Programming Strategies for Peak Power in the Weightroom

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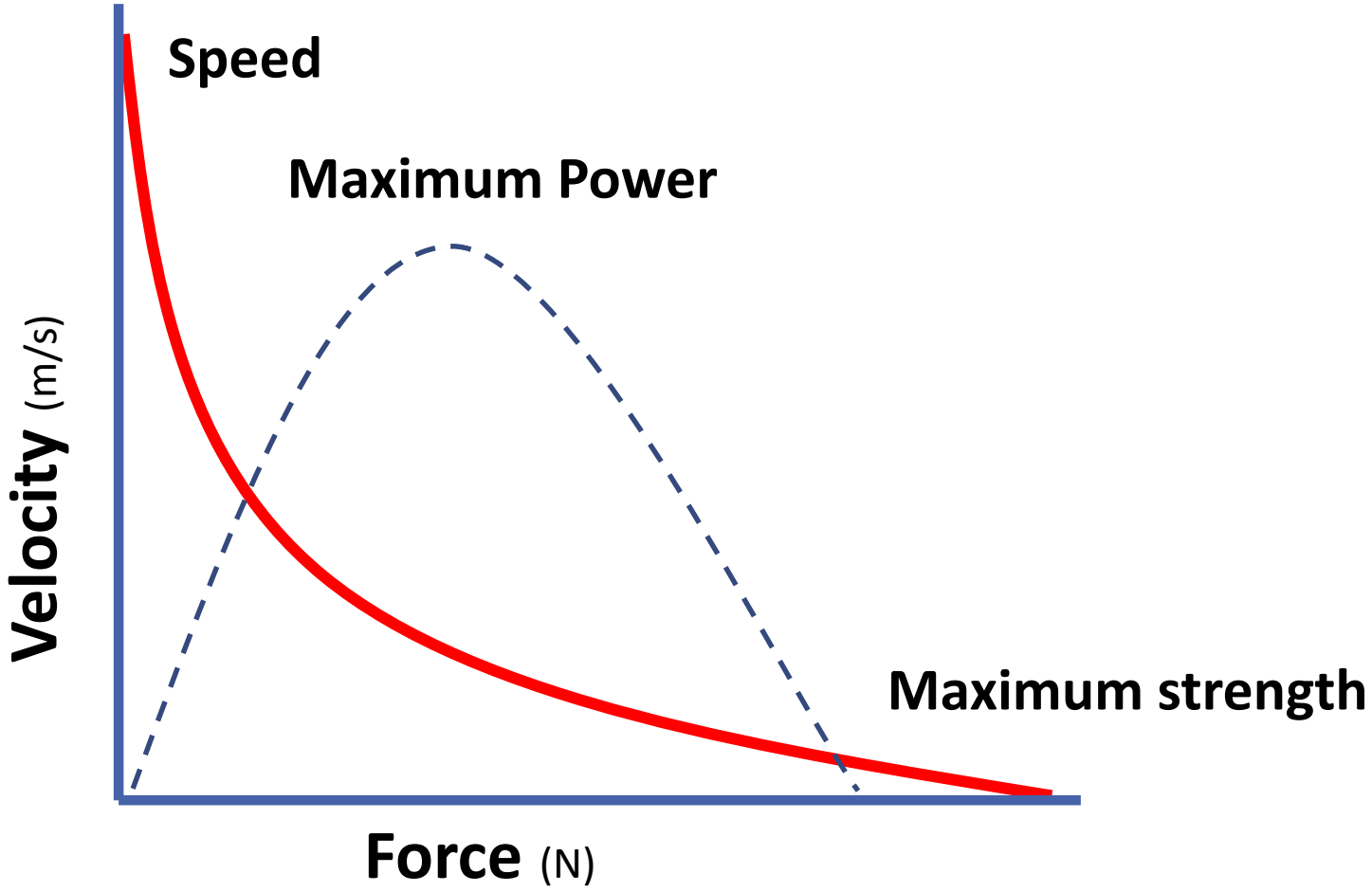
Eleiko Education

Overview

1. Why power is king in sport
2. How to improve power
3. Programming strategies to maximize power output

Load power curve

Max power: where force x velocity is highest



Who do you pick for the 100m dash?

