



LEARNING OBJECTIVES

- + Discuss the difference between a strength quality and a strength theme
- + Discuss the nature of hypertrophy and where it fits.
- + Review the key elements of each strength quality and how they are developed.

01

DEFINITIONS



Strength qualities develop based on how the nervous system controls the body.

STRENGTH QUALITIES DEFINED



- + Strength quality – “A series of interrelated functional and structural factors.”
- + “Neuromotor skills that are trained and displayed during a specific task.”

Known as the “S- factors”

Siff, M. C., & Verchošanskij, J. V. (2004). *Supertraining*. Supertraining Institute.

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5

STRENGTH



SPEED



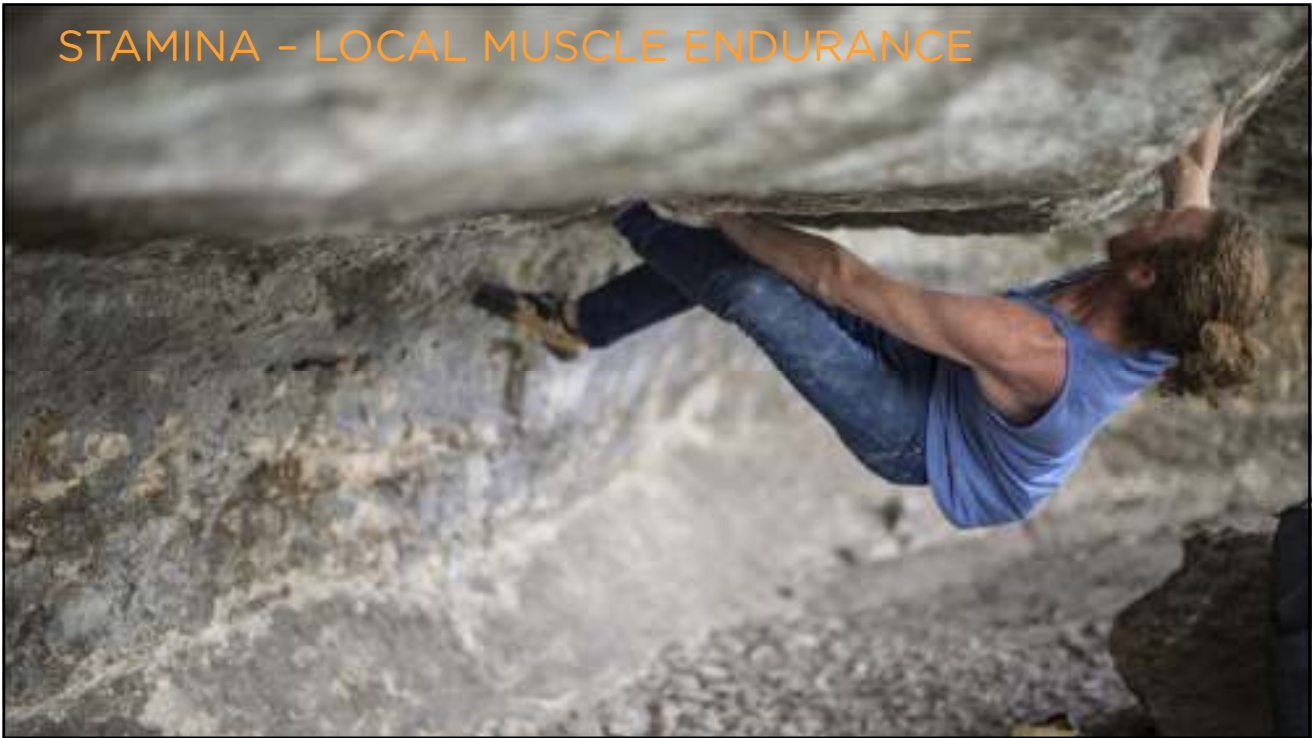
POWER



STAMINA - SYSTEMIC



STAMINA - LOCAL MUSCLE ENDURANCE

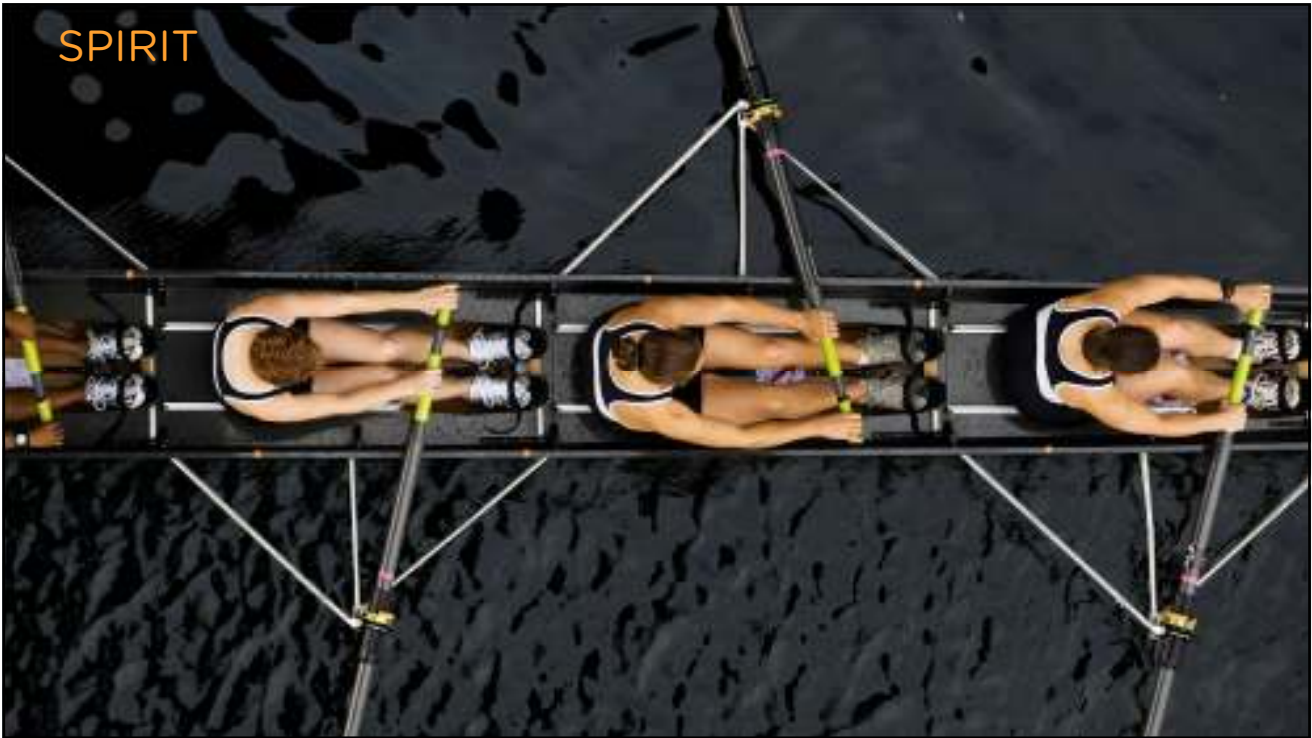


SUPPLENESS - FLEXIBILITY



SKILL



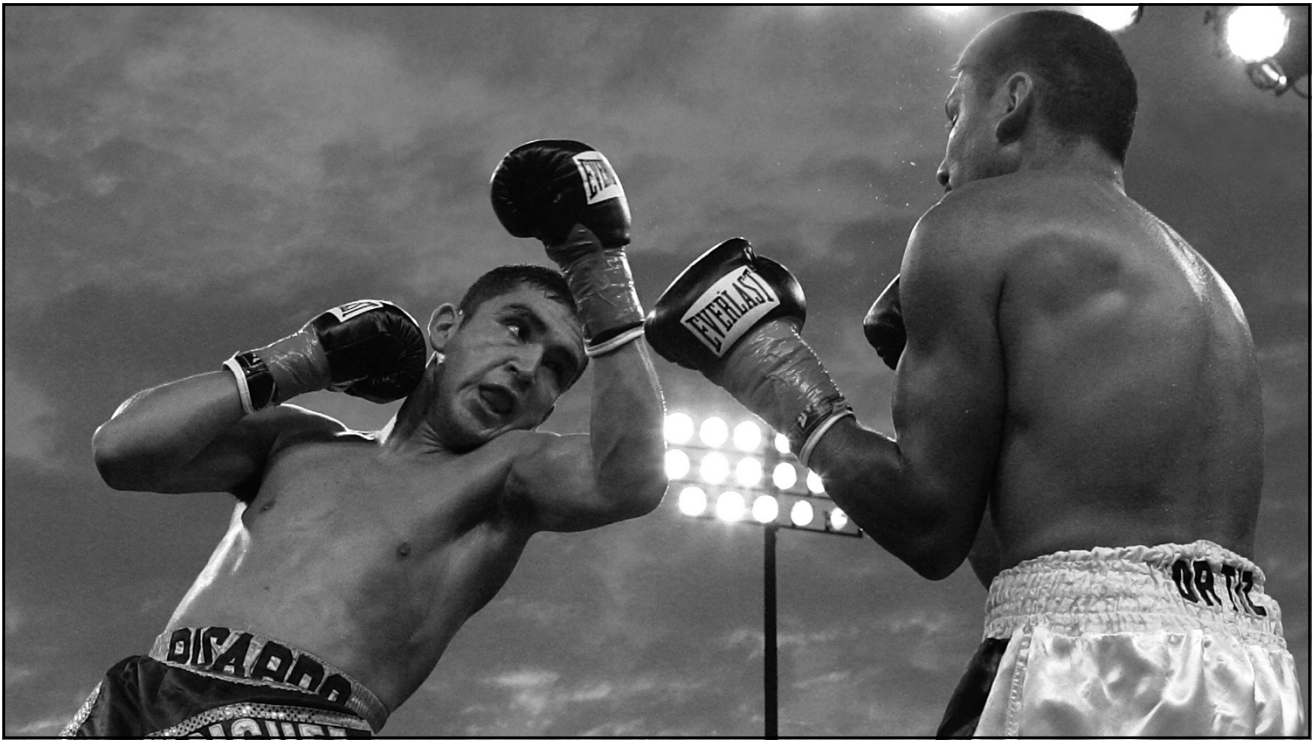


Where does hypertrophy fit?



Hypertrophy is not “demonstrated” during an action like strength, power and endurance.





Hypertrophy alone is not a strength quality, but
lean mass will affect quality expression



STRENGTH THEMES DEFINED

- + **Strength Theme** – the biologic adaptation that occurs in response to a specific training stimulus.
- + Categories of adaptation:
 - Central
 - Changes that occur in the nervous system
 - Peripheral
 - Changes that occur in the muscular system
 - Central and peripheral
 - Changes that occur in the neuromuscular system
- + Strength themes allow *categorization* and *management* of a training stimulus.
- + Strength themes *guide* the development of Strength Qualities.

IN SUMMARY

- + Strength qualities and themes are different
 - Qualities are specific neuromotor skills
 - Themes are a means of organizing the physiological response to a stimulus.
- + Hypertrophy is critical to the development of strength qualities, but by itself is not considered one.

CHECK FOR LEARNING



- + Strength Qualities and Strength Themes are different...looking at your current programming list each movement you chosen, plus the current loading strategy you've chosen and designate whether it's central, peripheral or both.
- + Following the above, now identify what particular strength quality those movements are training and observe whether they line up with your goals.

02

HYPERTROPHY: A CRITICAL MASS

+ A base of hypertrophy empowers maximum strength production in training.

