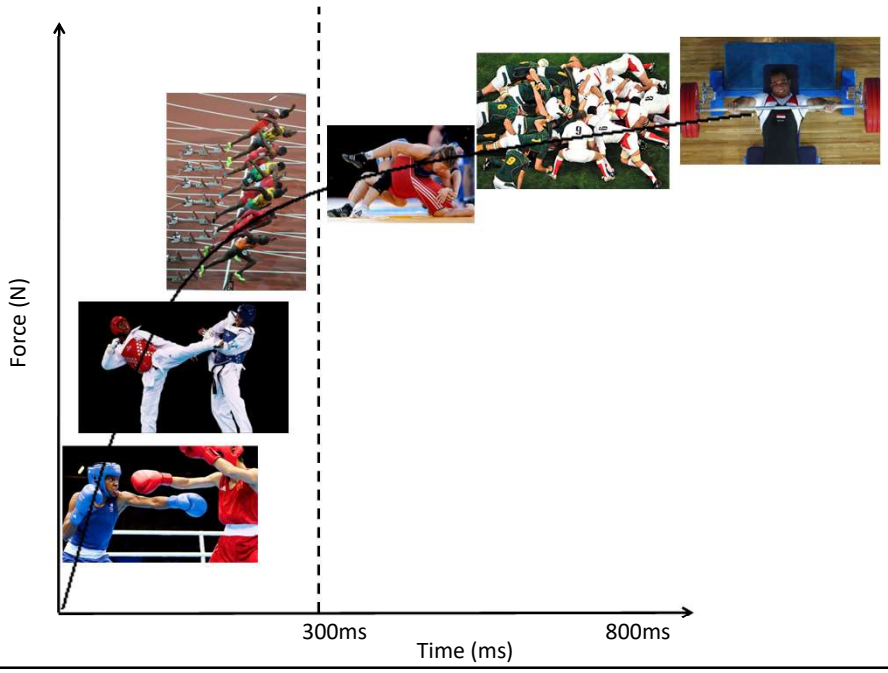
F-t curve

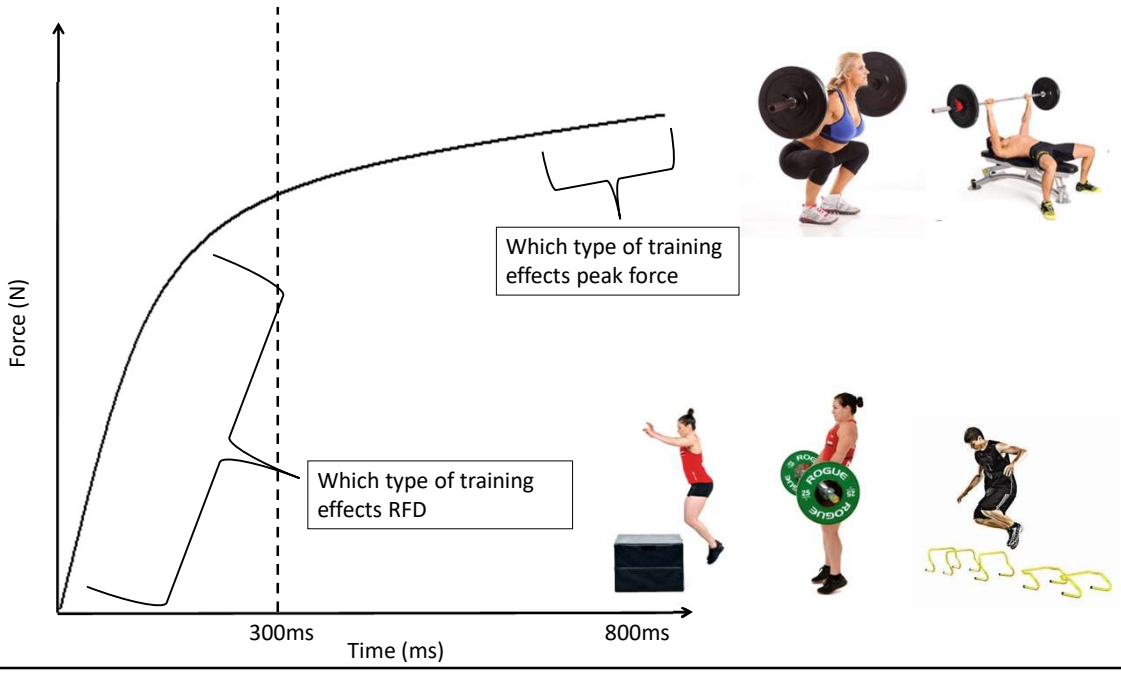


Who would you rather be?



Identify 5 actions 'a' would be better at and 5 actions 'b' would be better at

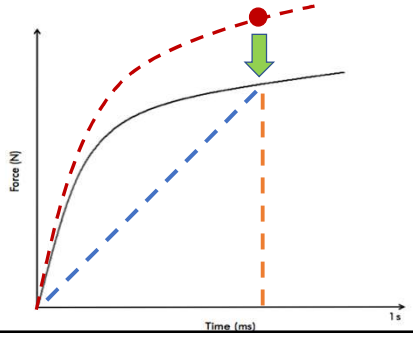




How high should you train an athlete to jump?

Measuring “explosive” strength

- RFD = Δ***F*** / time period of interest
- Epoch defined $\boldsymbol{J} = \Delta \boldsymbol{F} * t$ period of interest
- F @ defined time point



Dynamic Strength index (DSI)

- Athletes had mean DSI of 0.70
- low DSI ratio of <0.60 = ballistics
- high DSI ratio of >0.80 = max strength

IMTP = 3000 N

SJ = 1500 N

= 100/IMTP*SJ = 50%

IMTP = 2200 N

SJ = 2000 N

= 100/IMTP*SJ = 91%

	Peak Force (N)				
	Squat jump		Isometric midthigh pull		DSI
Mean	2137.30	÷	2781.33	=	0.78

Journal of Australian Strength and Conditioning

An evaluation of a strength qualities assessment method for the lower body. J. Aust. Strength Cond. 19(2)4-10. 2011 © ASCA

Peer Review

AN EVALUATION OF A STRENGTH QUALITIES ASSESSMENT METHOD FOR THE LOWER BODY

Jeremy M. Sheppard[1,2], Dale Chapman[1,3] and Kristie-Lee Taylor[4]

