



Sport and Performance

Reverse Engineering In Sport: Developing a High-Performance Road Map

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Training is a means
to an end. For
many sports, that
end is an agile
athlete



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Presentation outline

- What is RE
- *Our* top-down logic for RE in Agility
- CoDS
- Plyometrics
- Power
- Strength
- Imbalances and movement screening

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What even is RE!?

A process in which products are deconstructed to extract design information, so that they may be recreated

Used when a part of a machine is malfunctioning and no longer available

Via deductive reasoning, engineers will try to understand how the part functions and can be made

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Application to S&C



RE is similarly adopted in systems biology and may extend to S&C



Coaches will design a series of training programmes following a periodized and systematic approach, based on *"where would we like to be this time next year?"*

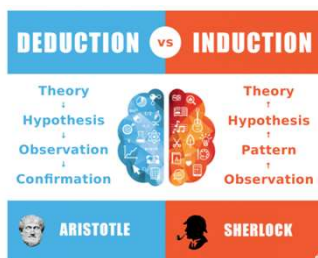


A coach may work backward, identifying KPI's, the physical attributes that map back to them, and then distribute the development of those over the allocated timeframe.



Therefore, exercise selection, frequency, reps, sets, and rest, designed to maximise performance via phase potentiation

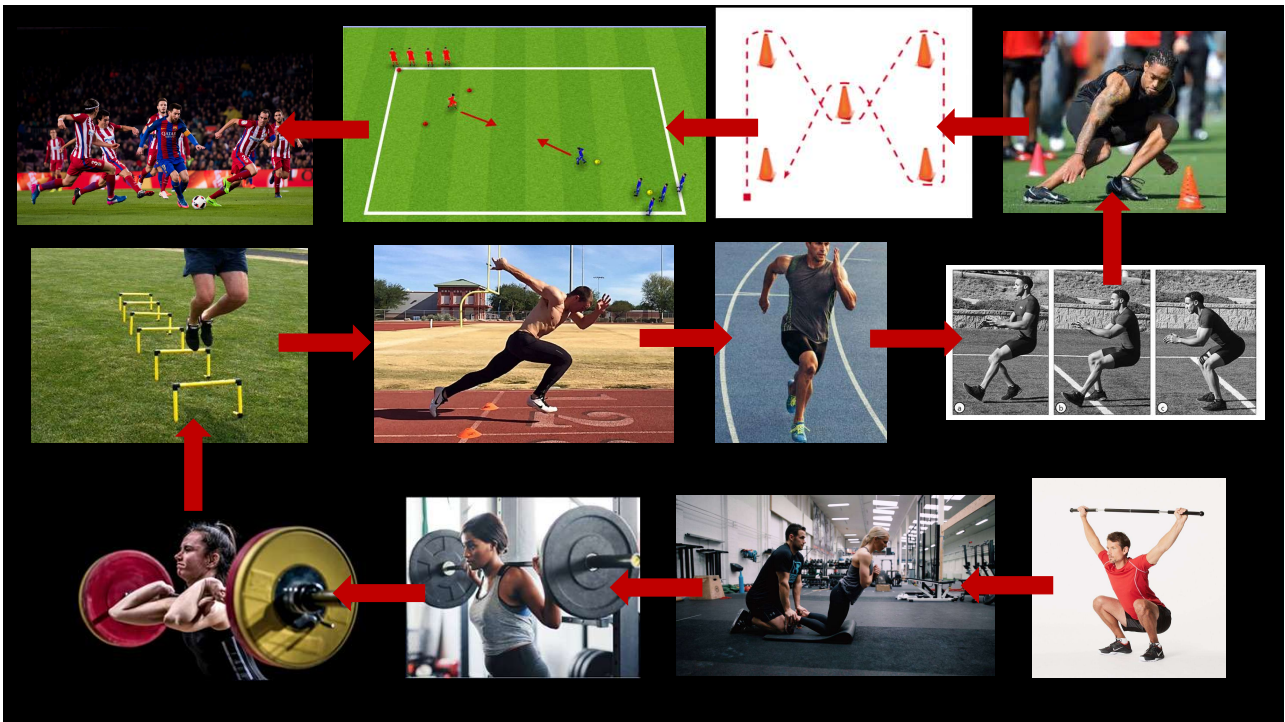
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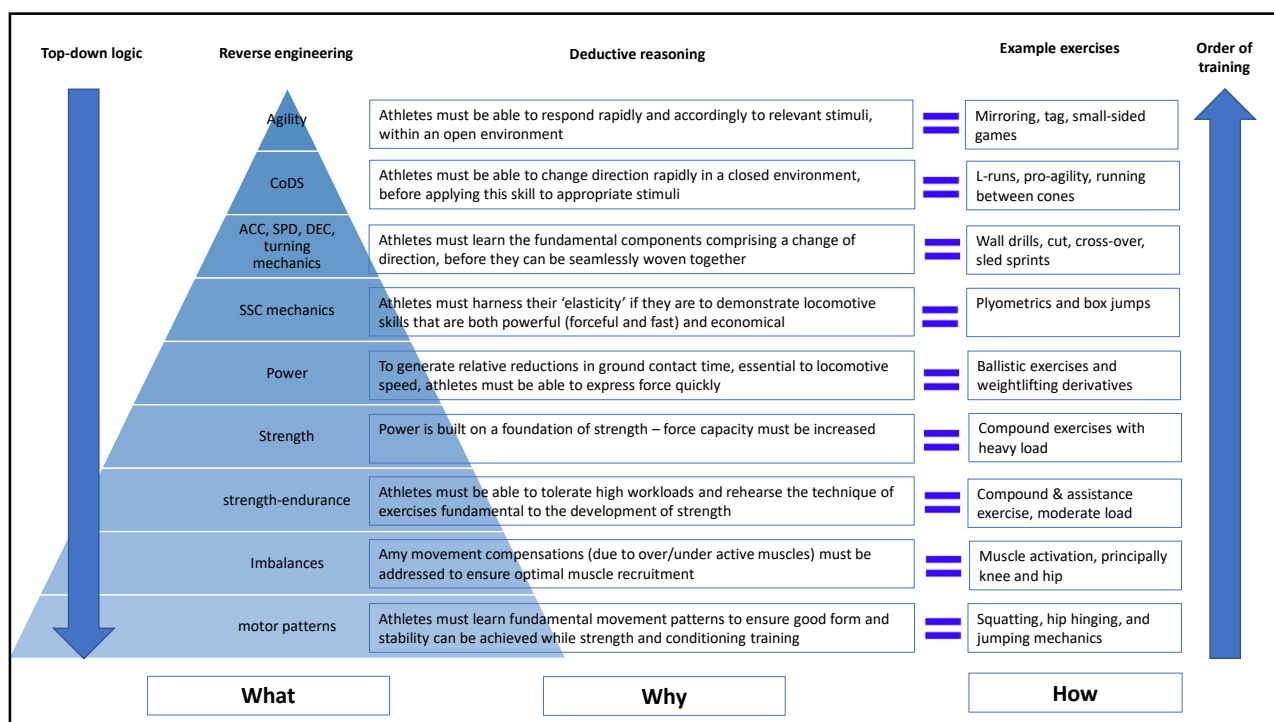
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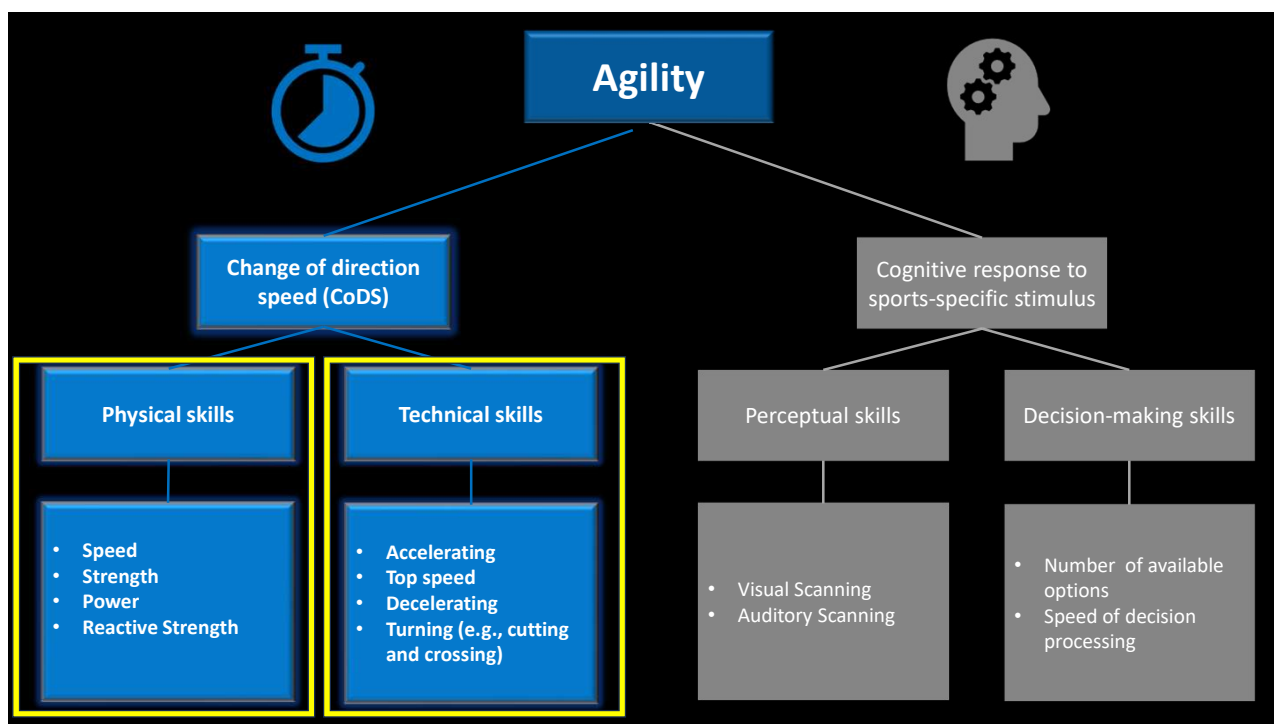
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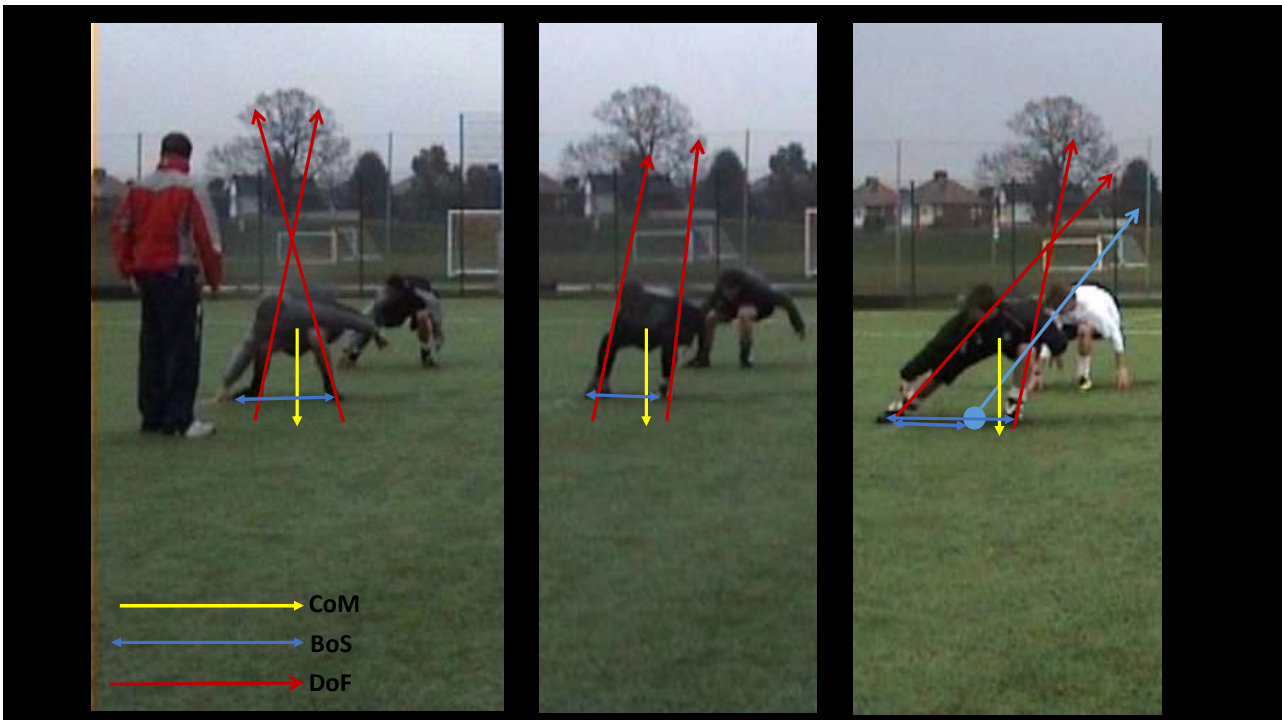
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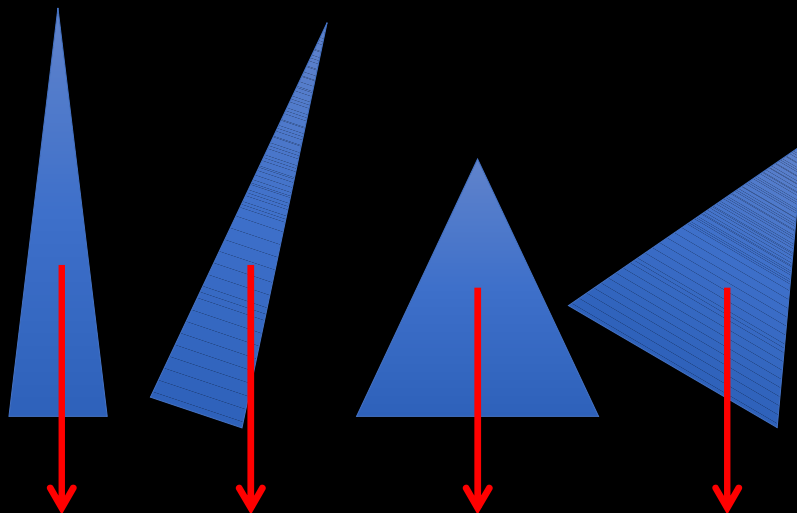