07



Slide 24

J7

creation of motor neurons

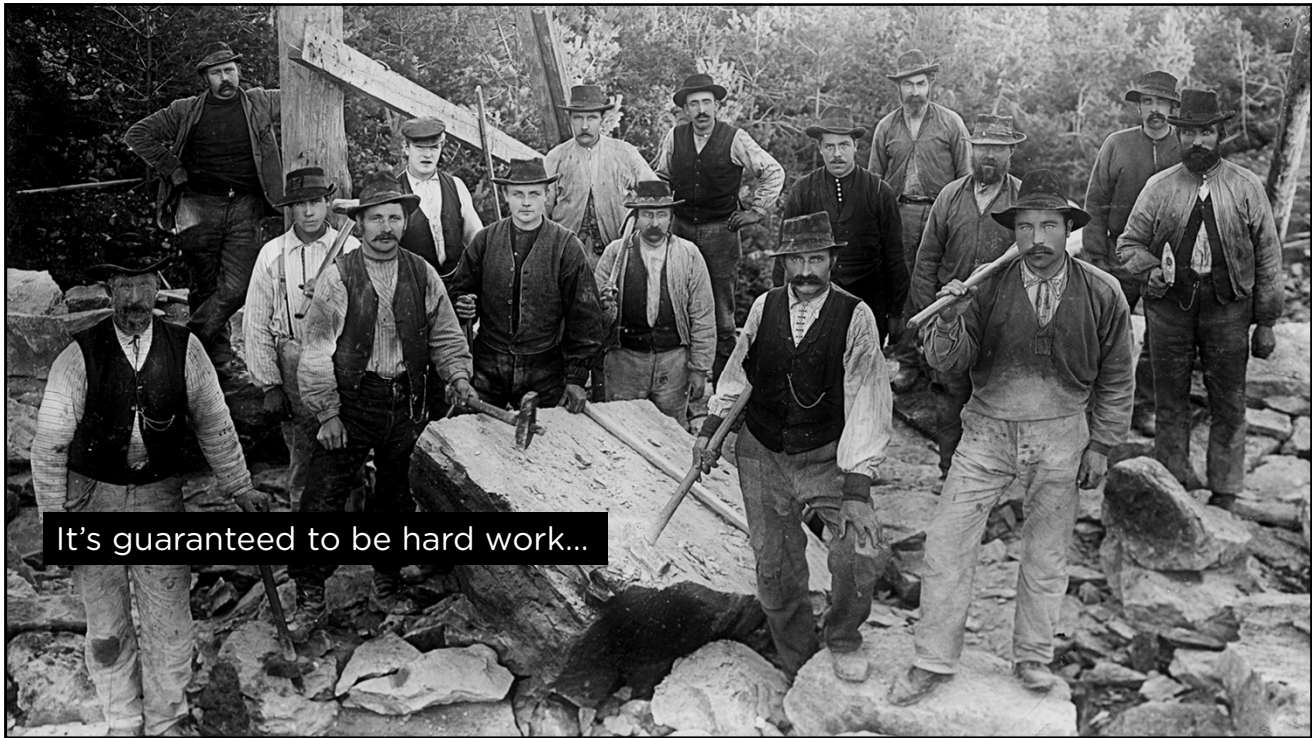
John, 6/13/2014



Hypertrophy is the foundation
for strength quality expression



Hypertrophy can be elusive...



It's guaranteed to be hard work...

DEFINING MUSCLE HYPERTROPHY - SARCOPLASMIC

- + Sarcoplasmic hypertrophy– Increased volume of sarcoplasm (fluid between myofibrils) and non-contractile proteins.
 - *Non-functional hypertrophy*

(Siff, 2003 & Zatsiorsky and Kraemer, 2006)

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RESISTANCE EXERCISE: STIMULUS FOR GROWTH

- + Metabolic demands
 - Local fatigue
 - Energetic theory of muscle hypertrophy
- + Increased muscle tension
 - Mechanical stress

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014



SARCOPLASMIC HYPERTROPHY

STRENGTH QUALITY	REPS	AVERAGE %1RM	BEGINNER 70%1RM INTERMEDIATE 70-80%1RM ADVANCED 70-100%1RM (85%***)
HYPERTROPHY-METABOLIC	9-12	70-80% 1RM	

SETS	TEMPO (TUT)	REST
3-6	40-70S	<1MIN

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J14 **the club**
John, 6/13/2014

In sport, sarcoplasmic hypertrophic gains tend to be seen,
not felt.

DEFINING MUSCLE HYPERTROPHY - MYOFIBRILLAR

- + Myofibrillar - Enlarged muscle fibers due to increased myofibrillar density and therefore the addition of sarcomeres in parallel.
 - *Functional hypertrophy*

(Siff, 2003 & Zatsiorsky and Kraemer, 2006)





Myofibrillar (*functional*) hypertrophy is the product of both time and intensity in training.

MECHANICAL STRESS (INTENSITY)

- + Muscle force determinants
 - Firing frequency
 - # Motor units recruited
- + Motor units recruited
 - Size principle
 - (Low threshold = Type I)
 - (High threshold = Type II)
- + High threshold recruitment