International Journal of Sports Physiology and Performance, 2015, 10, 542-545

http://dx.doi.org/10.1123/ijspp.2014-0255

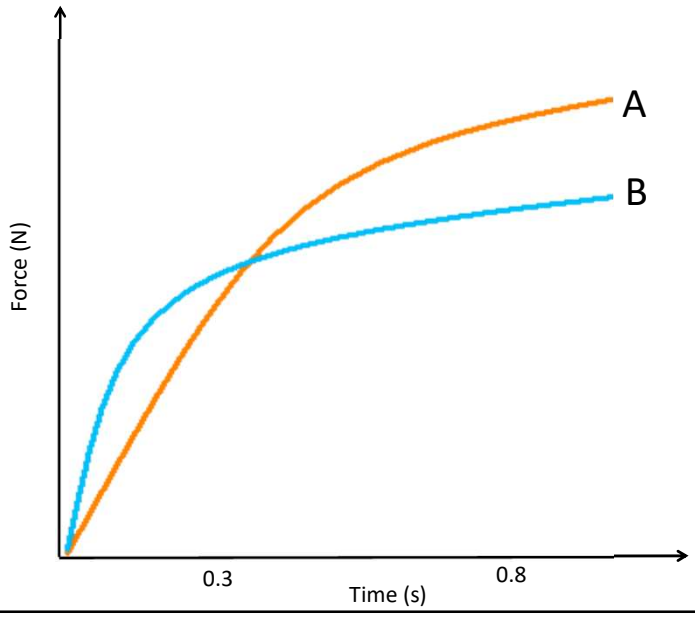
Human Kinetics

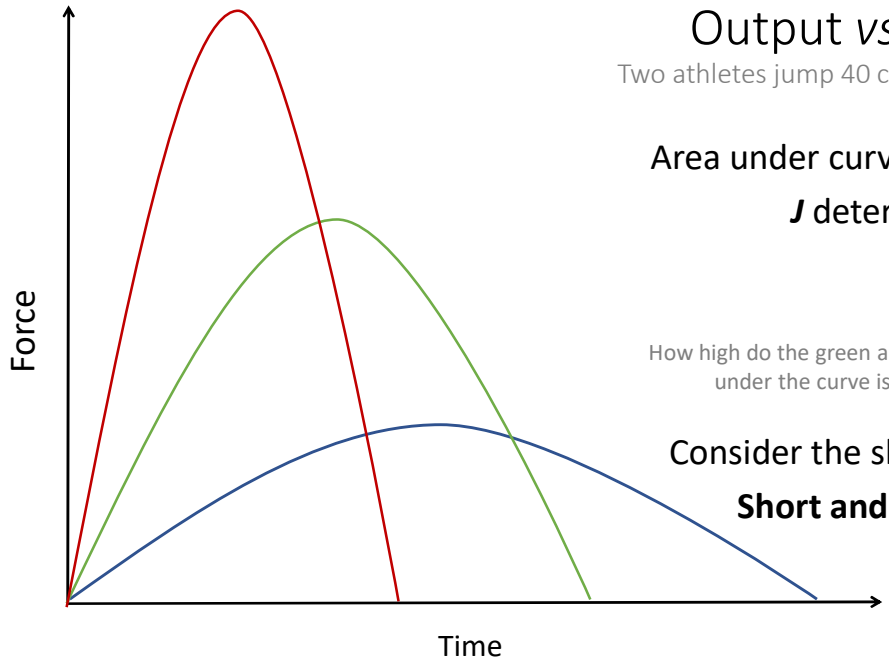
ORIGINAL INVESTIGATION

Reliability of the Dynamic Strength Index in College Athletes

Christopher Thomas, Paul A. Jones, and Paul Comfort

Should they train strength or P ?





Output *vs.* strategy

Two athletes jump 40 cm, who's the best!? 😐

Area under curve = impulse (***J***) = ***Ft***

J determines jump height

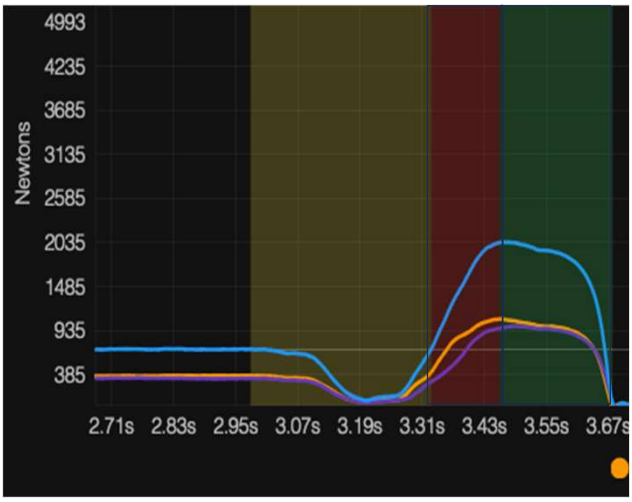
Ft = 40 cm

How high do the green and red athlete jump if the area under the curve is the same as the blue athlete's

Consider the shape of the impulse

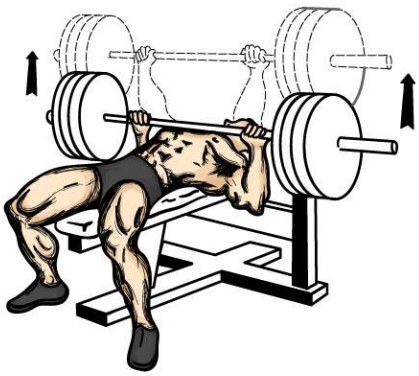
Short and fat *vs.* tall and thin

Instead of *RFD*…

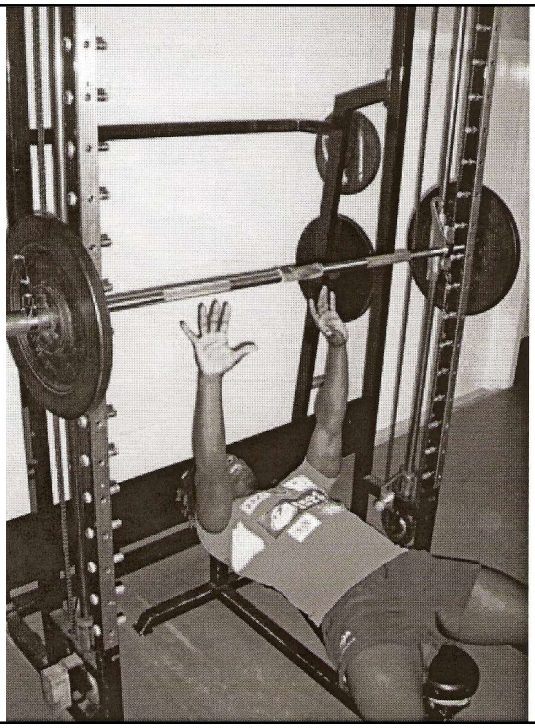


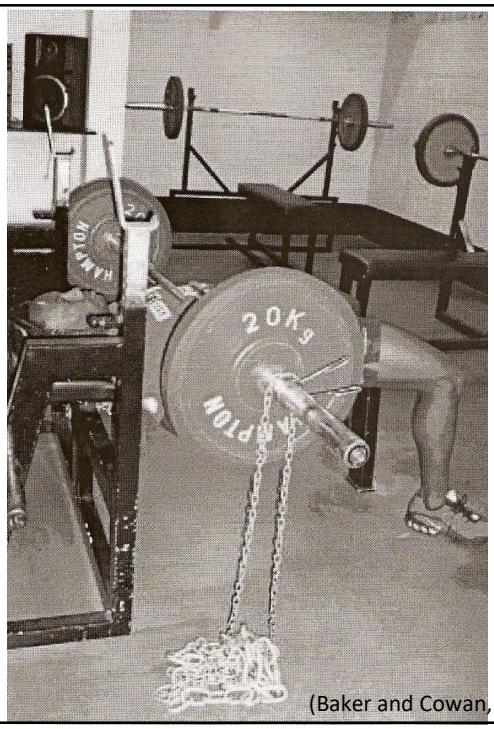
Metric	"Fast and high"
Height (cm)	49
CM depth (cm)	31
Ave Braking F (N)	1496
Braking phase (s)	0.13
Ave Propulsive F (N)	1697
Propulsive phase (s)	0.22
TTT	0.7
mRSI	0.7

What about speed reps?



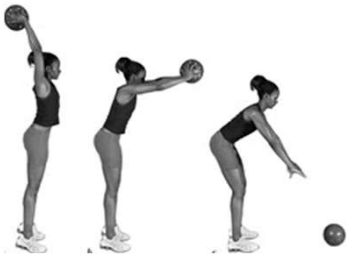
Dumbbell boxing

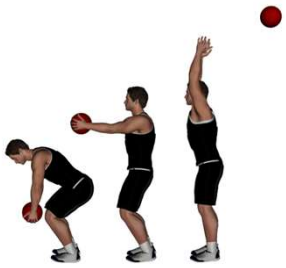




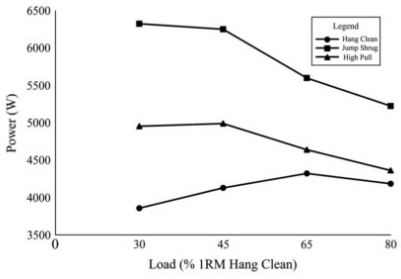
(Baker and Cowan, 2005)

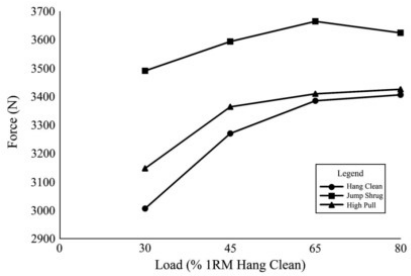


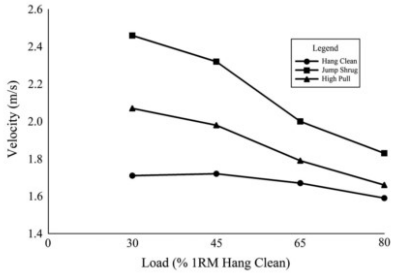


Just jump! Suchomel et al., (2014), JSCR







F-v curve

What is Power?