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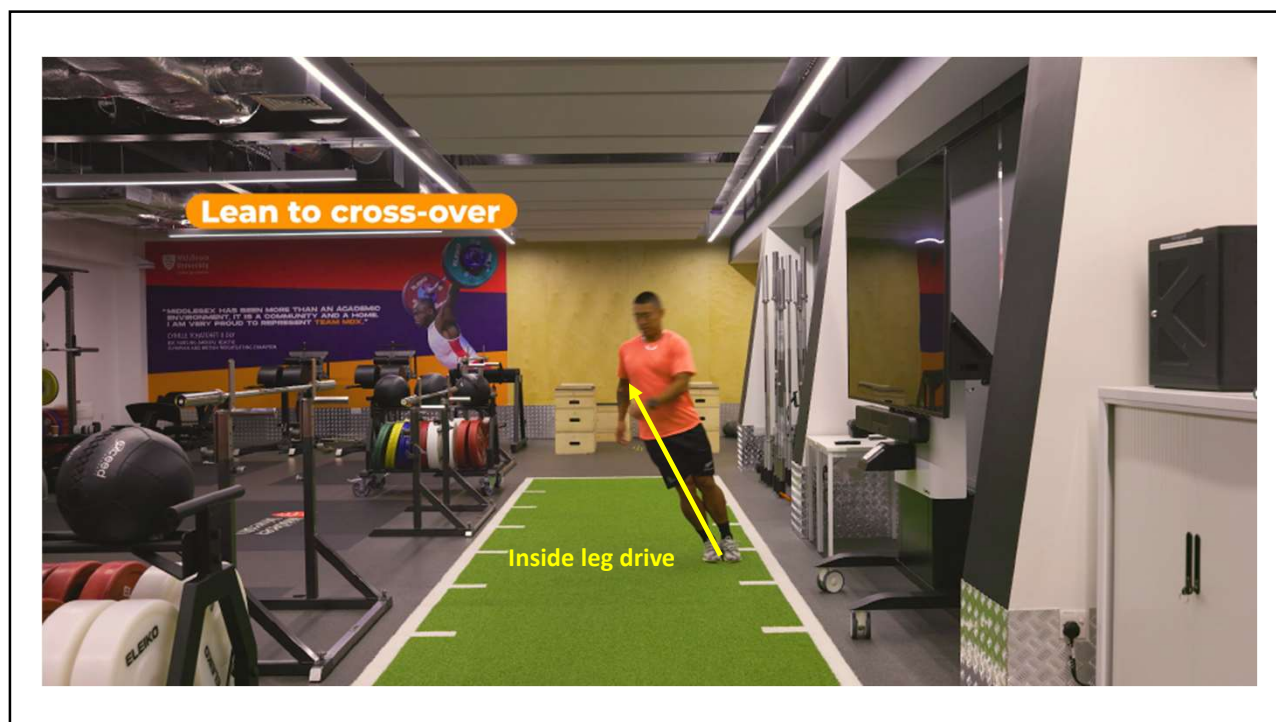
Resisting or Encouraging a CoD



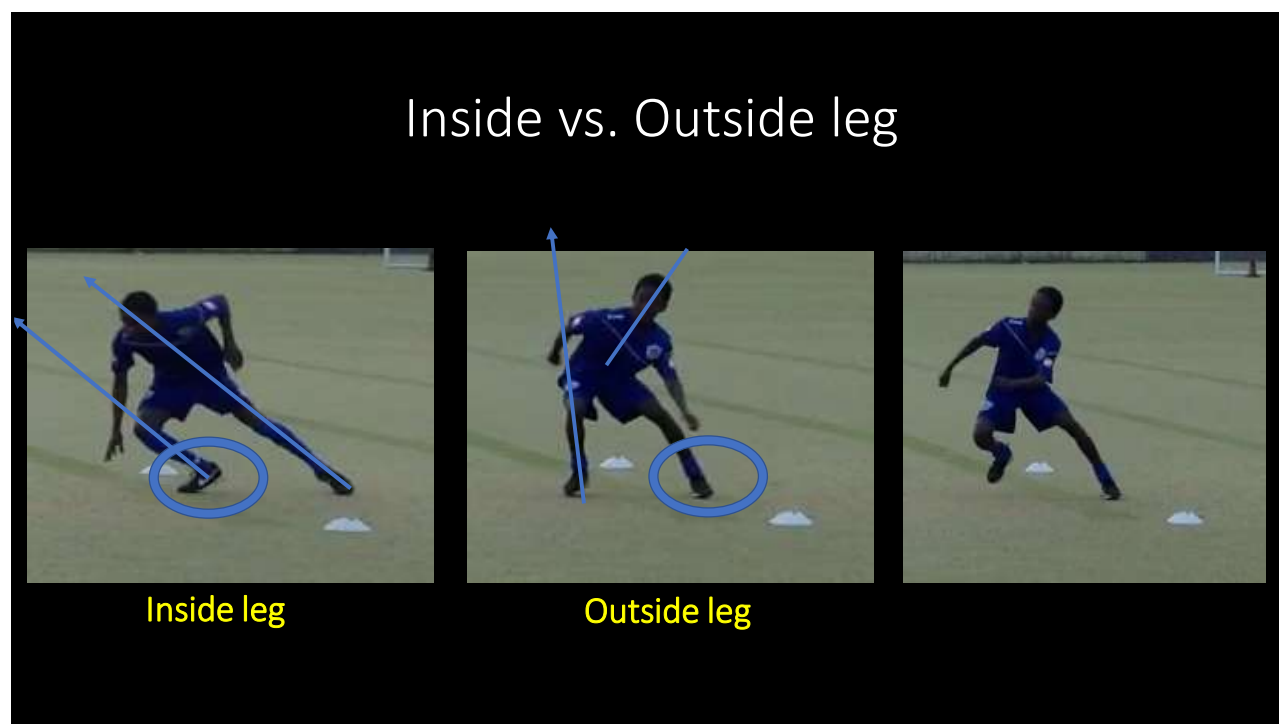
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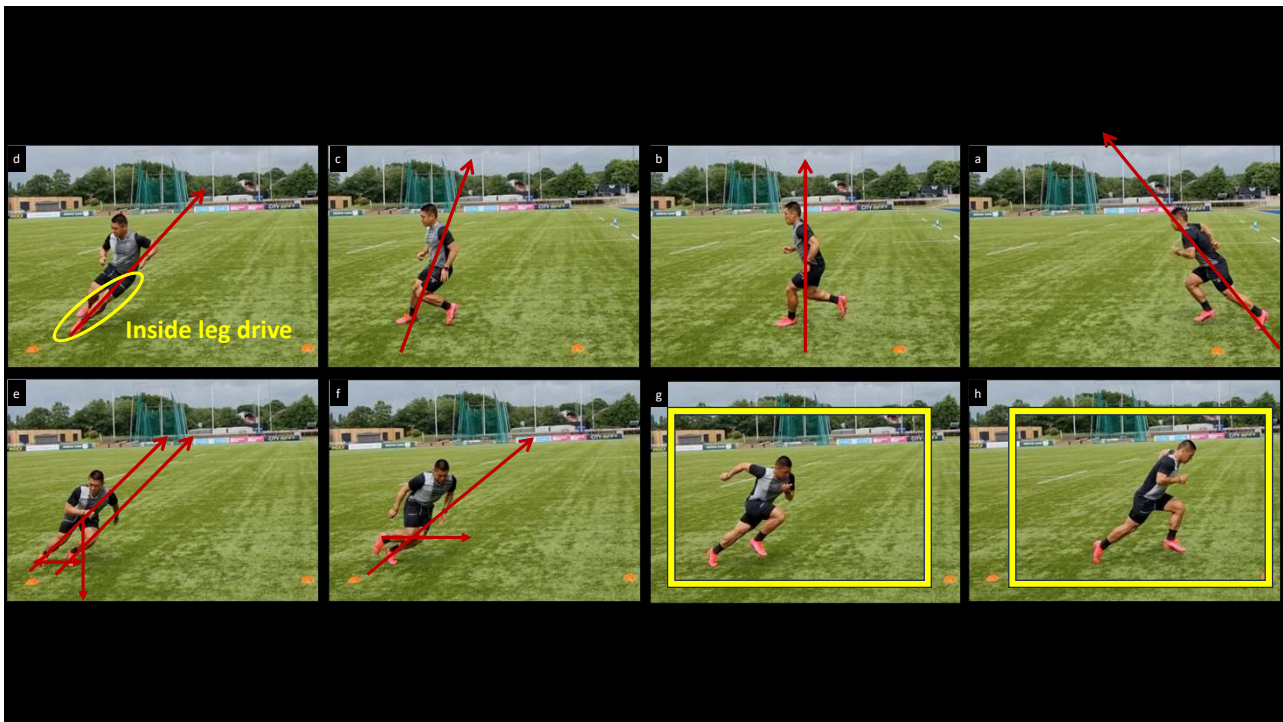
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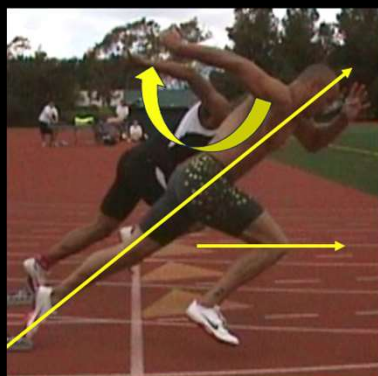
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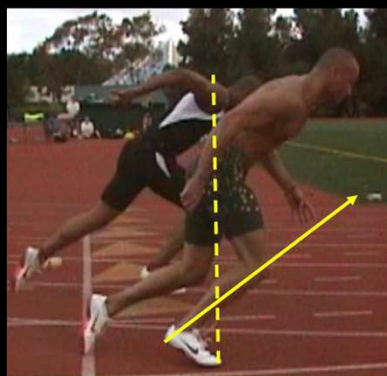
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To Summarise