 - Force = MASS x acceleration
 - Force = mass x ACCELERATION
 - Fatigue (Repeated Effort Method)
- + Muscle force capabilities
 - Eccentric → Isometric → Concentric

(Zatsiorsky and Kraemer, 2006)

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MYOFIBRILLAR HYPERTROPHY (*FUNCTIONAL*)

STRENGTH QUALITY	REPS	AVERAGE %1RM
FUNCTIONAL STRENGTH-HYPERTROPHY	6-8	79-85

SETS	TEMPO (TUT)	REST
4-8	20-40S	1-2MIN

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LOADING STRATEGIES

MECHANICAL STRESS



METABOLIC STRESS

Clusters (Haff et al., 2008)

Intra-rep rest intervals (15-30s)
Ex. 3rep 90% 1RM + 10/1rep 90% 1RM

Strip Sets

Intra-set load variations
(ex. Max 100lbs→80→60→40)

High Intensity Training (Goto et al., 2004)

Strength + HIT sets = ↑↑ anabolic hormones
Strength = ↑ anabolic hormones

Escalating Density Training (Charles Staley)

15min PR Zone – 2 Movements – 5reps (10RM)

Timed Sets

Increase reps/per time interval
Increase time interval

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NON-FUNCTIONAL vs. FUNCTIONAL

- + Non-functional – Preferential hypertrophy of structures that do not result in a positive performance transfer
 - i.e. decreased sprint speed
 - (*sarcoplasmic hypertrophy*)

- + Functional – Preferential hypertrophy of structures that results in positive performance transfer
 - i.e. increased relative strength
 - (*myofibrillar hypertrophy*)

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Slide 42

J17 sarcoplasmic hypertrophy
John, 6/13/2014

J18 myofibrillar
John, 6/13/2014





IN SUMMARY

- + There are two different types of hypertrophy, each developed by different methods.
- + The functional or non-functional nature of hypertrophic pathways has a critical impact on performance.