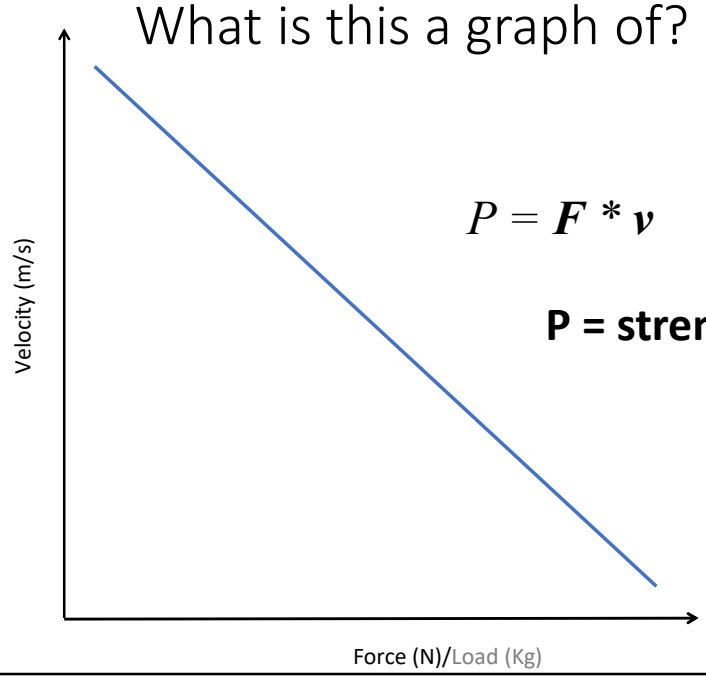
- Why is *Power* important to sports performance?
- What are the components of *Power*?

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{\text{Force} \cdot \text{Displacement}}{\text{Time}}$$

$$\text{Power} = \text{Force} \cdot \frac{\text{Displacement}}{\text{Time}}$$

$$\boxed{\text{Power} = \text{Force} \cdot \text{Velocity}}$$

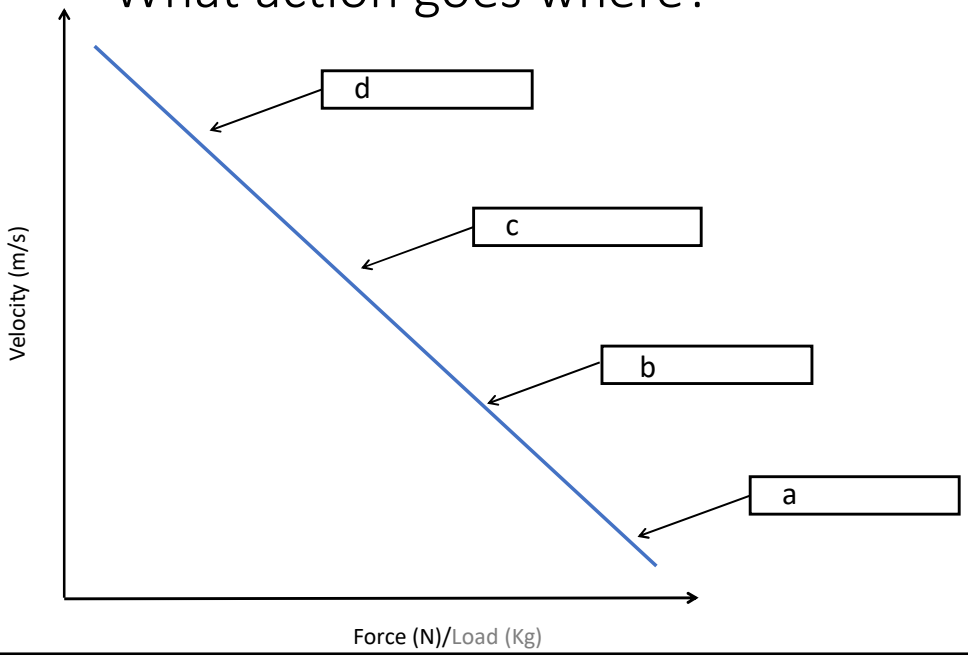
What is this a graph of?