~ 45° lean, knee (~ 90°)
through glass, arm snap



~ Land under hips,
+ve shin angle



Low recovery (~ under knee)
at ankle cross



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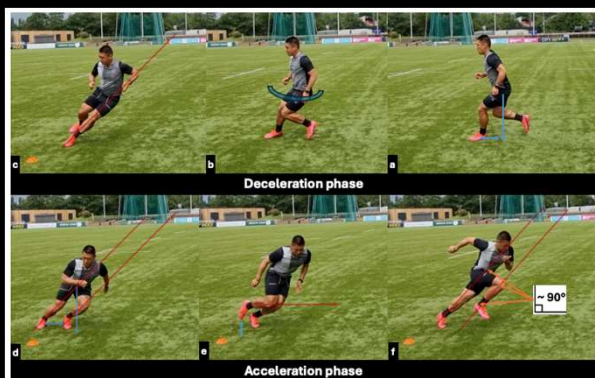
Focus on
technique
not just
time!

Process driven outcome



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5-2-180 check sheet



Phase	Movement sequence	Left Turn	Score	Right Turn	Score
Deceleration	a Distance between CoM (hips) and CoP (foot) increases as athlete "sits"	Yes ☐ No ☐		Yes ☐ No ☐	
	b Athlete re-orientes themselves into a side-on position	Yes ☐ No ☐		Yes ☐ No ☐	
	c Penultimate foot contact: inside leg performs a shallow squat with DoF orientated toward intended direction of travel	Yes ☐ No ☐		Yes ☐ No ☐	
Acceleration	d At final foot contact: - upper body and shins are aligned to direction of travel (~ 45°) - CoM (belly button) falls outside narrow BoS (feet); At turn, "head never goes between toes" - Outside leg "bounces" off ground	Yes ☐ No ☐		Yes ☐ No ☐	
	e Outside leg: - knee drives ~ horizontally forward - foot stays close to ground, and will pass ~ below opposite knee	Yes ☐ No ☐		Yes ☐ No ☐	
	f Athlete achieves acceleration posture: - ~ 90° at ankle (dorsiflexion) - ~ 90° at knee - ~ 90° at hips - Shins run ~ parallel	Yes ☐ No ☐		Yes ☐ No ☐	
		Yes ☐ No ☐		Yes ☐ No ☐	
		Yes ☐ No ☐		Yes ☐ No ☐	
Total score (out of 24, 12 points per side)		Left Total		Right Total	

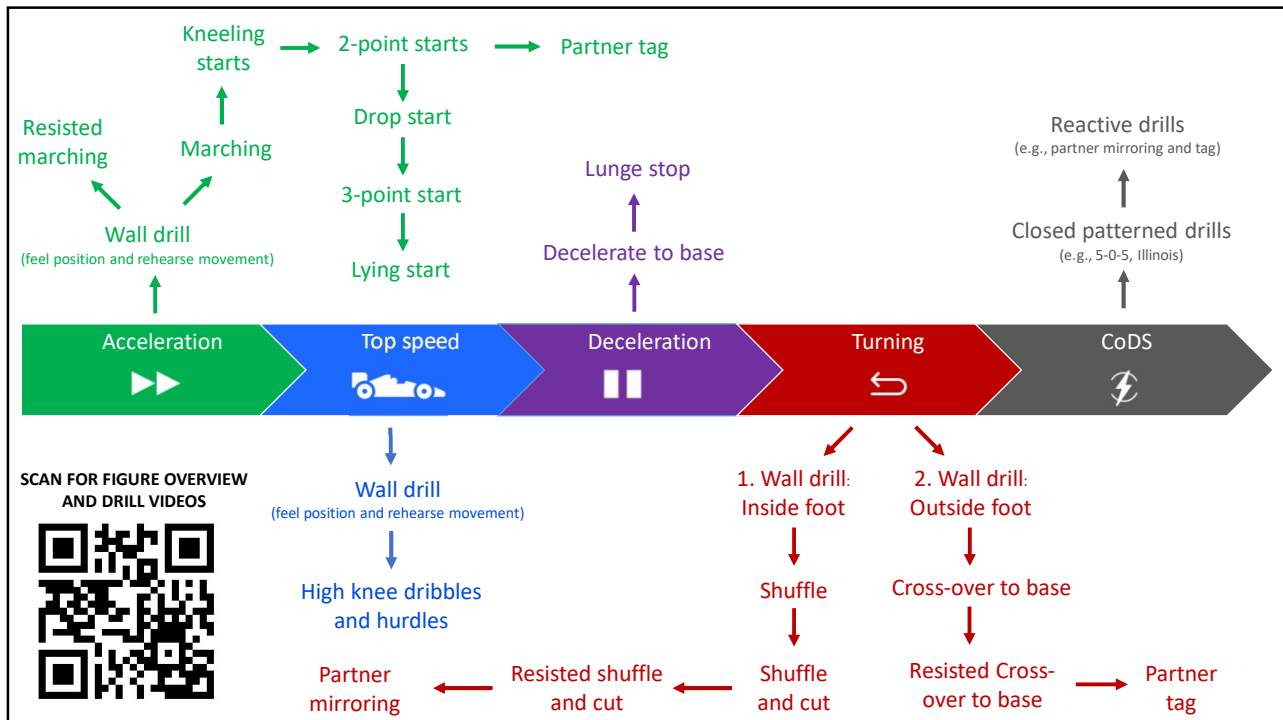
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Principles first

- The Key is to understand the mechanics.
- With this you can train all CoD manoeuvres (e.g., 60°, 90° cut)
- It's about manipulating:
DoF, BoS and CoM

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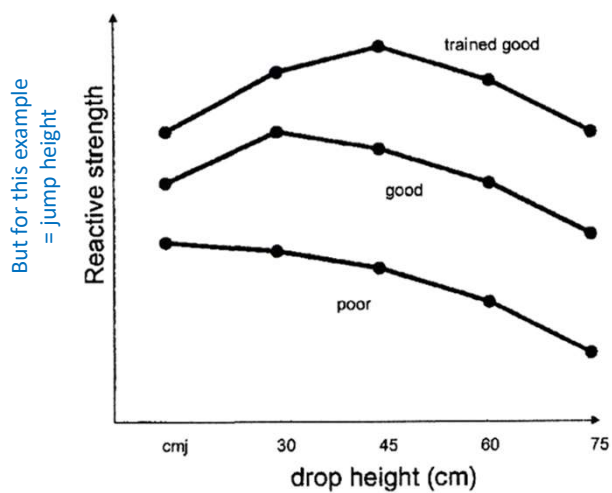
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Assessing SSC ability



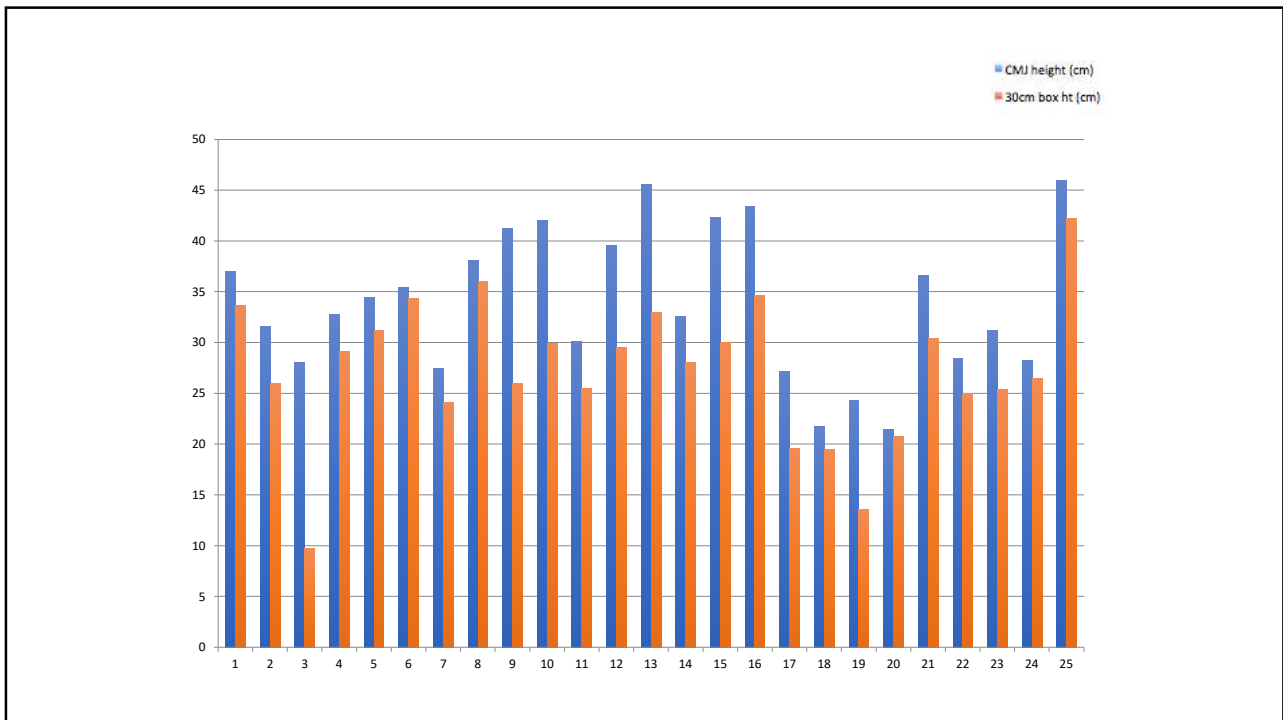
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How do you know when your SSC ability is really bad!?