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CHECK FOR LEARNING



- + Hypertrophy, technically, is not a strength quality, but its development is based upon the manipulation of intensity and time. Identify 3-5 ways you could manipulate intensity and time to induce Sarcoplasmic Hypertrophy.
- + Identify 3-5 ways you could induce Myofibrillar Hypertrophy.

03

CRITICAL QUALITIES

+ These 'S-Factors' play a critical role in developing the complete athlete.

STAMINA - (*WORK CAPACITY*)



WORK CAPACITY & FITNESS

- + Work capacity is defined as the general ability of the body to produce work of different intensity and duration using appropriate energy systems
- + Fitness is work capacity applied to cope with the demands of a specific task.

Work capacity should be a starting point to developing optimal athletic abilities.



Remember, both time and intensity in training are the critical variables that determine success.

STRENGTH THEMES DEFINED

- + A strength theme can be defined by the biologic adaptation that occurs in response to a specific training stimulus.
 - Categories of adaptation
 - Central
 - Changes occur in the nervous system
 - Peripheral
 - Changes that occur in the muscular system
 - Central and peripheral
 - Changes that occur in the neuromuscular system.

 - + The primary adaptations through training are peripheral, necessitating an approach inclusive of central emphasis.
-

LOCAL MUSCULAR ENDURANCE vs. ENDURANCE

"Thus, the development of endurance is associated with functional specialization of the skeletal muscles, particularly the enhancement of their strength and oxidative qualities, rather than improvement of cardiorespiratory ability."



VO₂max has classically been the central element in endurance



VO₂max may not be the best indicator of performance in specific sport tasks.



PARAMETERS: WORK CAPACITY

STRENGTH QUALITY	REPS	AVERAGE %1RM	SETS	TEMPO (TUT)	REST
WORK CAPACITY	10-20+	30-45%	2-4	EXPLOSIVE	<45 SEC

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IN SUMMARY

- ✦ When discussing stamina, or work capacity, there are two major categories:
 - Cardiorespiratory endurance
 - Local muscular endurance.

- ✦ Work capacity and the ability to perform work for extended periods of time is usually the starting point in fitness development.

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STRENGTH



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Strength should act as a springboard to developing optimal athletic abilities.

STRENGTH

- + Strength is defined as the ability of a given muscle or group of muscles *to generate muscular force under specific conditions.*
- + This "specificity" leads to the numerous types of strength that can be expressed given specific conditions
 - i.e. strength-endurance vs. max strength

Slide 63

J24

springboard
John, 6/13/2014

STRENGTH

- + **Absolute strength** - maximum voluntary muscular force produced irrespective of time
- + **Starting strength** - the ability of muscles to develop force at the beginning of a contraction
- + **Speed-strength** - the ability to quickly execute an unloaded movement or a movement against a relatively small resistance.
- + **Strength-speed** - the ability to perform rapid movements against heavy loads.
- + **Strength endurance** - the ability to effectively maintain muscular functioning under work conditions of long duration.
 - Dynamic Strength-Endurance- cyclic exercises in which considerable tension is repeated without interruption
 - Static Strength-Endurance- activities where it is necessary to exert isometric tension of varying magnitude and duration.

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STRENGTH

- + Strength is determined by the expression of FORCE
 - $\text{FORCE} = \text{Mass} \times \text{Acceleration}$