MIKE

500lb back squat

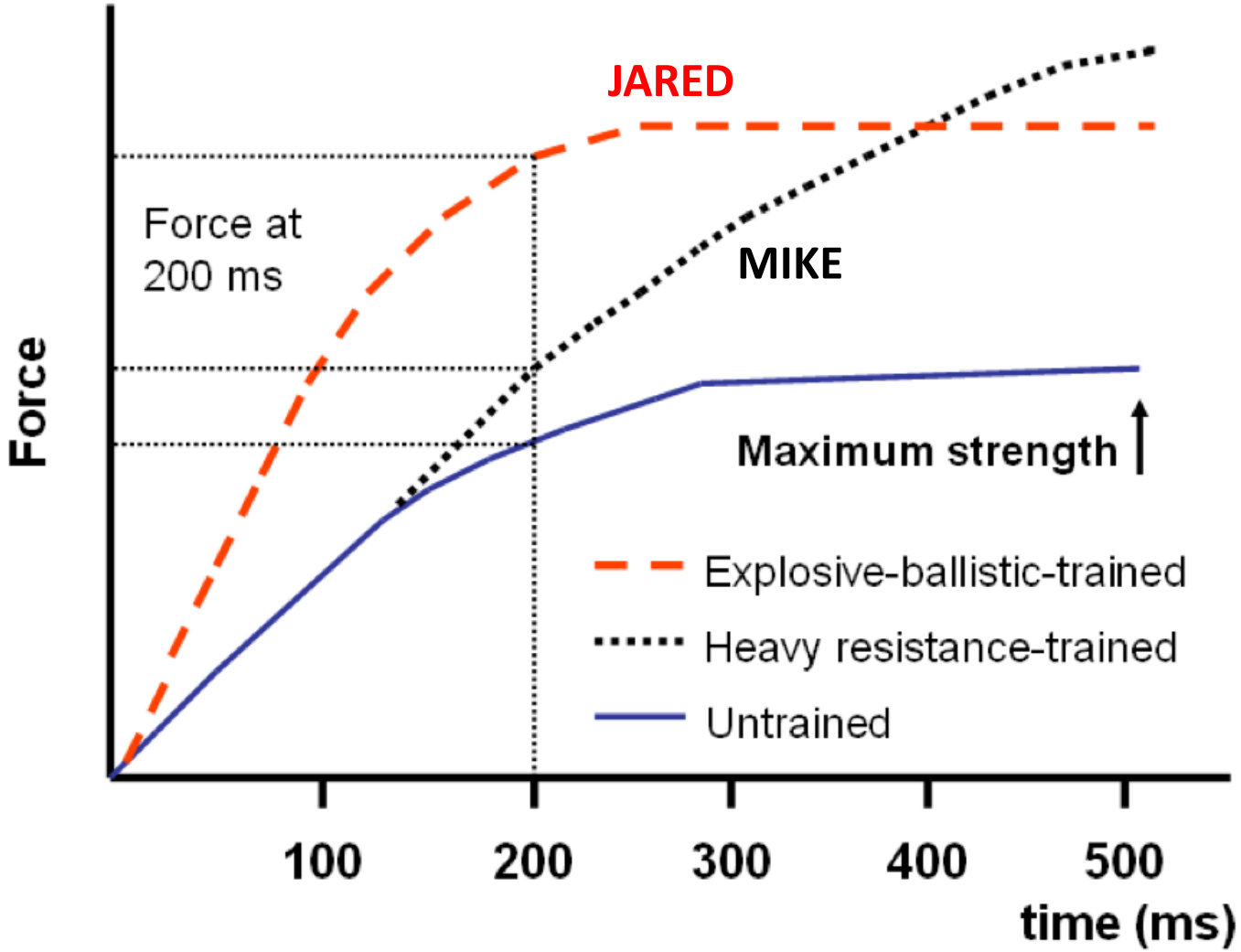
20” vertical jump

JARED

400lb back squat

35” vertical jump

Why stronger is not always better



How to improve max power output?