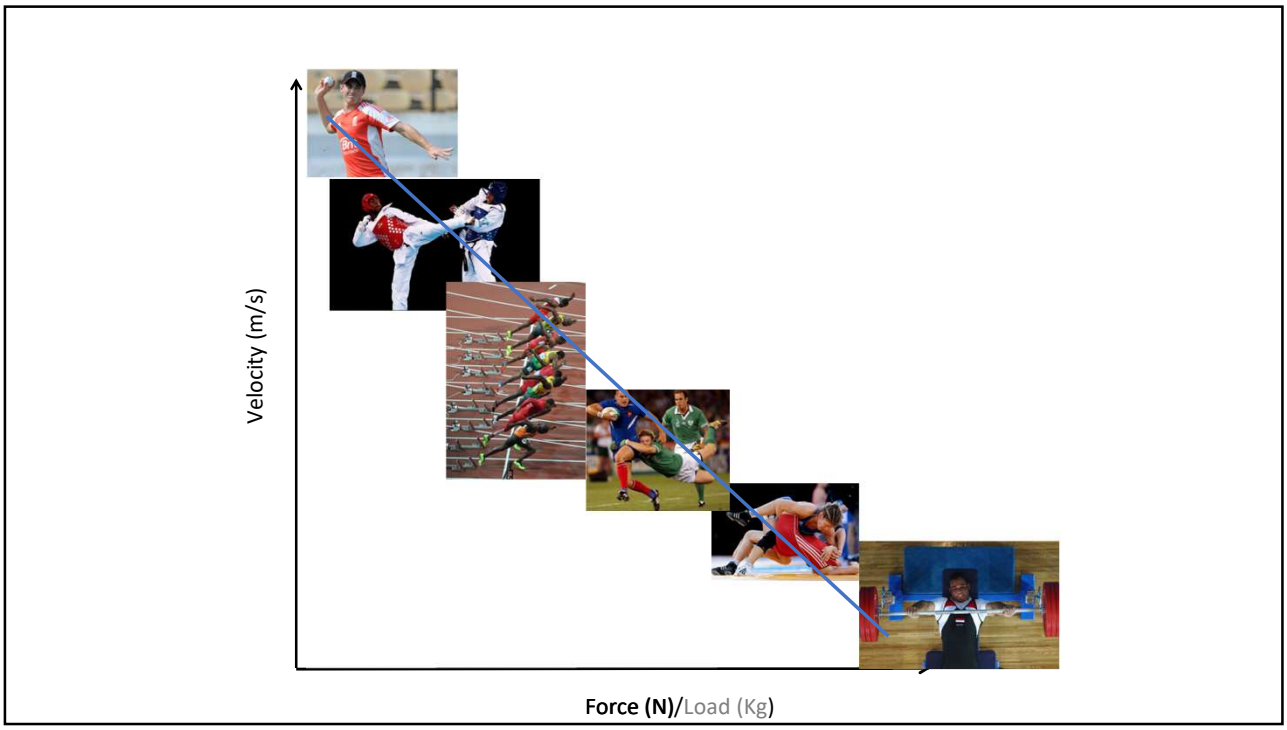


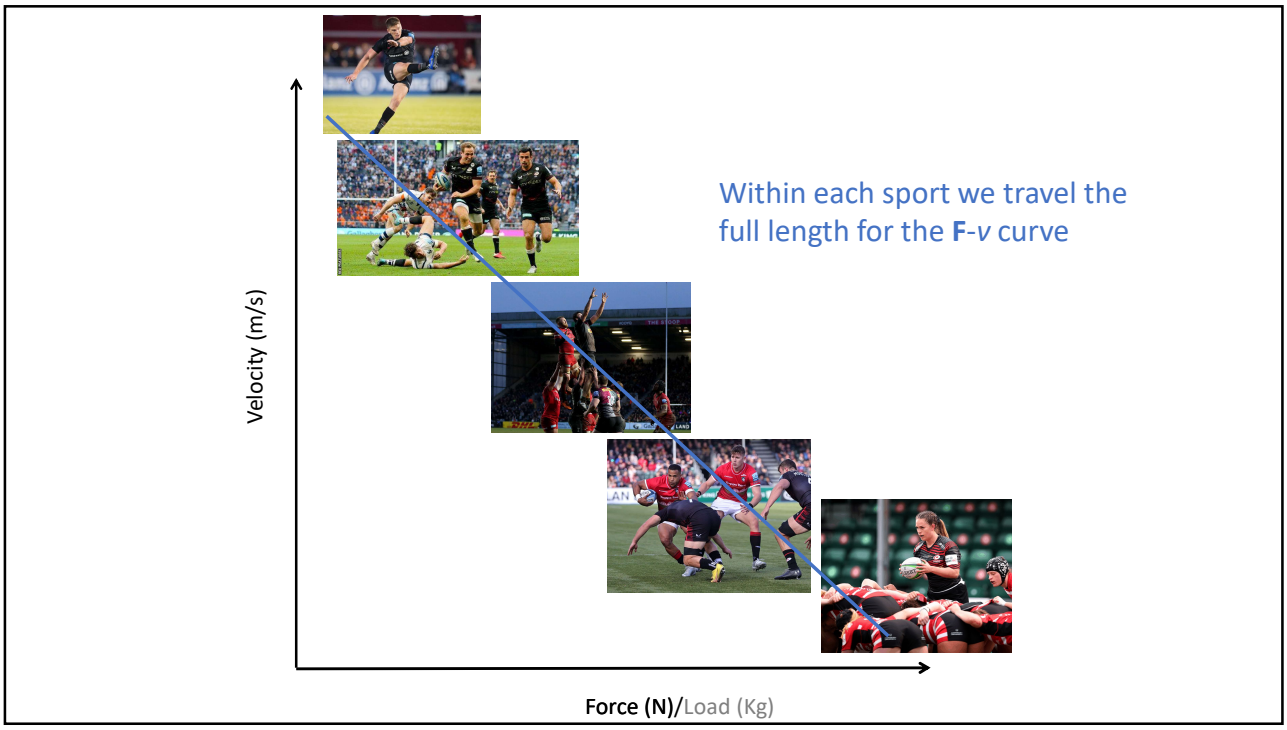
$$P = F * v$$

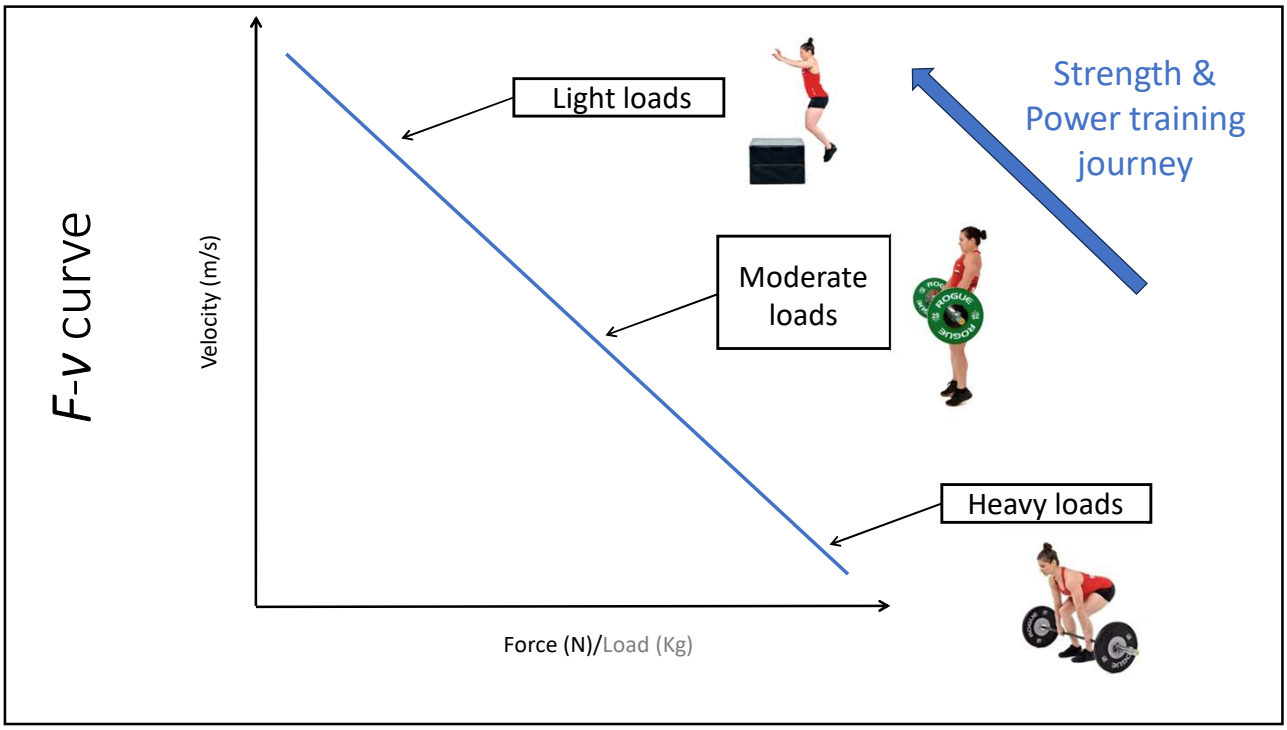
P = strength x speed

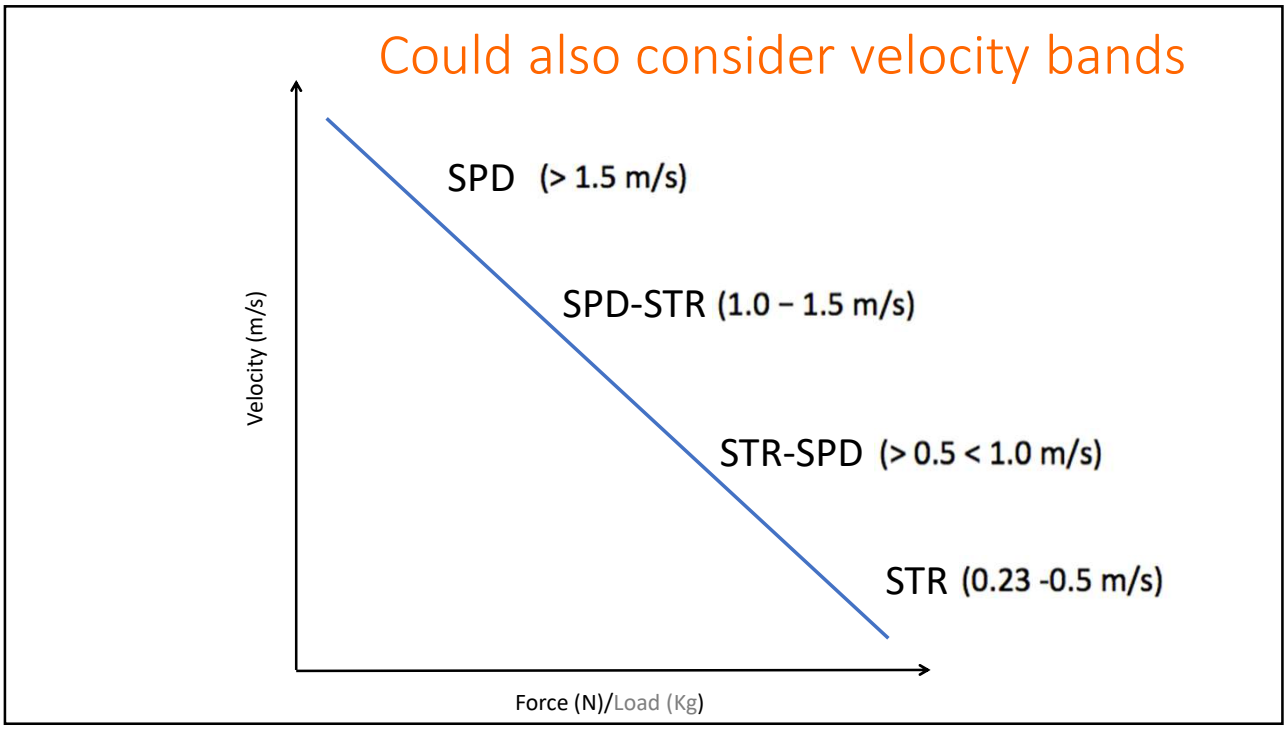
What action goes where?