 - MASS x acceleration

 - mass x ACCELERATION

 - MASS x ACCELERATION

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66

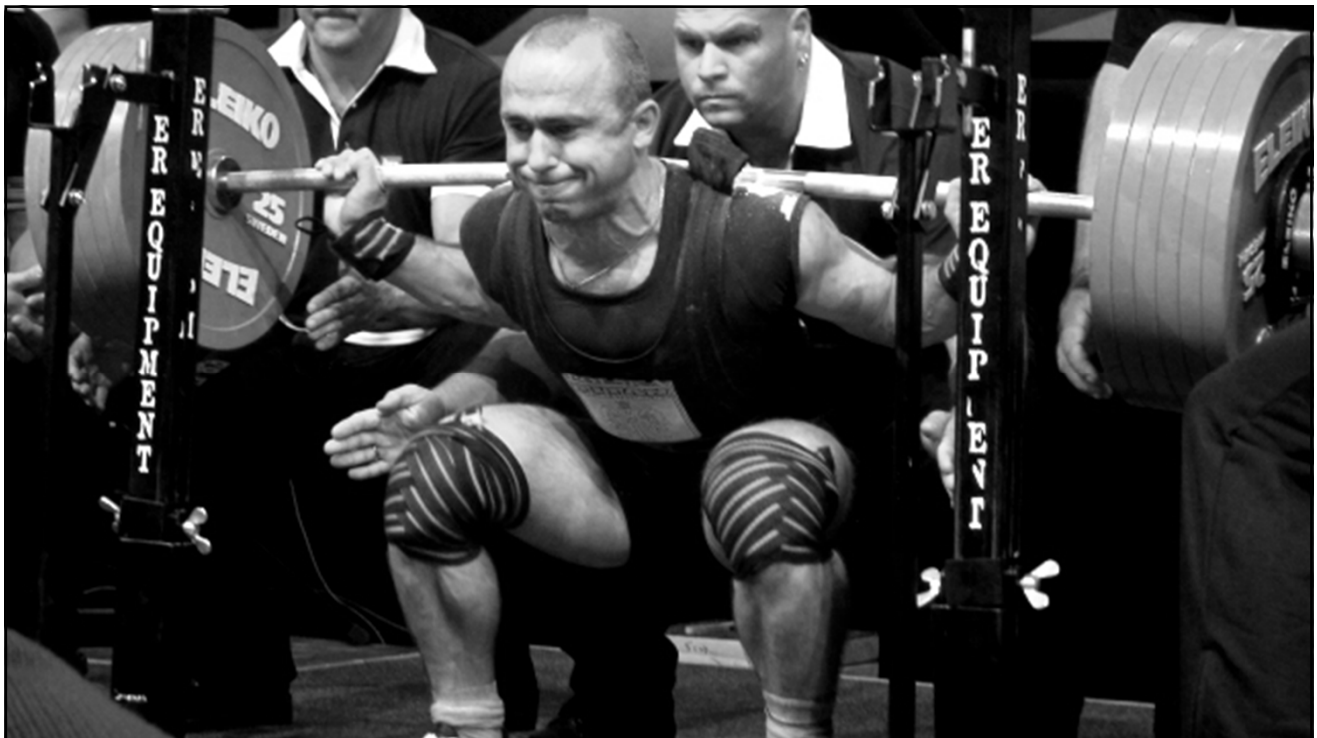
ESSENTIAL STRENGTH PRINCIPLE

“As strength increases, the intensity of the stimulus required to produce a training effect should be increased, and reach **80-95%** of the athlete’s maximum”

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STRENGTH

- + Strength is determined by the expression of FORCE
 - FORCE=Mass X Acceleration

 - MASS x acceleration

 - mass x ACCELERATION

 - MASS x ACCELERATION

“Maximum strength is produced for an optimum, not a maximum, frequency of nerve firing.”

STRENGTH

SCENARIO 1 1 set, 5 reps		SCENARIO 2 3 sets, 5 reps	
F= M x A (9.8 m/s)		F= M x A (9.8 m/s)	
Rep 1-	185lbs x 14.6 m/s = 2700N	Rep 1-	185lbs x 14.6 m/s = 2700N
Rep 2-	185lbs x 14 m/s= 2500N	Rep 2-	185lbs x 14 m/s= 2500N
Rep 3-	185lbs x 13.5 m/s= 2497N	Rep 1-	185lbs x 14.6 m/s= 2700N
Rep 4-	185lbs x 11.5 m/s= 2127N	Rep 2-	185lbs x 14 m/s= 2500N
Rep 5-	185lbs x 10 m/s= 1850N	Rep 1-	185lbs x 14.6 m/s= 2700N
TOTAL FORCE = 11, 679N		TOTAL FORCE = 13,100N	

“Optimal Frequency changes with the level of muscle fatigue!”

A goal should be to find appropriate combinations of loading and acceleration.

ESSENTIAL STRENGTH PRINCIPLE

“Research has shown that the Threshold Training Stimulus necessary for increasing muscular strength in the average person *should not be less than one-third of the maximal strength.*”

PARAMETERS: MAX (RELATIVE) STRENGTH

STRENGTH QUALITY	REPS	AVERAGE %1RM
MAX-RELATIVE STRENGTH	≤5	85-100%

SETS	TEMPO (TUT)	REST
≤6-12	≤20S	3-5MIN

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IN SUMMARY

- + Strength is the ability to applied force in a *specific scenario*, leading to many different expressions of strength
- + Force = Mass x Acceleration; it is the appropriate interplay between these two variables that leads to optimum force achieved, which is preferable to maximum force.