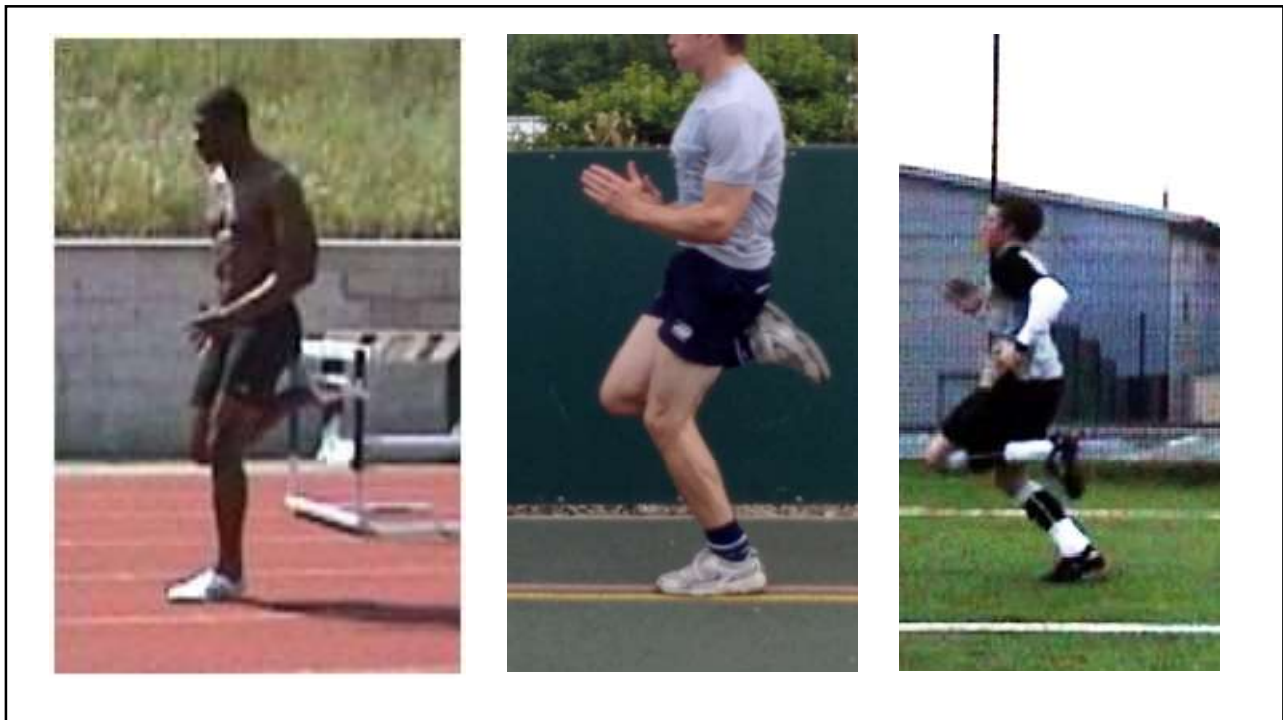


Newton & Dugan (2005)

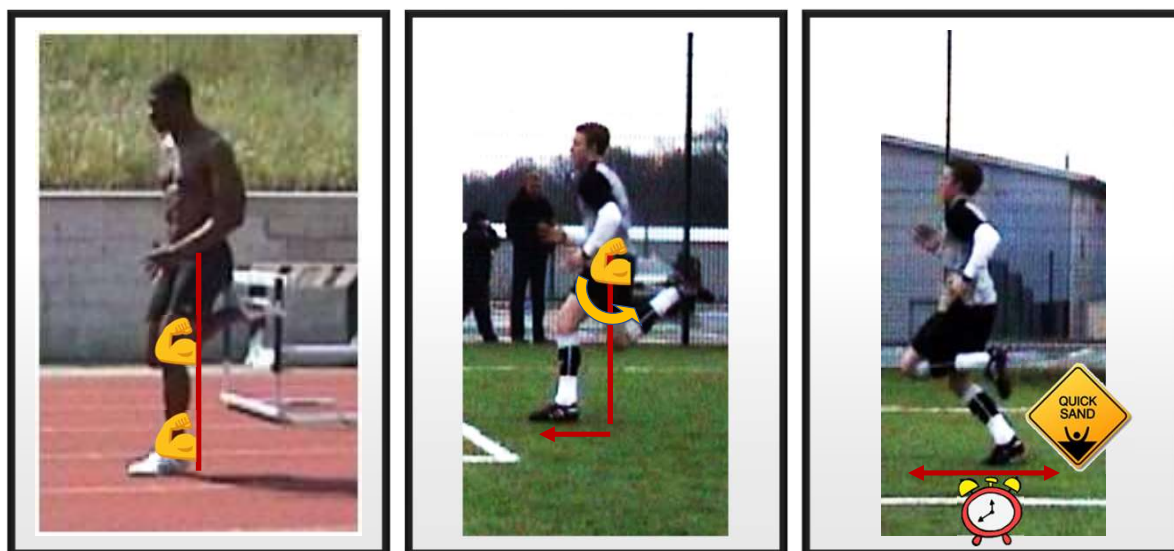
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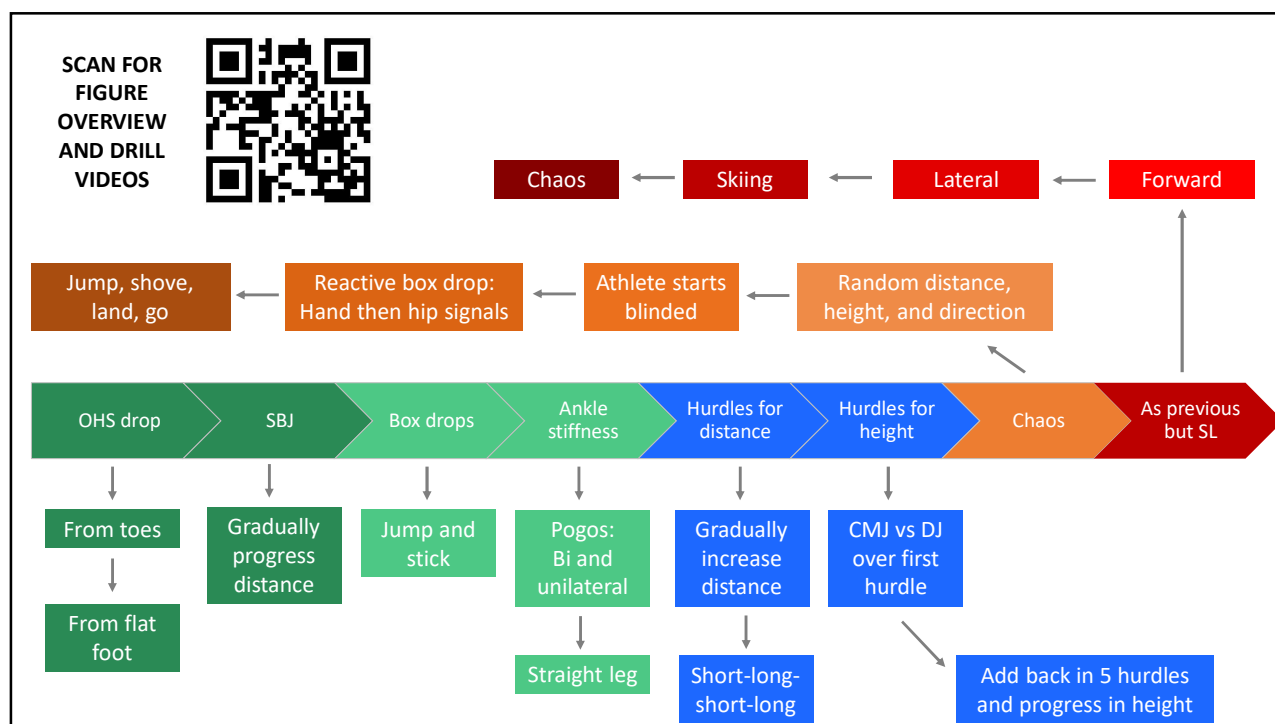
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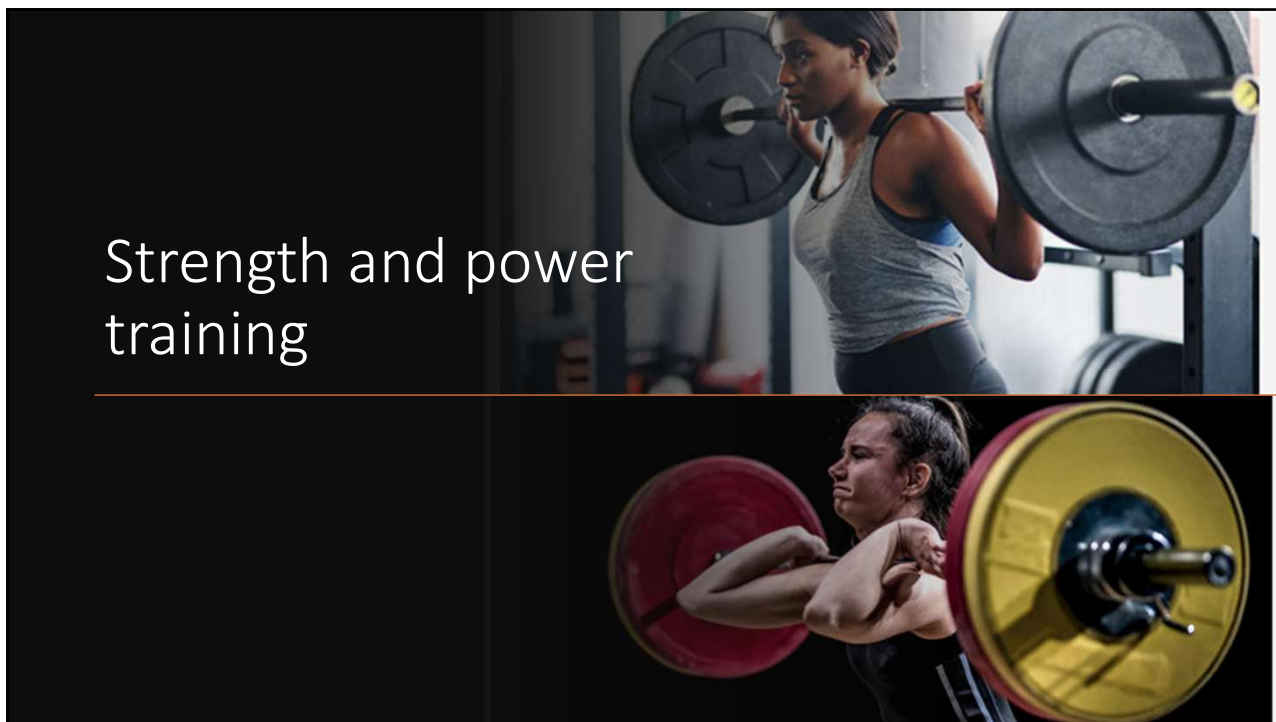