Velocity (m/s)
Force (N)/Load (Kg)

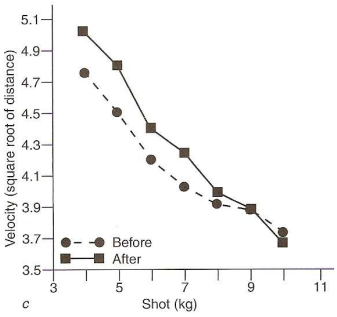

Velocity (m/s)
Force (N)/Load (Kg)
Within each sport we travel the full length for the F-v curve

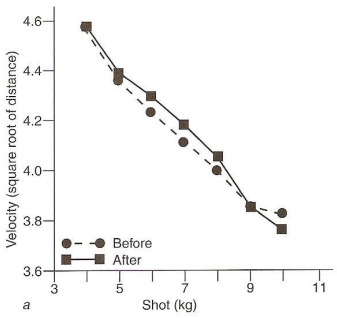

F-v curve
Velocity (m/s)
Force (N)/Load (Kg)
Light loads
Moderate loads
Heavy loads
Strength & Power training journey

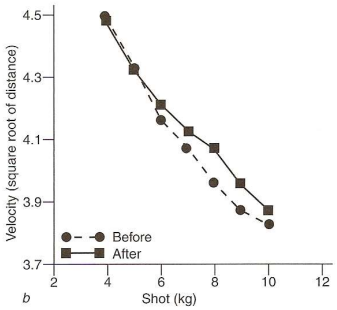

Could also consider velocity bands
Velocity (m/s)
Force (N)/Load (Kg)
SPD (> 1.5 m/s)
SPD-STR (1.0 – 1.5 m/s)
STR-SPD (> 0.5 < 1.0 m/s)
STR (0.23 -0.5 m/s)

Shot Put

Which graph is which: heavy, light or standard?







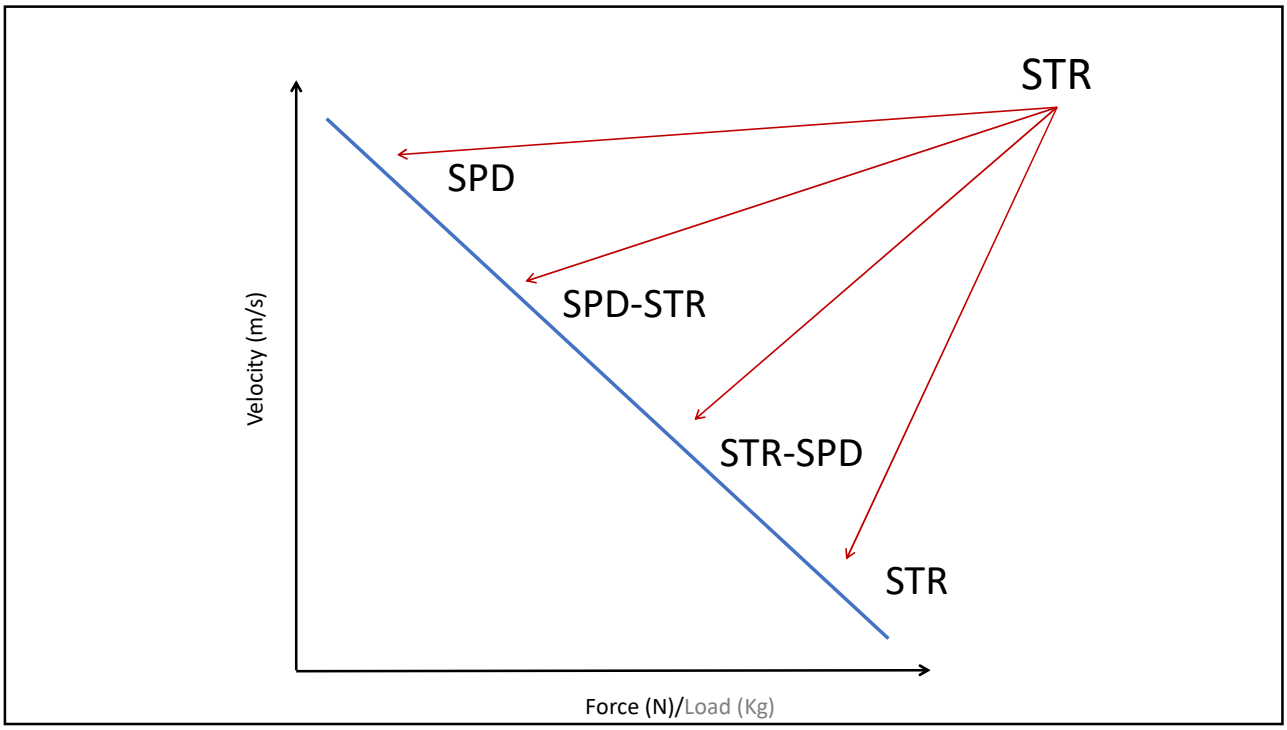
STR...

STR Important Because $F = m*a$

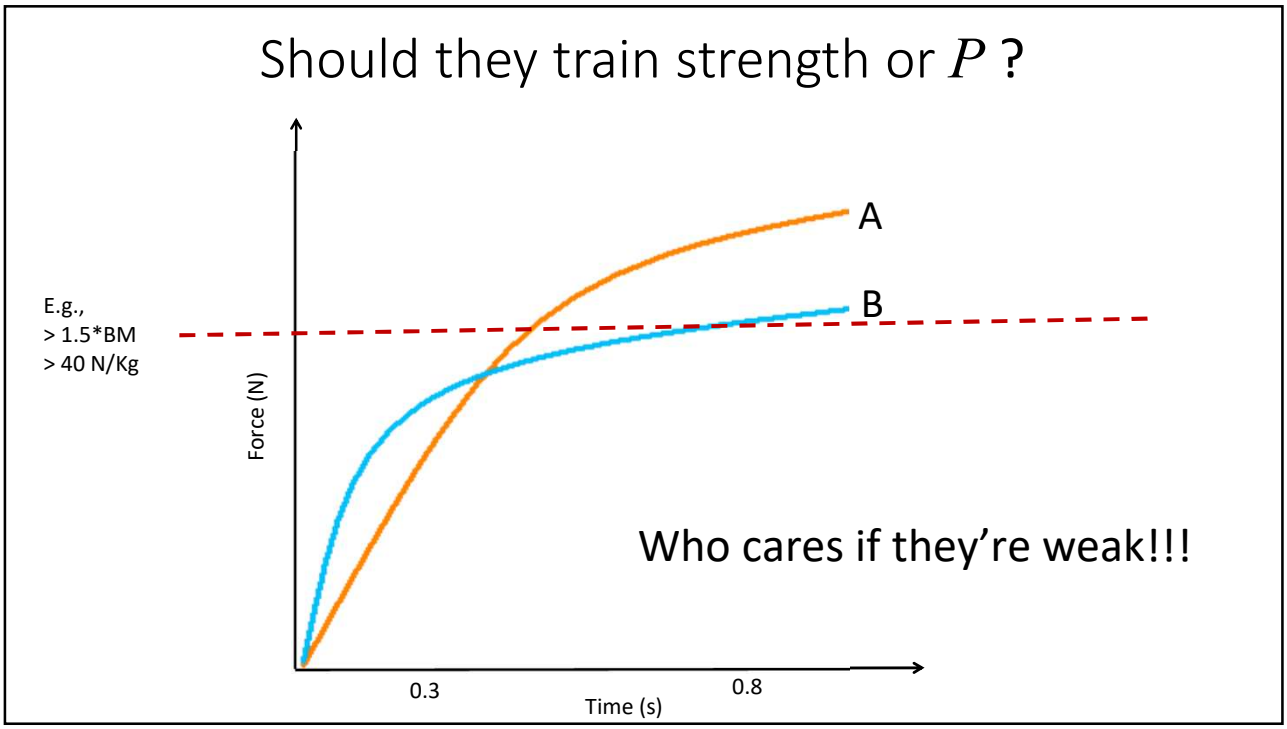
- $a = F/m$
- $F = m * a \rightarrow F = m * v/t \rightarrow v = F * t/m$
- $P = F * v$
- $J = F * t$
- High *r* between strength and P