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76

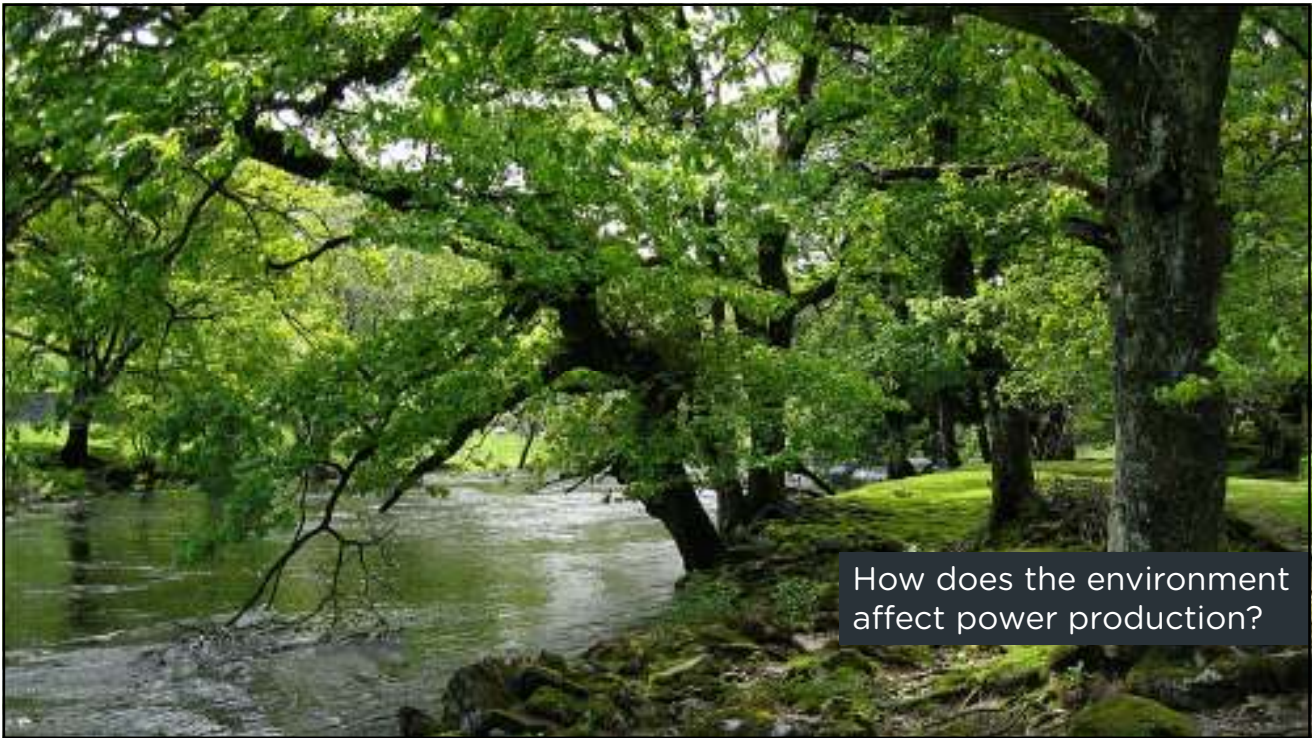
SPEED (POWER)



SPEED & POWER

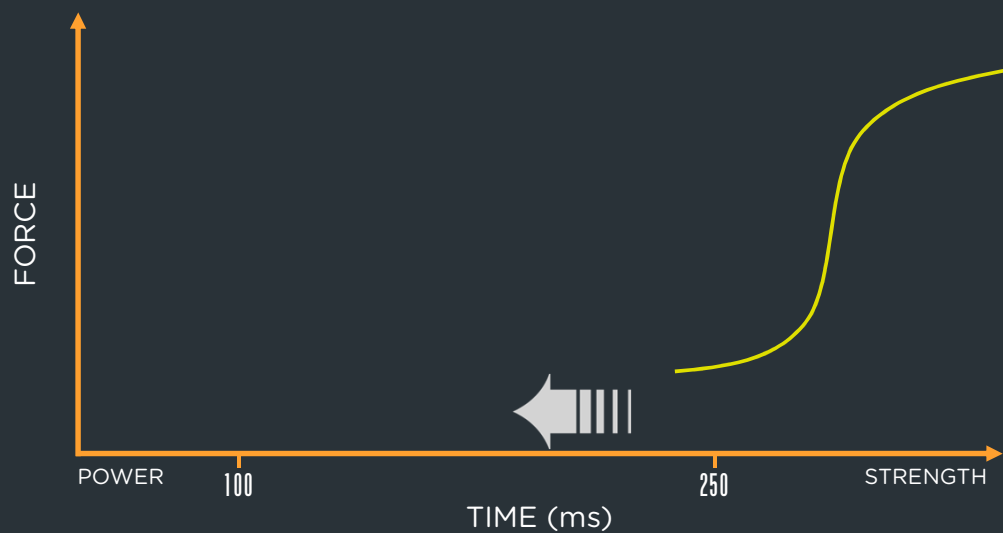
- + **Work**- The energy involved in moving from one state or position to another
- + **Power**- The rate at which work is done at any instant (*It thus combines the factors of intensity and duration, per unit of time.*)
- + **Speed**- the combination of all necessary S-factors in response to the external conditions under which the motor task is to be executed.