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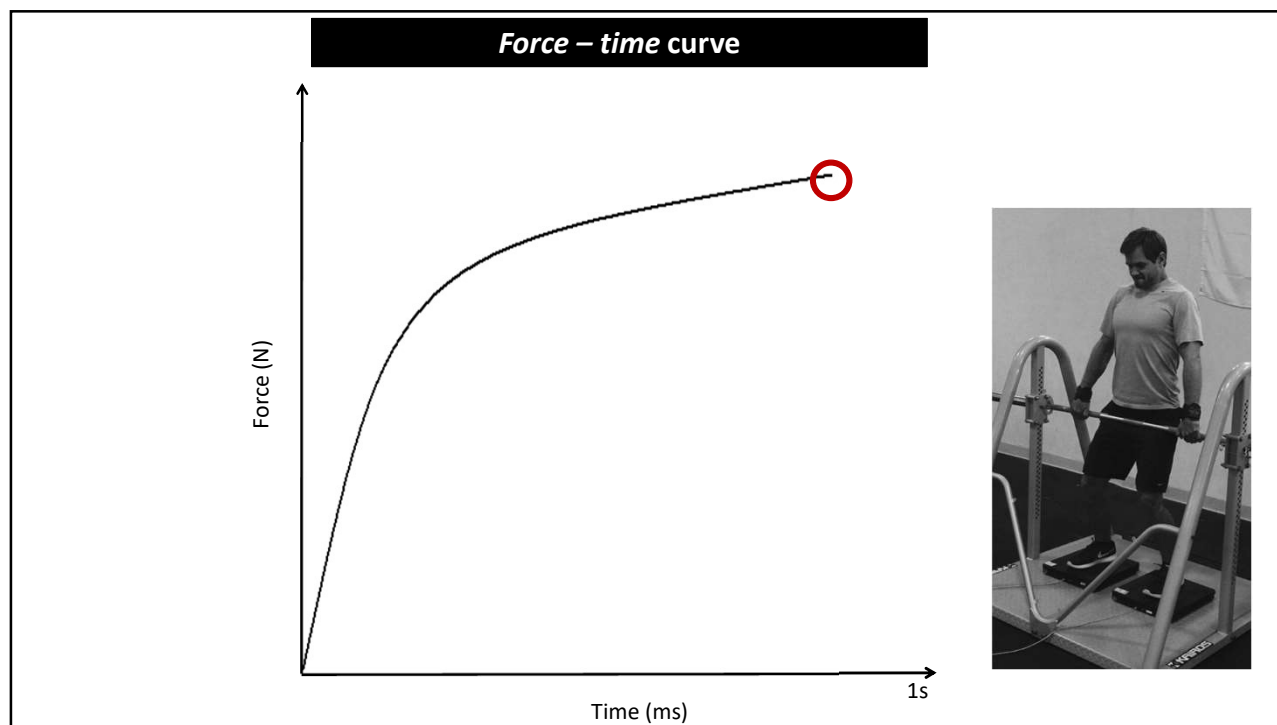


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Strength and power training

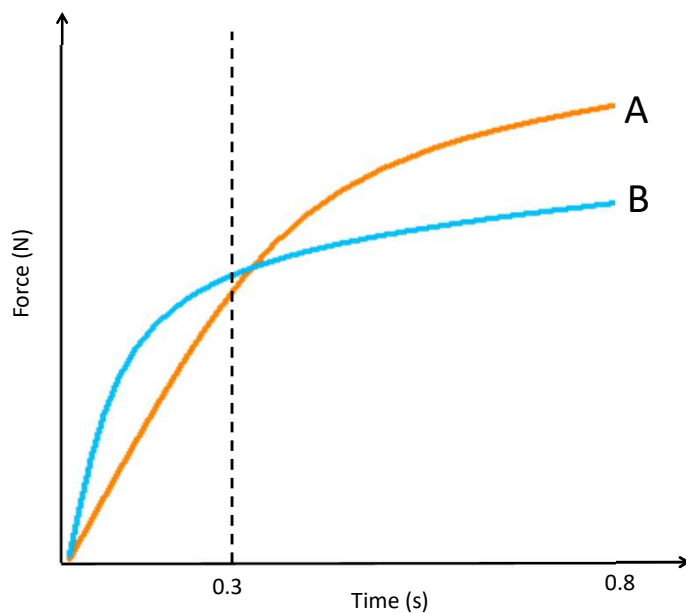


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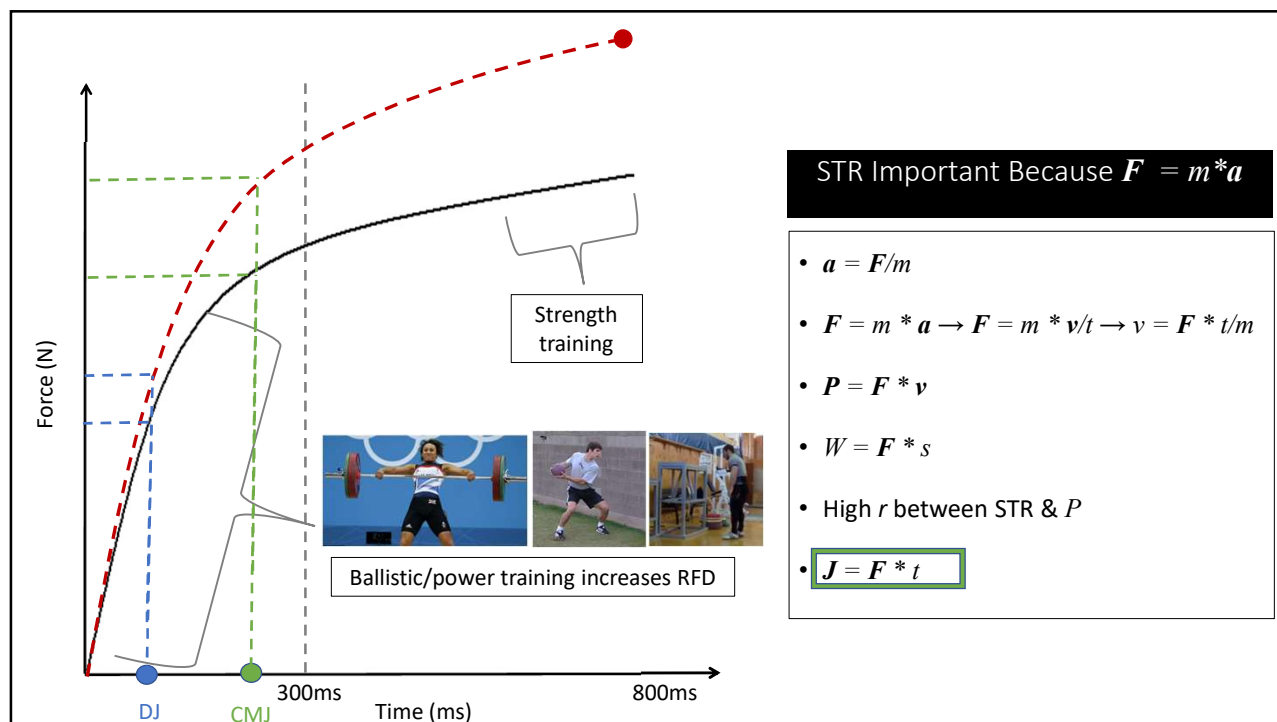


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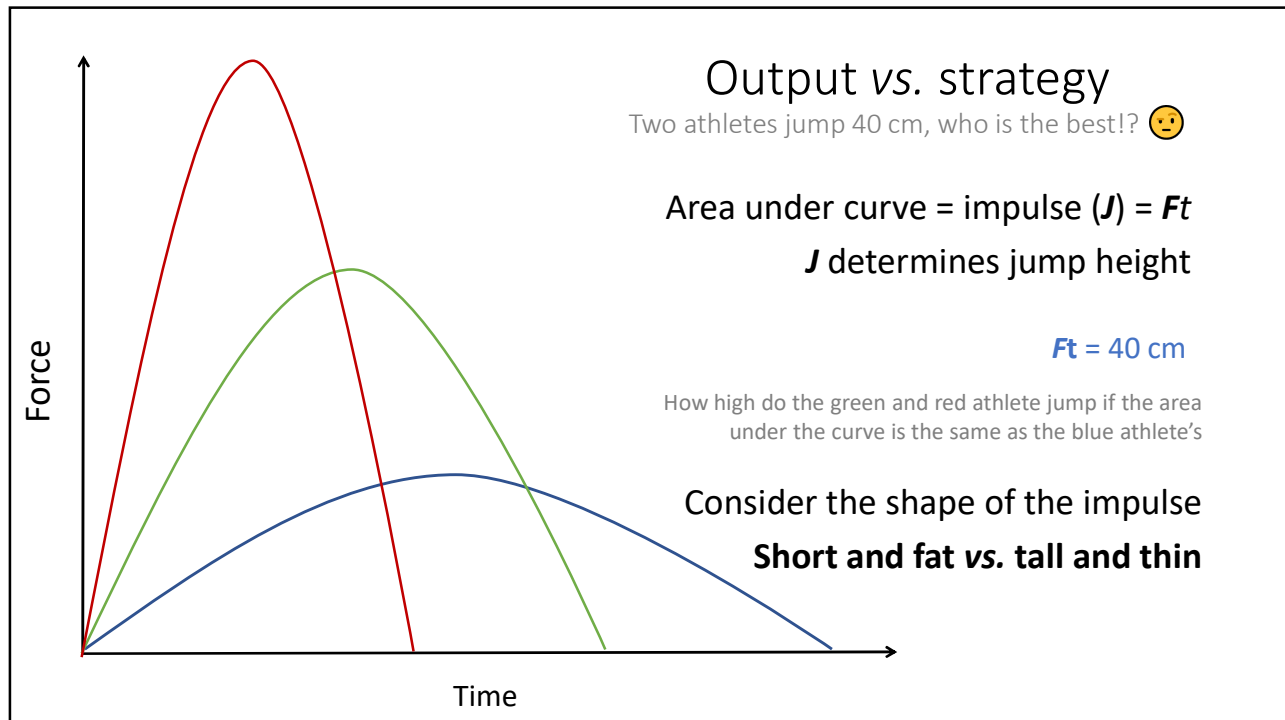
Who would you rather be?