1. Use exercises with high power outputs
2. Train with a load that maximizes power
3. Select optimal set/rep scheme and minimize overall fatigue levels
4. Do 1-3 in SP/COMP/PEAK phases of block periodized training plan

Cormie, McCaulley, Triplett, et al., 2007; Stone et al., 2007; Wilson, Newton, Murphy, & Humphries, 1993

Power output of various exercises

(Power = force x velocity)

Lift (max effort)	Time to complete	Bar velocity	Power
Bench	~1-5 sec	~0.6 m/s	~300 W
Deadlift	~1-10 sec	~0.5 m/s	~1300 W
Back squat	~1-5 sec	~0.5 m/s	~1300 W
2nd pull snatch or clean	**~ 100-200 ms**	**~1.6 m/s**	**~4000 W**

Garhammer, 1980; Garhammer, 1981; Garhammer, 1984; Garhammer, 1993; Stone et al., 2007

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What % of 1RM does peak power occur?

- Squat/ Deadlift
- Clean/Snatch
- Jump squat

What % of 1RM does peak power occur?

- For ballistic exercises, typically between 40-80% 1RM
  - NOT helpful to coaches for training prescription
- Evidence for 0% (jump squat) up to 90% (mid-thigh clean pull) 1RM

Comfort et al., 2012; Dugan et al., 2004; Hardee et al., 2012; Siegel et al., 2002; Stone, Stone, & Sands, 2007; McBride et al., 2011; ; Cormie, McCaulley, & McBride, 2007

How to make sense of conflicting reports

Wide range due to interplay of factors such as:

1) The exercise being performed

2) Training status and age of the subjects

3) **Methodology and equipment used to calculate power**

Argus et al., 2014; D. Baker & Newton, 2007; Cormie, McBride, & McCaulley, 2007; Cormie, McCaulley, & McBride, 2007; Cronin & Sleivert, 2005; Baker et al. (2001b); Stone et al. (2003)

Measurement of power

Power values depend largely on measurement and mathematical methodology to calculate it

Measuring devices:

- Wireless accelerometers
- Force plates
- Video analysis and linear pot
- 3D motion capture
- Force plates and linear pot

Cronin & Sleivert, 2005; Dugan et al., 2004; Sato, Sands, & Stone, 2012; Sato, Smith, & Sands, 2009; Moreno, Brown, Coburn, & Judelson, 2014; Dalziel, Neal, & Watts, 2002; Haff et al., 2003; Kipp, Harris, & Sabick, 2013; McBride et al., 2011; Cormie, McCaulley, Triplett, et al., 2007; Hardee et al., 2012

Is % of 1RM where peak power occurs static?

Power is not static

Power output fluctuates in response to training demands, training volume, and fatigue (D. Baker, 2001a, 2001b; Stone et al., 2007)

- Large differences between populations studied
- Phase of training rarely noted in literature

Fitness Quality	Sensitivity to Fatigue
Max. Strength	Low
Peak Power	High
Max Speed	High
Rate of Force Development	Very high

What does it mean for coaches?

- Use the literature as a rough guide; don't forget common sense
  - Work across a range of %
    - Ex: 65-80% for snatch and clean
- Monitor/manage fatigue; use EYES to set loads
  - How are you feeling today?
  - Does not have to be fancy or expensive
  - Good relationship = good feedback