Strength Maintenance

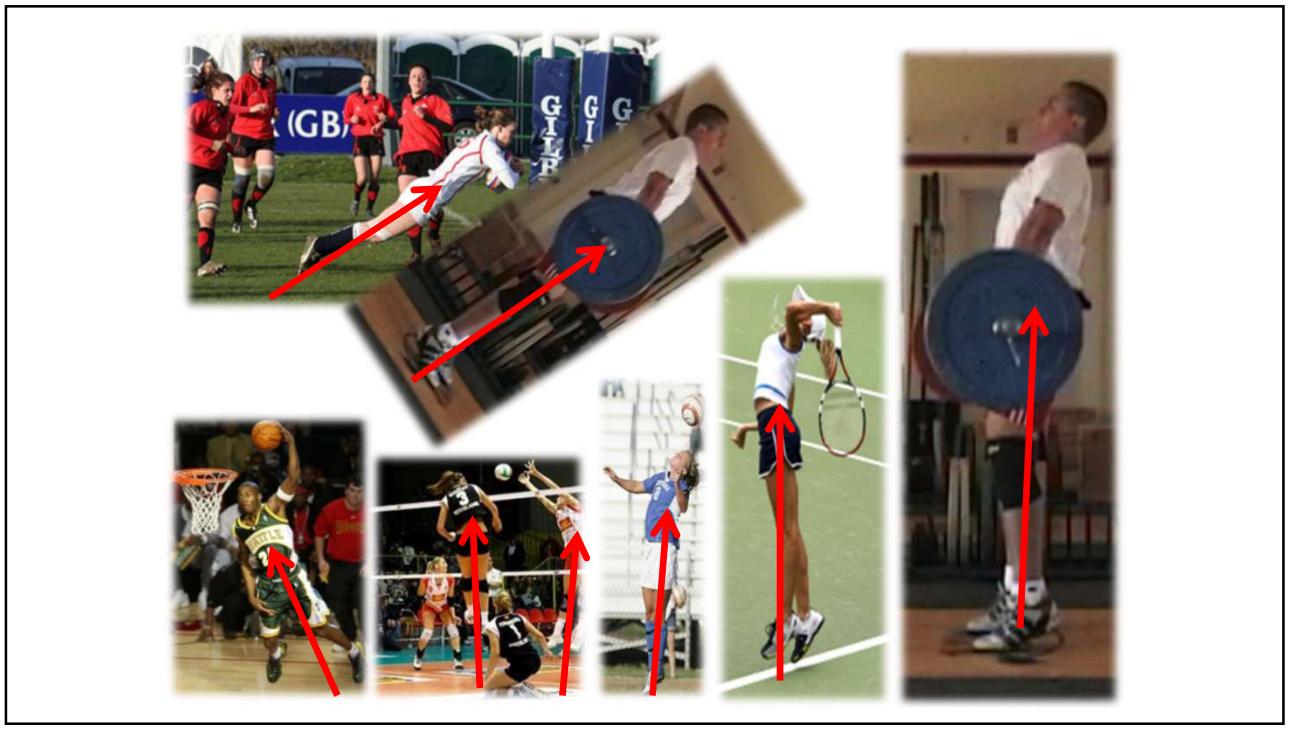
- Strength levels may only be maintained for up to 2wks…
- Therefore?



Should they train strength or P ?