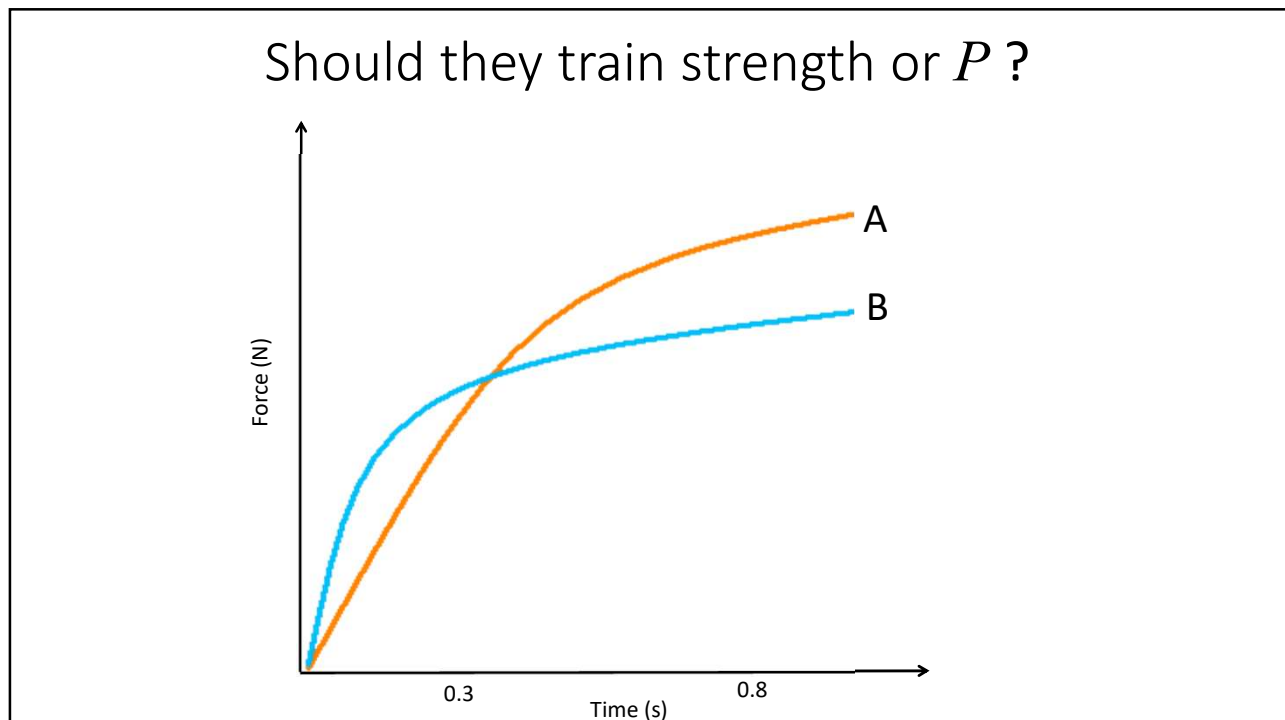
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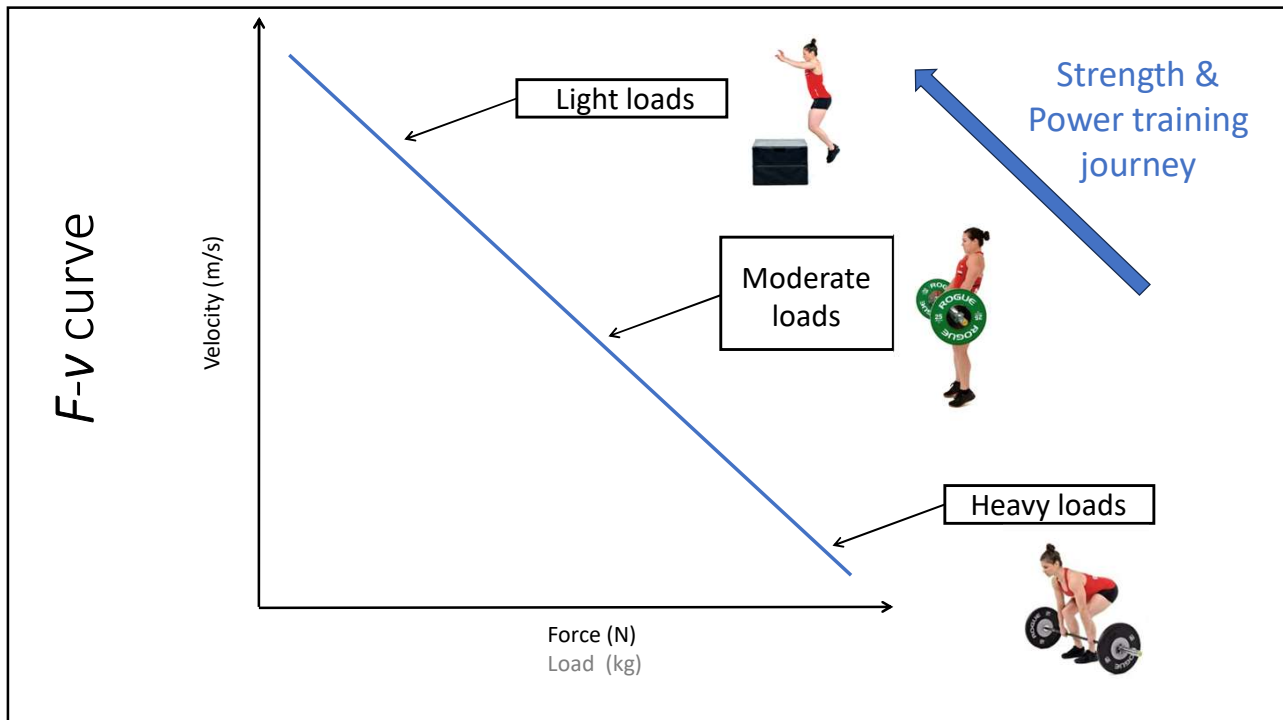
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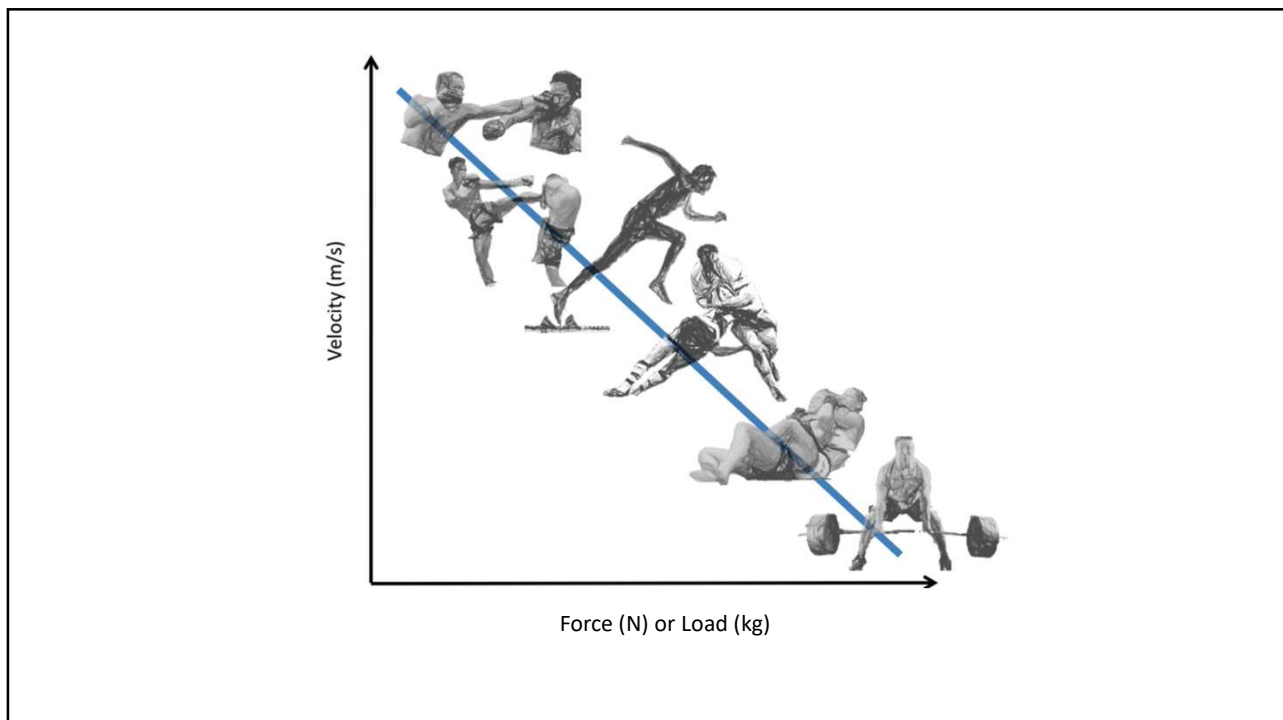
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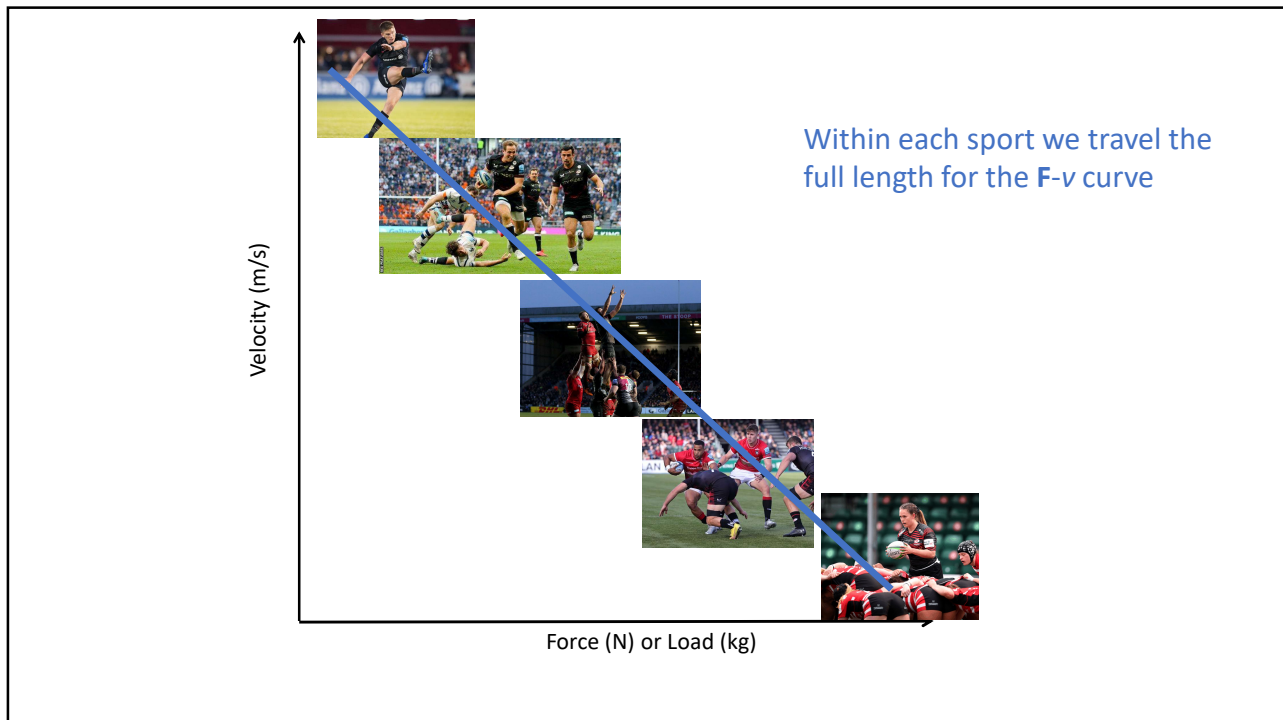
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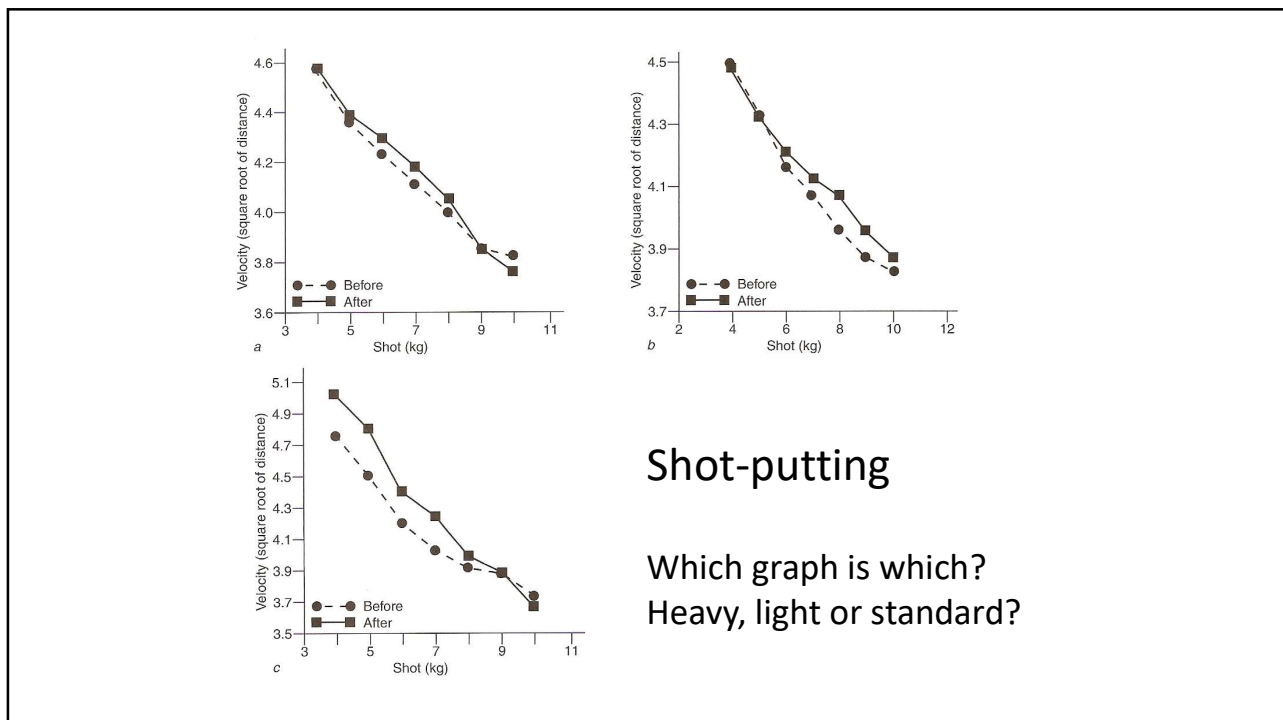
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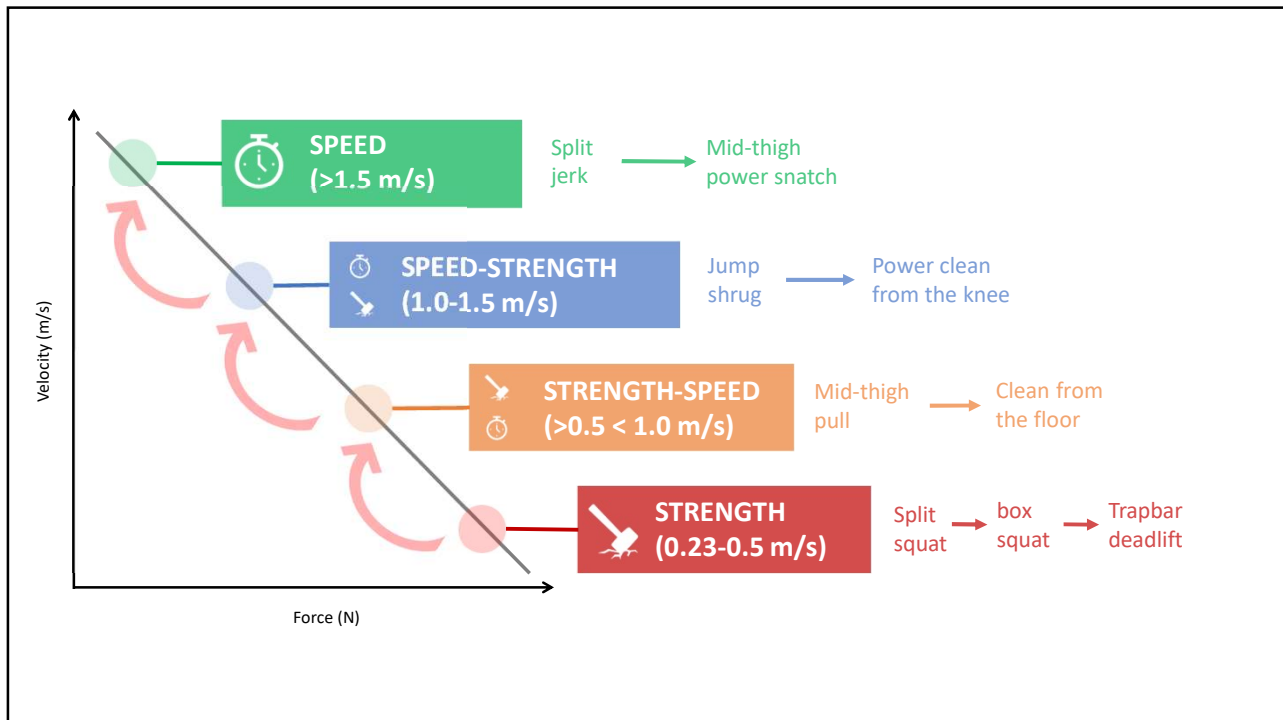
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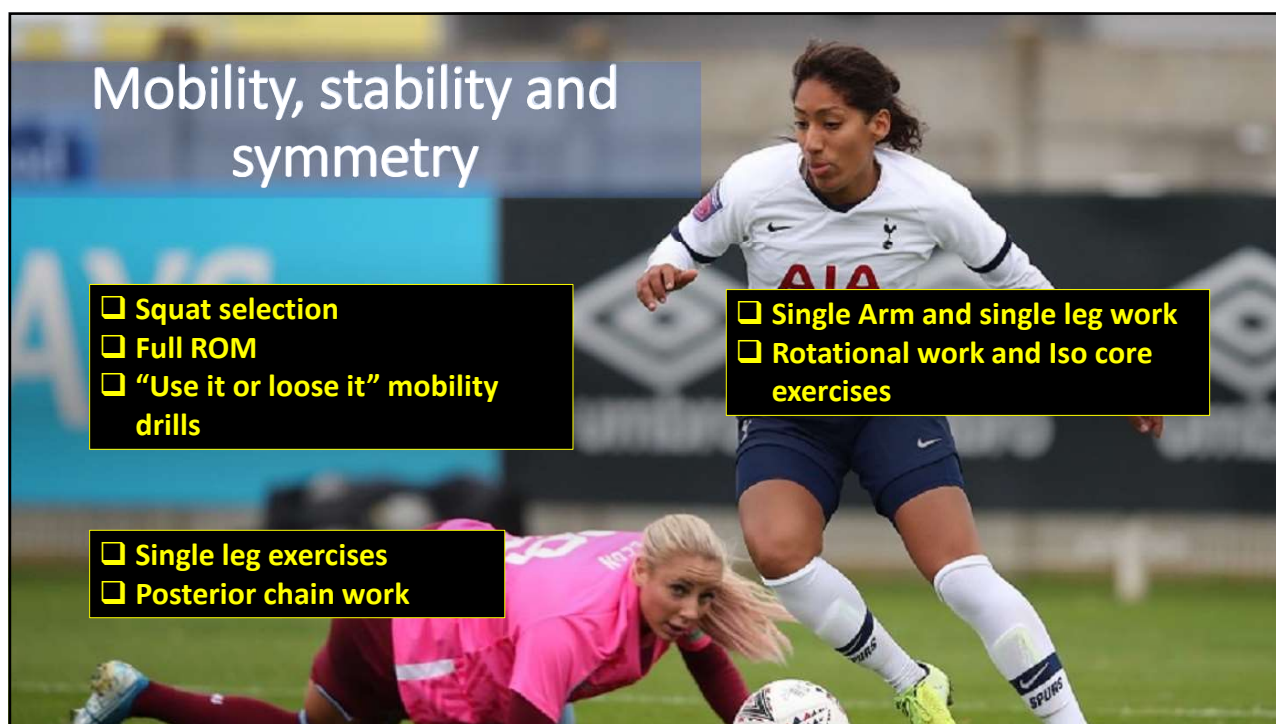
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What's the best squat!?