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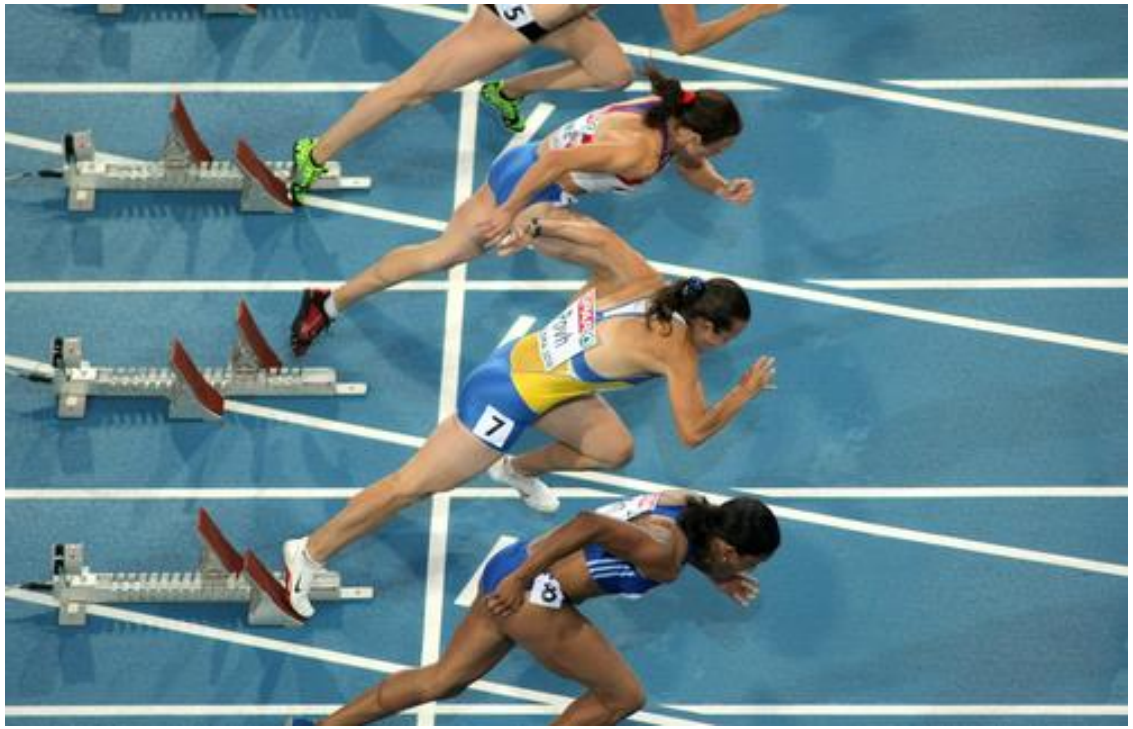
Programming strategies for power development

1. Cluster sets
2. Potentiation complexes
3. Ladder sets



Why do we need cluster sets?

- Cluster can be one or more reps
  - Typical inter-rep rest 20-60 sec
  - Inter-set rest 2-3 min

- In a traditional set, PP, PF, PV decline
  (Haff et al., 2003; Hansen, Cronin, & Newton, 2011; Hardee, Triplett, Utter, Zwetsloot, & McBride, 2012; Swisher 2016, unpublished data)
- Fatigue compromises technique (Hardee et al., 2013; Sakamoto & Sinclair, 2006; Stone et al., 2007)