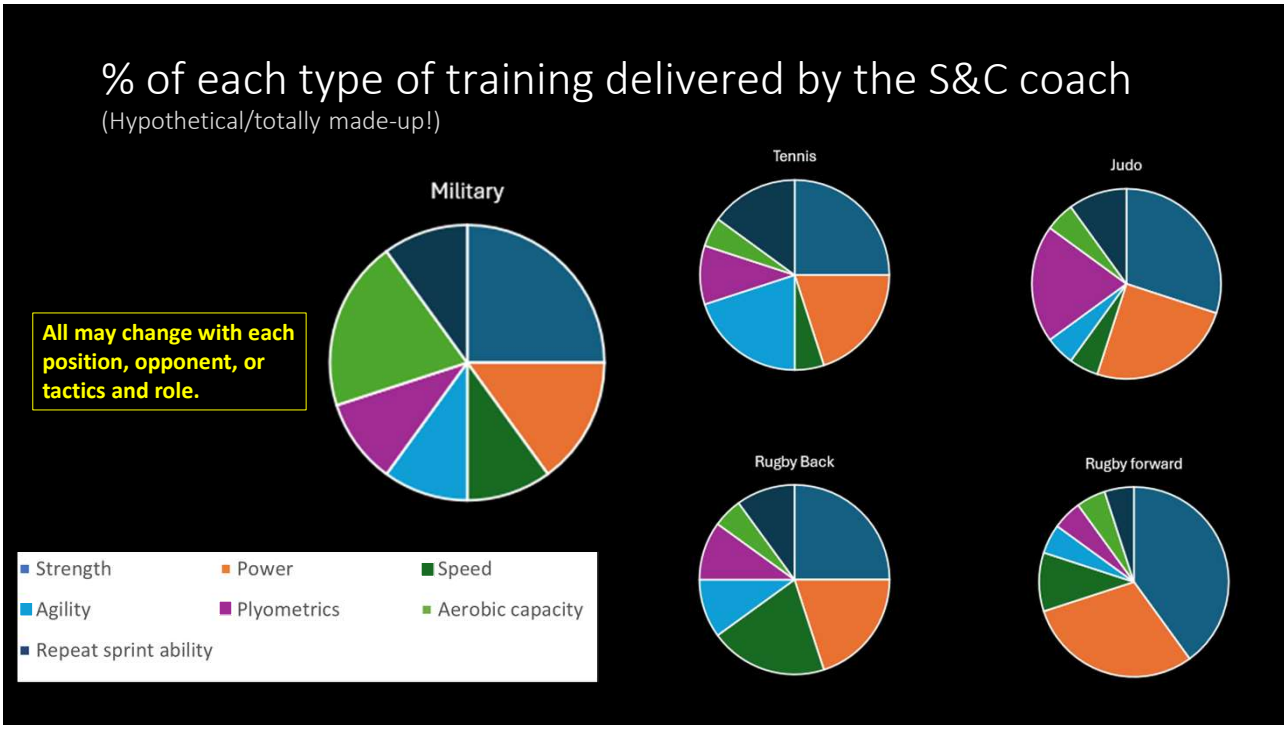


Strength Training and Sport Specificity

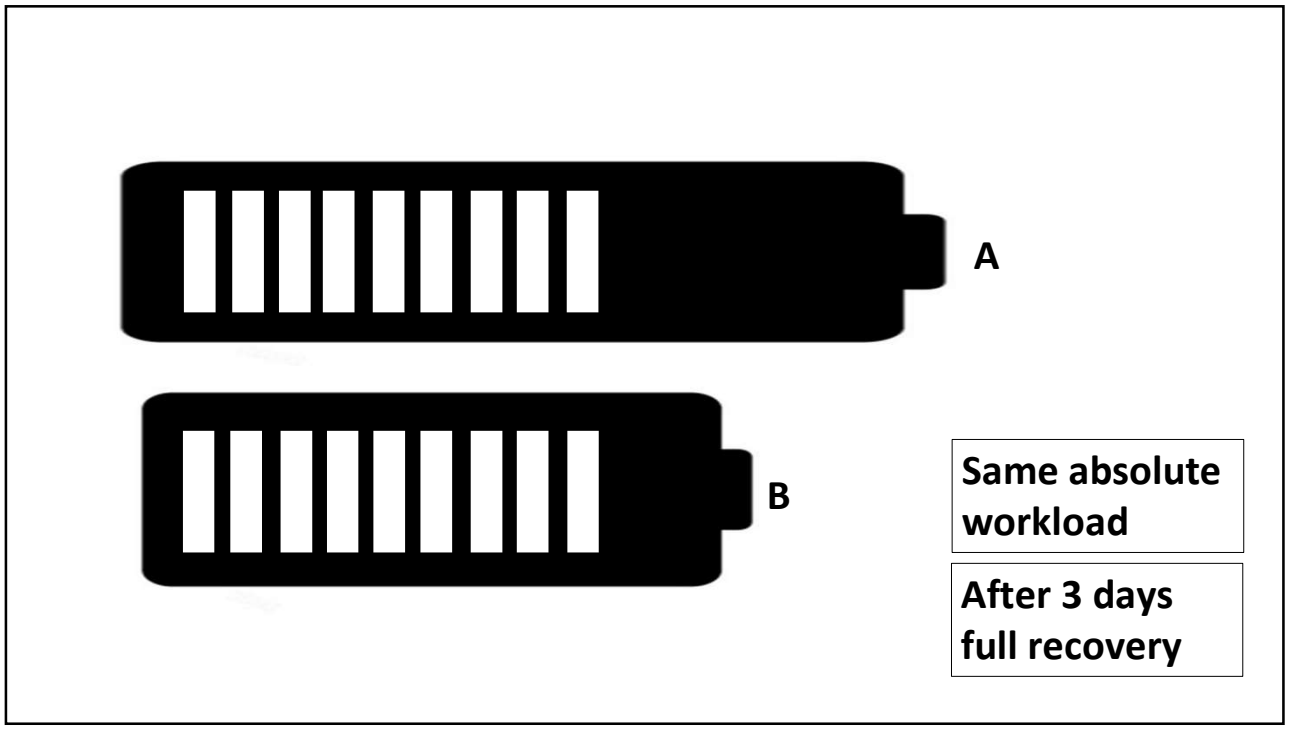


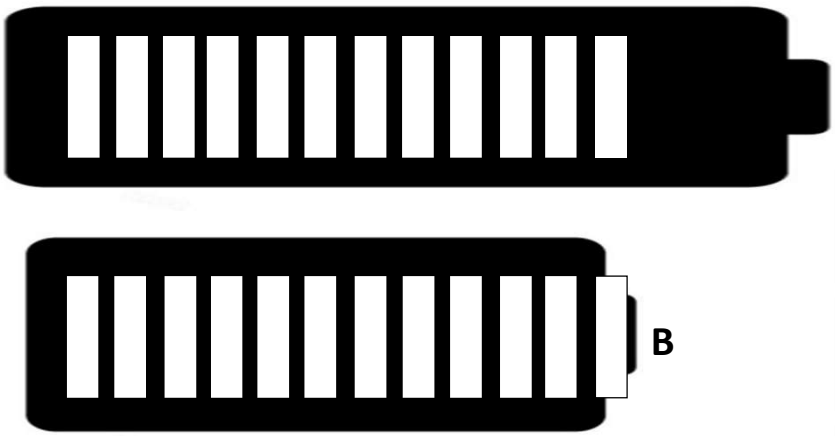
% of each type of training delivered by the S&C coach

(Hypothetical/totally made-up!)




Fitter, Stronger, Faster:
Athleticism and Injury Risk
Malone, S., Hughes, B., Doran, D.A., Collins, K. and Gabbett, T.J., 2018. Can the workload–injury relationship be moderated by improved strength, speed and repeated-sprint qualities?. Journal of Science and Medicine in Sport.
@shakebotapp
40 amateur male hurling players had their training loads, injuries, and physical capabilities monitored over 2 consecutive seasons
Fitness
Fitter athletes had lower injury risk, compared with less-fit athletes.
Repeated Sprint Ability (RSA) Times
30.0s
30.5 - 34.0s
34.5 - 36.0s
36.5 0 - 40.0s
1.5x risk
3.2x risk
5.1x risk
Strength
Stronger athletes (relative to bodyweight) had lower injury risk, compared with weaker athletes.
Trapbar Deadlift 3RM, relative to body mass
3x BW
2.5-2.9x BW
1.7-2.4x BW
1.0-1.7x BW
1.8x risk
2.6x risk
6.1x risk
Speed
Faster athletes had lower injury risk, compared with slower athletes.
20-meter Sprint Times
2.85s
2.85-2.89s
2.89-3.01s
>3.01s
2.1x risk
3.1x risk
4.6x risk


A
B
Same absolute workload
After 3 days full recovery



After only 1 day's recovery

Then they go again…

And again…

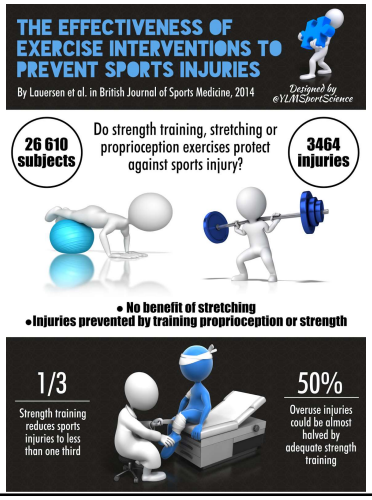
And again…

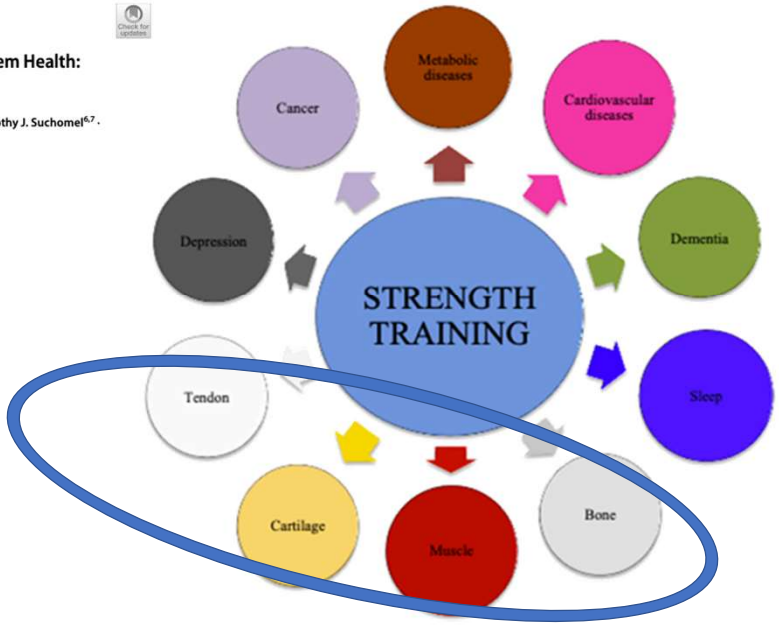
Sports Medicine (2020) 50:1431–1450
https://doi.org/10.1007/s40279-020-01309-5

REVIEW ARTICLE

The Benefits of Strength Training on Musculoskeletal System Health: Practical Applications for Interdisciplinary Care

Luca Maestroni[1,2,3] · Paul Read[4,5] · Chris Bishop[3] · Konstantinos Papadopoulos[3] · Timothy J. Suchomel[6,7] · Paul Comfort[7,8,9] · Anthony Turner[3]





= MyHC IIX → MyHC IIa

Scand J Med Sci Sports 2010: 20 (Suppl. 2): 32–38
doi: 10.1111/j.1600-0838.2010.01196.x

SCANDINAVIAN JOURNAL OF MEDICINE & SCIENCE IN SPORTS

Review

Effects of strength training on muscle fiber types and size; consequences for athletes training for high-intensity sport

J. L. Andersen[1], P. Aagaard[2]

Use it or lose it:
Exercise reinnervation of skeletal muscle in elderly people

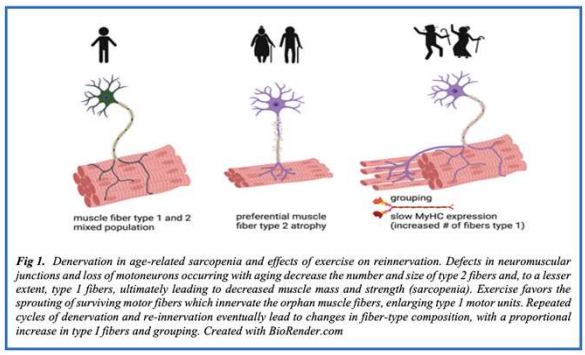


Fig 1. *Denervation in age-related sarcopenia and effects of exercise on reinnervation. Defects in neuromuscular junctions and loss of motoneurons occurring with aging decrease the number and size of type 2 fibers and, to a lesser extent, type 1 fibers, ultimately leading to decreased muscle mass and strength (sarcopenia). Exercise favors the sprouting of surviving motor fibers which innervate the orphan muscle fibers, enlarging type 1 motor units. Repeated cycles of denervation and re-innervation eventually lead to changes in fiber-type composition, with a proportional increase in type 1 fibers and grouping. Created with BioRender.com*