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Mobility, stability, and form

OVERHEAD SQUAT FOR MOVEMENT SCREENING

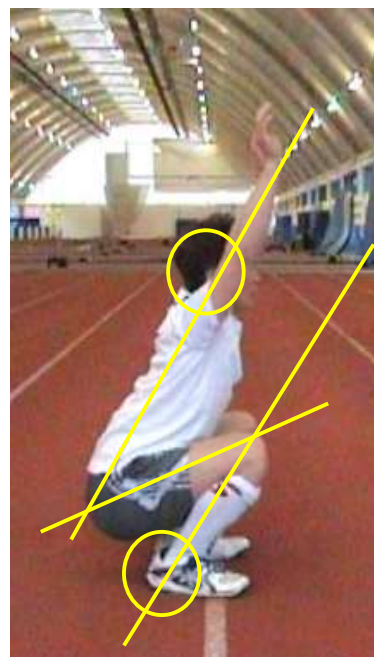
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Screening movement dysfunctions using the overhead squat

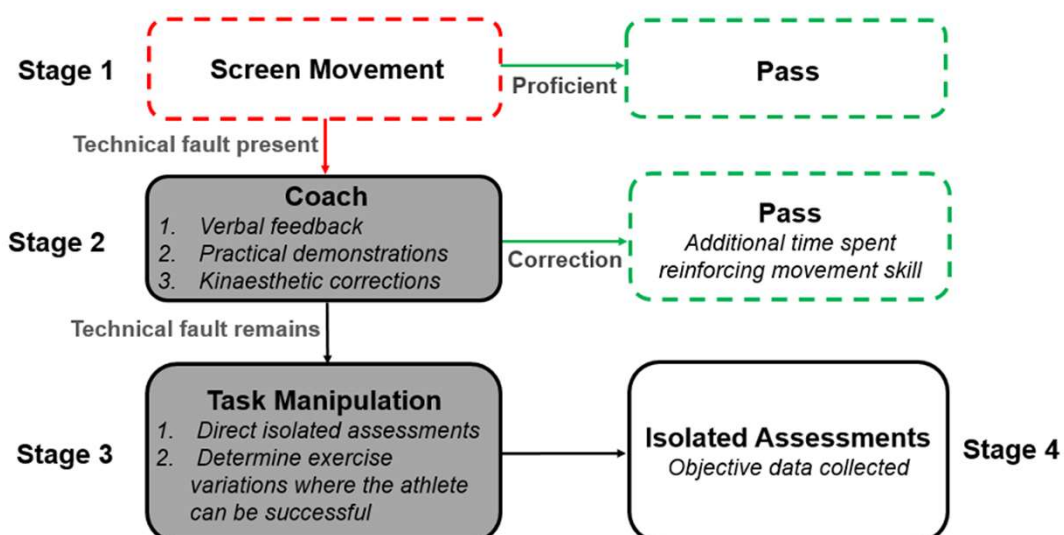
By Chris Bishop, MS, ACSM, ASCS, Mike Edwards MS, ASCS, and Anthony Turner, MS, MS, ASCS, CSCS
London Sport Institute, Middlesex University