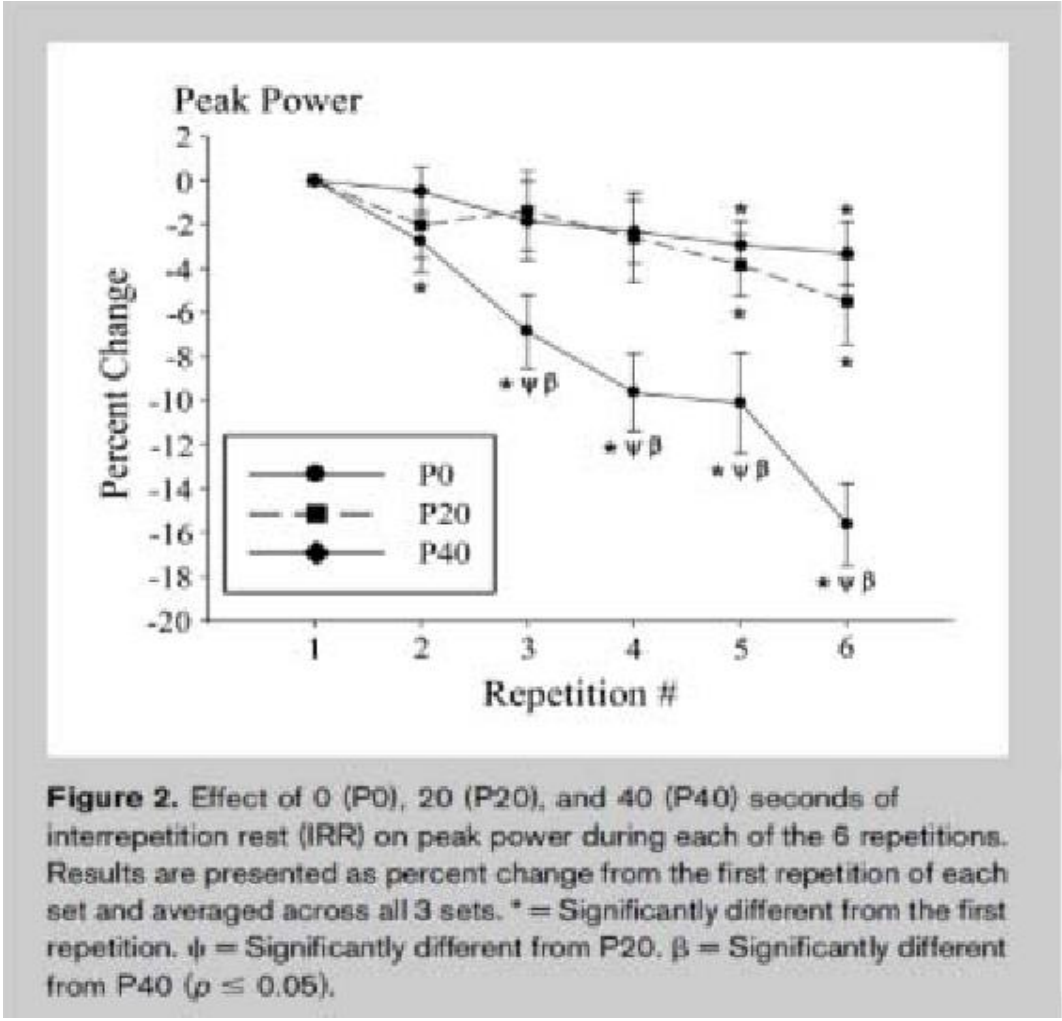


Figure 2. Effect of 0 (P0), 20 (P20), and 40 (P40) seconds of interrepetition rest (IRR) on peak power during each of the 6 repetitions. Results are presented as percent change from the first repetition of each set and averaged across all 3 sets. * = Significantly different from the first repetition. ψ = Significantly different from P20. β = Significantly different from P40 ($p \leq 0.05$).

Hardee et al., 2012

Cluster sets

Cluster sets have been shown to

1. Increase PF, PP, and PV across sets (Hansen, Cronin, & Newton, 2011; Hansen, Cronin, Pickering, & Newton, 2011; T. W. Lawton et al., 2006; Oliver et al., 2013)
2. Increase training volume via higher loads/more reps (Haff, Burgess, & Stone, 2008)
3. Limit fatigue-induced alterations in technique (>20 sec IRR) via lower metabolite accumulation and partial PCr regeneration (Haff et al., 2008; Hardee et al., 2013)

Sample cluster programming

Flat loading

Exercise	Sets x reps	Intensity (% 1RM)	Inter-rep rest
Power clean block above knee	3 x (1+1+1+1)	75%	30 sec
	3 x (2+2+2)	75%	30 sec
	3 x (3+3)	70%	45 sec

Ascending loading

Exercise	Sets x reps	Intensity (% 1RM)	Inter-rep rest
Power clean block above knee	3 x (1+1+1+1)	72,75,77, 80%	30 sec
	3 x (2+2+2)	75, 77, 80%	45 sec

Potentiation (PAP) complexes

Acute enhancement of power and explosiveness based on preceding exercise

- Heavy/slow exercise followed by light/fast movement with similar biomechanics
- Best in a peaking phase or to maximally develop power and speed

Potentiation: Mechanisms

- Increased recruitment of larger MUs and more crossbridges formed
- Increased calcium and phosphorylation of MLCs
  - Increased sensitivity of myosin head to calcium ions released by the sarcoplasmic reticulum
  - Increase of calcium lowers the threshold of muscle activation

(Likely more going on than we currently know… ask Dr. Lee Brown)

Tillin and Bishop, 2009; Wilson et al., 2013; Joyce and Lewindon, 2014

Potentiation: Four most practical ways to program

1) Overload (heavy + light)
    1) Max isometric snatch pull + light snatch
    2) Heavy back squat + CMVJ
    3) Barbell bench throws + MB throws