Eur J Transl Myol. 2016 Dec 15; 26(4): 5972.
Published online 2016 Nov 25. doi: 10.4081/ejtm.2016.5972
PMCID: PMC5220213
PMID: 28078066

Use it or Lose It: Tonic Activity of Slow Motoneurons Promotes Their Survival and Preferentially Increases Slow Fiber-Type Groupings in Muscles of Old Lifelong Recreational Sportsmen

Simone Mosole,[(1)(2)] Ugo Carraro,[(3)] Helmut Kern,[(2)(4)] Stefan Loefler,[(2)] and Sandra Zampieri[(1)(2)]

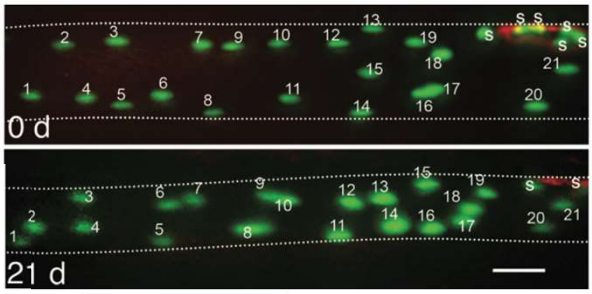
Exercise-mediated reinnervation of skeletal muscle in elderly

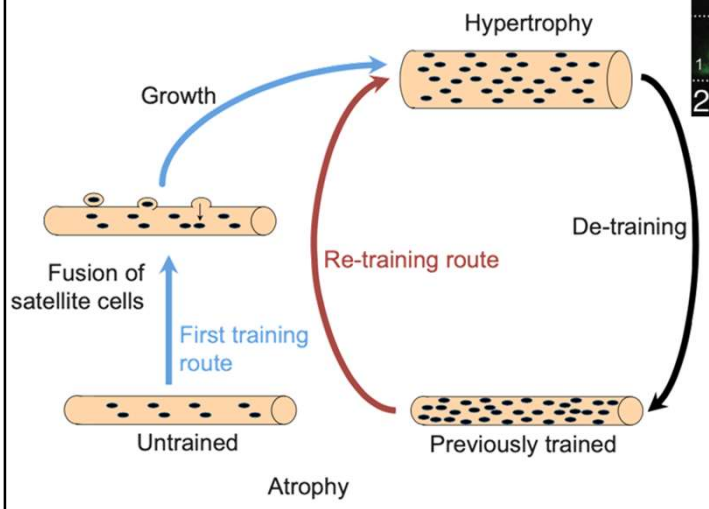
Eur J Transl Myol 32 (1): 10416, 2022 doi: 10.4081/ejtm.2022.10416

Exercise-mediated reinnervation of skeletal muscle in elderly people: An update

Claudia Coletti (1), Gilberto F Acosta (1), Stefan Keslacy (1), Dario Coletti (2,3,4)

Muscle Memory





Original Research

The MMAAS Project: An Observational Human Study Investigating the Effect of Anabolic Androgenic Steroid Use on Gene Expression and the Molecular Mechanism of Muscle Memory

REVIEW

Muscle memory and a new cellular model for muscle atrophy and hypertrophy

Kristian Gundersen*

REVIEW ARTICLE

ACTA PHYSIOLOGICA

The concept of skeletal muscle memory: Evidence from animal and human studies

Tim Snijders[1] | Thorben Aussieker[1] | Andy Holwerda[1] | Gianni Parise[2] | Luc J. C. van Loon[1] | Lex B. Verdijk

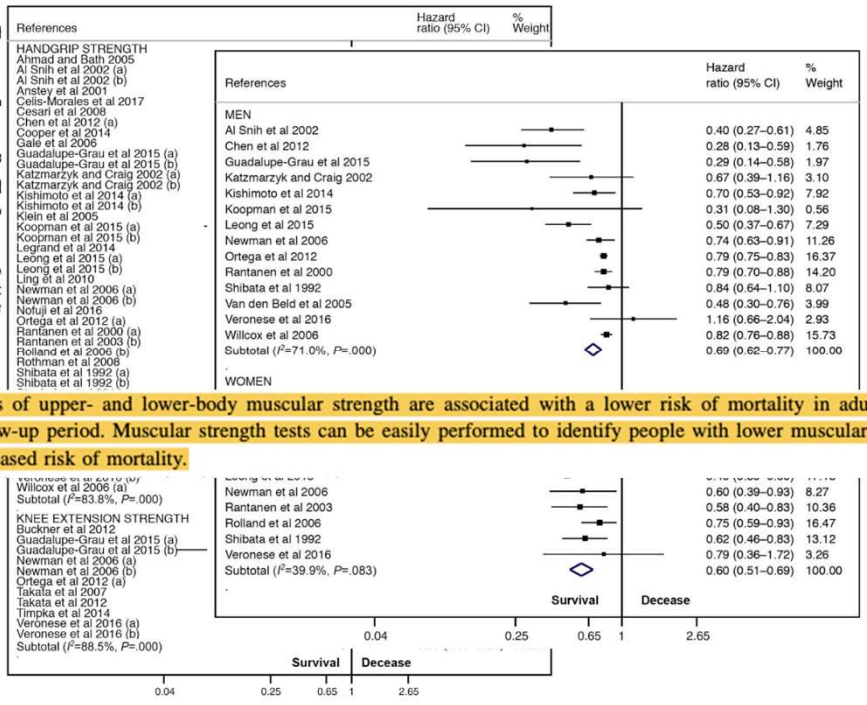
ACRM

Archives of PI

REVIEW ARTICLE (META-ANALYSIS)

Muscular Strength as a P Mortality in an Apparent Systematic Review and M Approximately 2 Million

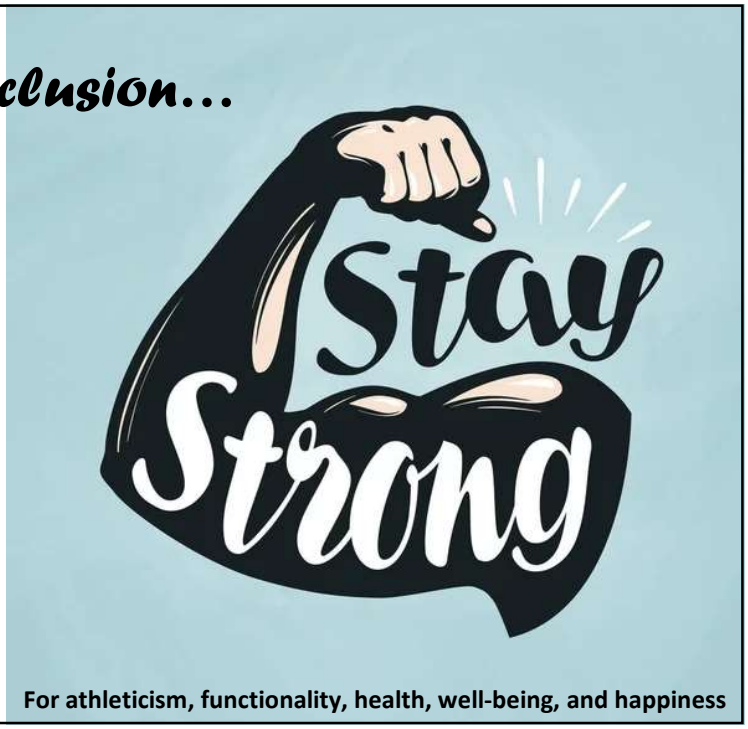
Antonio García-Hermoso, PhD,[a] I Robinson Ramírez-Vélez, PhD,[c] Jc Duck-Chul Lee, PhD,[e] Vicente Mar



Conclusions: Higher levels of upper- and lower-body muscular strength are associated with a lower risk of mortality in adult population, regardless of age and follow-up period. Muscular strength tests can be easily performed to identify people with lower muscular strength and, consequently, with an increased risk of mortality.

In conclusion…

Get Strong



For athleticism, functionality, health, well-being, and happiness

Q's?