Table 3. Proposed grading criteria for the overhead squat assessment (guided by suggestions from the NASM) ^{8,10}

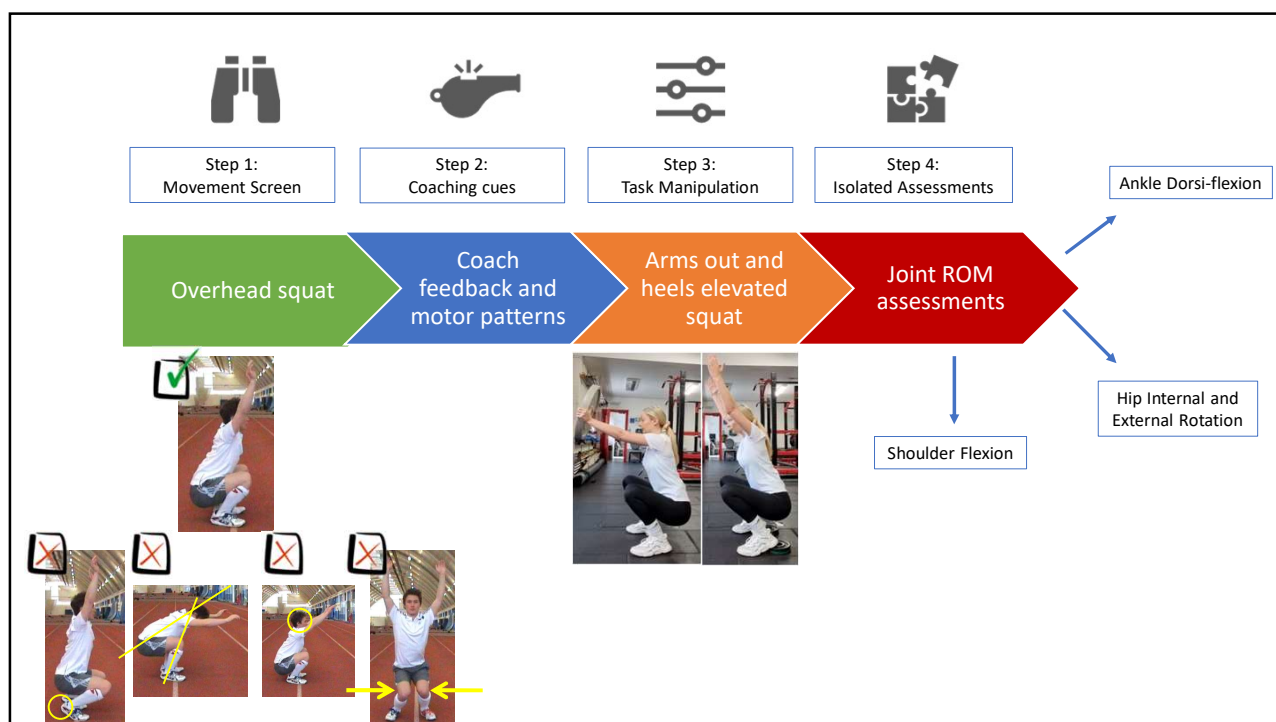
JOINT	COMPENSATION	LEFT	RIGHT	NOTES
Foot/ankle	External rotation	○	○	
	Feet flatten	○	○	
	Heel raise	○	○	
Knee	Valgus	○	○	
	Varus	○	○	
LPHC	Forward lean		○	
	Lumbar arching		○	
	Lumbar rounding		○	
Shoulder	Arms fall forward	○	○	
	Elbows flex	○	○	
Head	Protruding		○	
Score: Left/Right				
Total score:				



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75



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In Conclusion...



The theoretical or biological basis for how we move and respond to exercise stimuli, coupled with an understanding of how these are best sequenced such that one stimuli and subsequent adaptation can potentiate the next, is a means of devising effective and efficient training plans

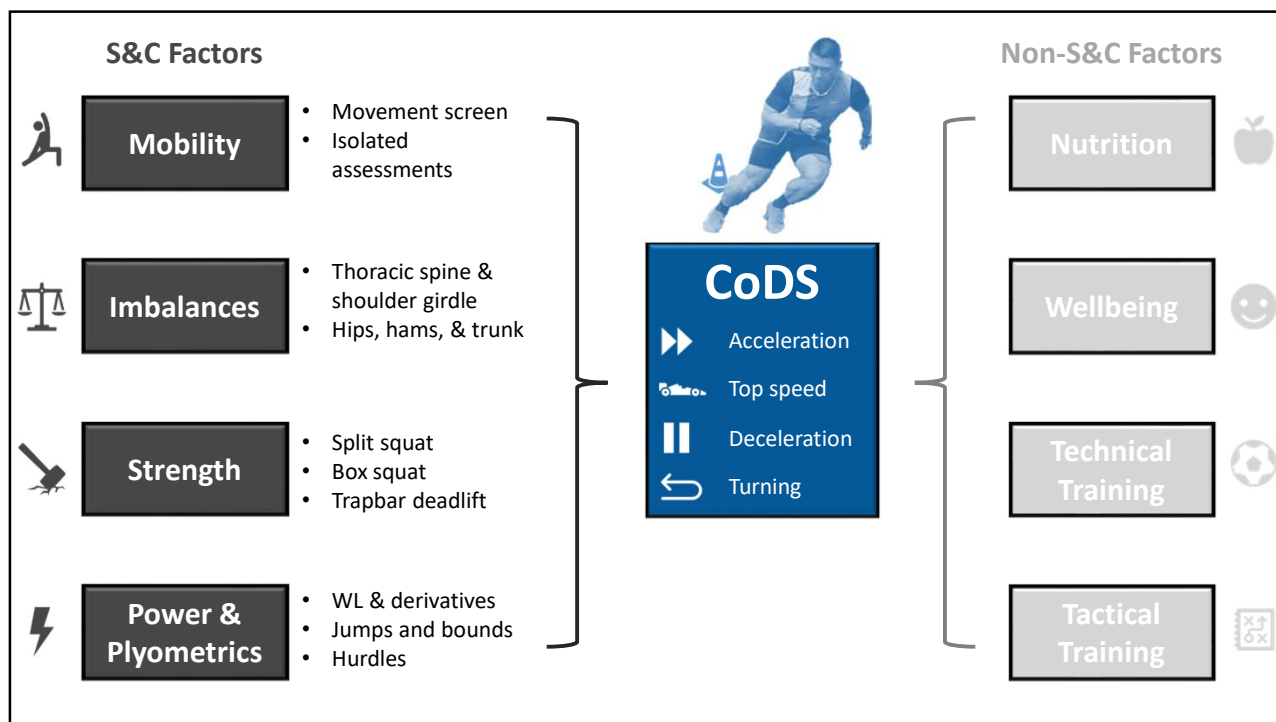


Such an approach likely gives our athletes the best chance of attaining their goal



So, consider reverse engineering your performance outcomes

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Recommended Reading 😊

Performance Modeling: A System-Based Approach to Exercise Selection

Paul J. Read, MSc, CSCS¹, Chris Bishop, MSc, CSCS², Jon Brazier, MSc,³ and Anthony N. Turner, MSc, CSCS^{1,2}
¹School of Sport, Health and Applied Science, St Mary's University, London, United Kingdom; and ²London Sports Institute, Middlesex University, United Kingdom



Building a High-Performance Model for Sport: A Human Development-Centered Approach

Anthony N. Turner, PhD,¹ Chris Bishop, MSc,¹ Jon Brazier, MSc,² Paul J. Read, PhD,³ Andy McClain,⁴ Brett Bartholomew, MSc, CSCS^{1,2}, RSCC^{1,2}, and Laurence Halbert¹
¹Faculty of Science and Technology, London Sports Institute, Middlesex University, London, United Kingdom; ²Human Performance Lead, UK Military, Department of Psychology, Faculty of Health, Psychology and Social Care, Manchester Metropolitan University, Manchester, United Kingdom; ³The Bridge Human Performance and the Art of Coaching; and ⁴Danish Fitness Federation, Copenhagen, Denmark



Reverse Engineering in Strength and Conditioning: Applications to Agility Training

Anthony N. Turner, PhD,¹ Paul J. Read, PhD,² Luca Mustoni, MSc,³ Ryan Chavda, MSc,¹ Xiang-Yao, MSc,⁴ Alessio Fregolante, PhD,⁵ Adam Wright, MSc,⁶ Anne Scoppellato, MSc,⁷ and Chris Bishop, PhD,¹
¹London Sports Institute, Middlesex University, London, United Kingdom; ²Institute of Sport, Exercise and Health, Bournemouth University, Bournemouth, United Kingdom; ³College of Human and Health Sciences, University of Vermont, Burlington, Vermont



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Recommended Reading:

Power and underpinning mechanics

Developing Powerful Athletes, Part 1: Mechanical Underpinnings

Anthony N. Turner, PhD,¹ Paul Comfort, PhD,² John McMahon, PhD,³ Chris Bishop, MSc,¹ Shyam Chavda, MSc,¹ Paul Read, PhD,⁴ Peter Mundy, PhD,⁵ and Jason Lake, PhD⁶
¹London Sports Institute, Middlesex University, Gownlands Lane, United Kingdom; ²University of Salford, School of Health and Society, Salford, United Kingdom; ³Aspetar Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar; ⁴Centre for Exercise and Sports Science Research, Edith Cowan University, Joondalup, Australia; ⁵Coventry University, Coventry, United Kingdom; and ⁶Chichester Institute of Sport, University of Chichester, Chichester, United Kingdom



Developing Powerful Athletes Part 2: Practical Applications

Anthony N. Turner, PhD,¹ Paul Comfort, PhD,^{2,3} John McMahon, PhD,³ Chris Bishop, MSc,¹ Shyam Chavda, MSc,¹ Paul Read, PhD,⁴ Peter Mundy, PhD,⁵ and Jason Lake, PhD⁶
¹London Sports Institute, Middlesex University, London, United Kingdom; ²School of Health and Society, University of Salford, Salford, United Kingdom; ³Centre for Exercise and Sports Science Research, Edith Cowan University, Joondalup, Australia; ⁴Aspetar Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar; ⁵Coventry University, Coventry, United Kingdom; and ⁶Chichester Institute of Sport, University of Chichester, Chichester, United Kingdom



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Q's?



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