Weber et al., 2008; Stone et al., 2007

Potentiation: Drop sets

2) Drop Sets

1) Squat 3x5 @ 75% 1RM

1x5 @ 60% 1RM

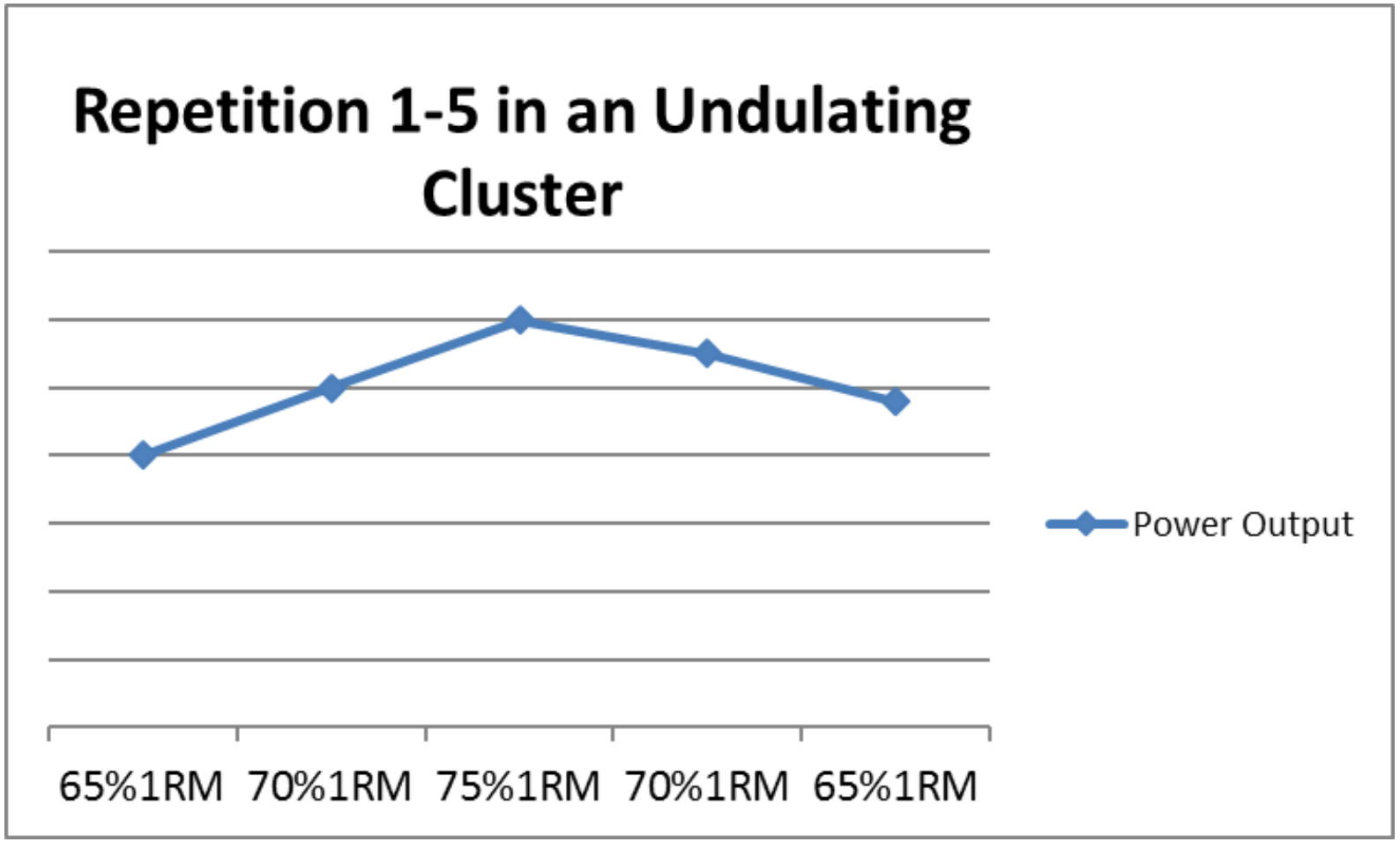
2) Push jerk 3x3 @ 75% 1RM

1x5 @ 60% 1RM

Potentiation: Undulating clusters

3) Undulating clusters

Power clean @ 65,70,75,70,65% 1RM with 30 seconds IRR



Potentiation: Wave loading

4) Wave loading

3 x (3,2,1)

- 85,90,95%
- 87,92,97%
- 90,95,100%

3 x (2,2,1)

- 85,87,90%
- 87,90,92%
- 90,92,95%

Potentiation caveats
(It depends, always…)

- Training age and strength levels matter
  - Not effective on weak, recreationally trained
  - Fatigue masks PAP so correct rest intervals are key
    - No firm consensus but range from ~1-15 min
    - Depends on the type of PAP protocol
- Requires individualized tinkering to get the right loads, rest
- Best for sports/activities with single or repeated maximal efforts

Chiu et al., 2003; Lowery et al., 2012

Ladder Sets

LADDER SETS

2x 65% 1RM

2x 67% 1RM

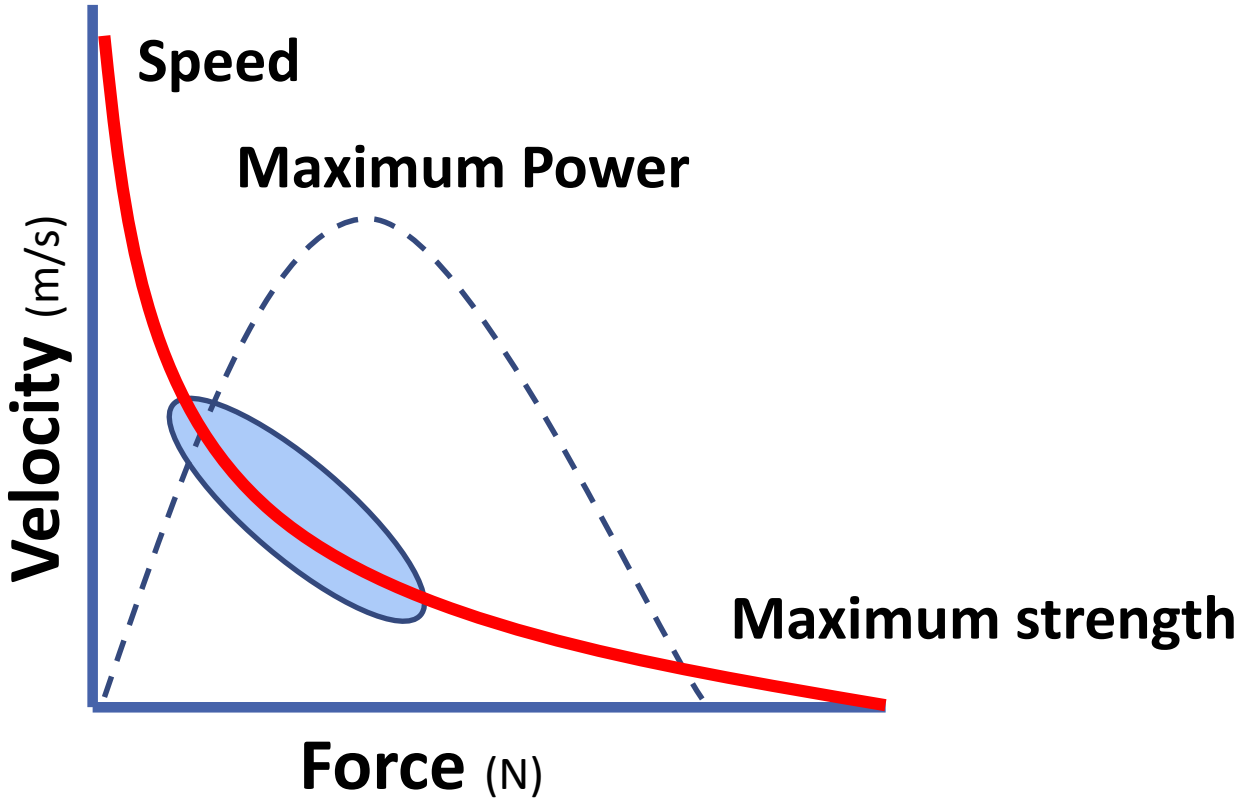
2x 70% 1RM

2x 72% 1RM

2x 75% 1RM

2x 77% 1RM

“Surf the curve”



Can combine various methods

- Ladder sets with a drop set
  - 5x2 ladder sets + 1x5 @ 10% less than last set of 2
- Wave loading as part of an overload (heavy + light) potentiation complex
  - Ex: Hip snatch waves + OH MB throws between sets

Maximizing power development

- Train across a broader load-power spectrum to facilitate a more complete adaptation across the force-velocity curve
(Cronin & Sleivert, 2005; Haff & Nimphius, 2012; Stone et al., 2007)
  - Combine high-velocity and low-load exercises (e.g., plyometrics, jump squats) and high force and moderate velocity exercises (e.g., power cleans, squats)

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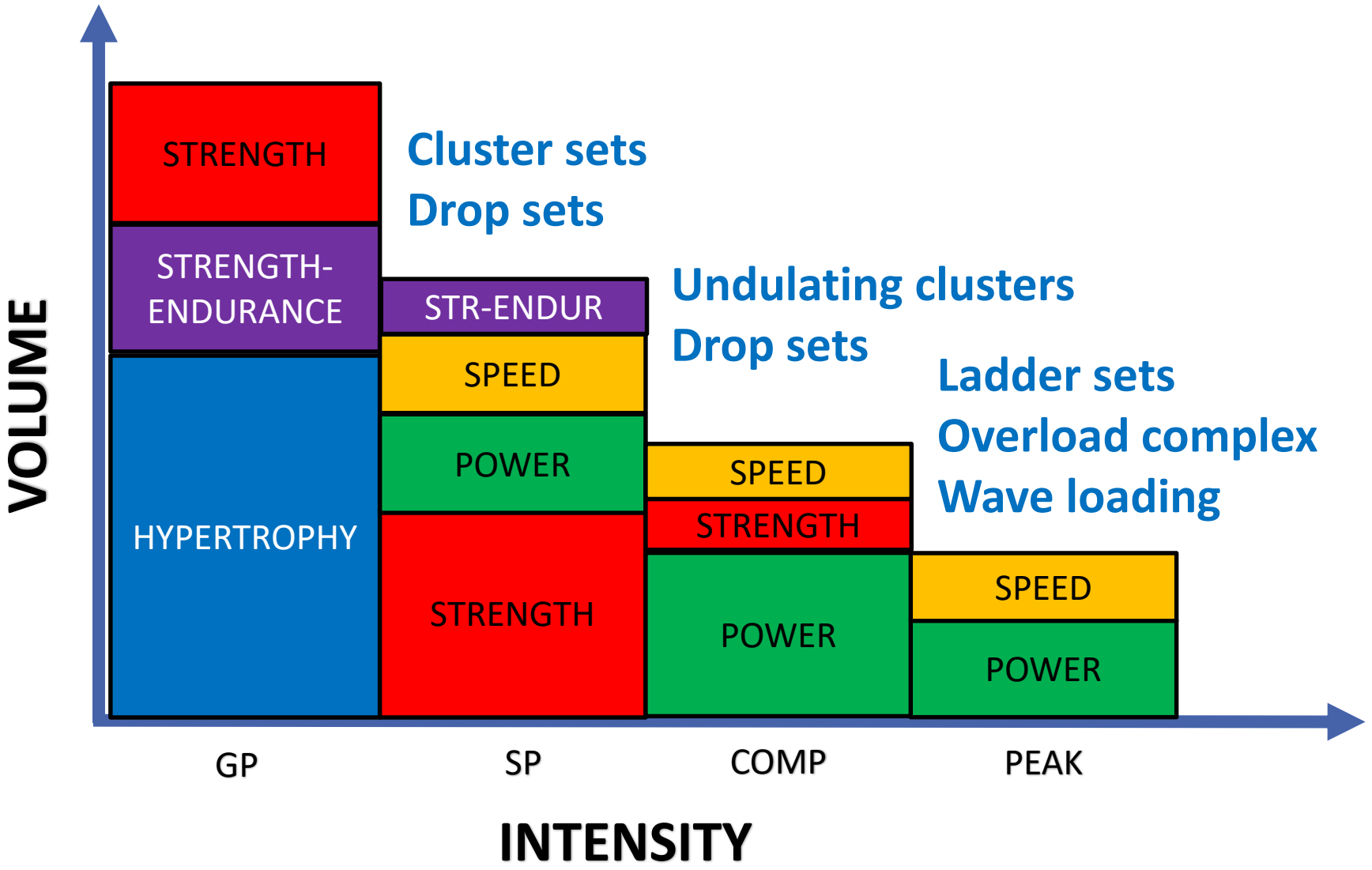
Sport with single peak



Acknowledgements

(No one gets anywhere alone)

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Questions?

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