Task x Resistance
So what exactly is the difference between speed & power?
Time



How does the environment affect power production?

IMPROVING RFD



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To be clear, the specific variables of the environment are important (i.e. loads to be worked against and times to be completed in) BUT, the environment itself does not impact power.

The loads worked against and the times needed to complete the work do.



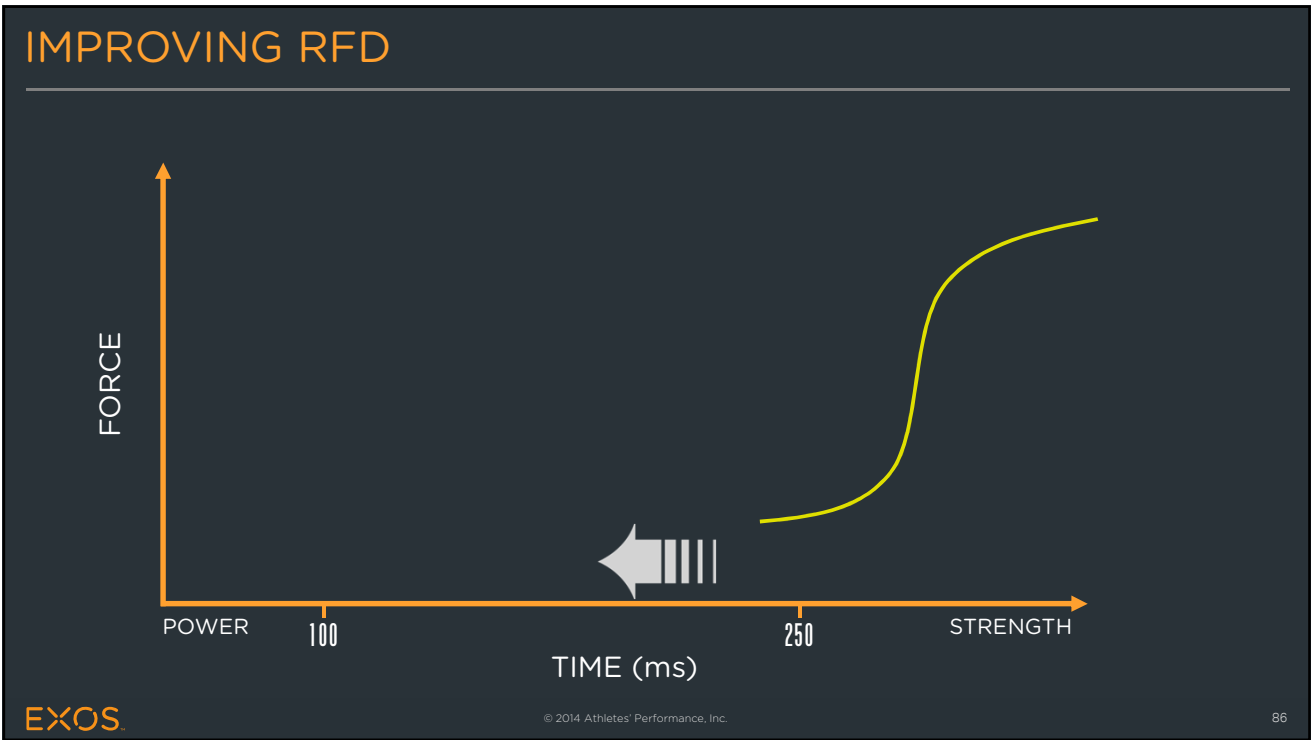
POWER IS A CLOSED LOOP SYSTEM...

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83





PARAMETERS: MAX (RELATIVE) POWER

STRENGTH QUALITY	REPS	AVERAGE %1RM
MAX-RELATIVE POWER	≤5	45-65%
SETS	TEMPO (TUT)	REST
≤6-12	EXPLOSIVE	3-5MIN

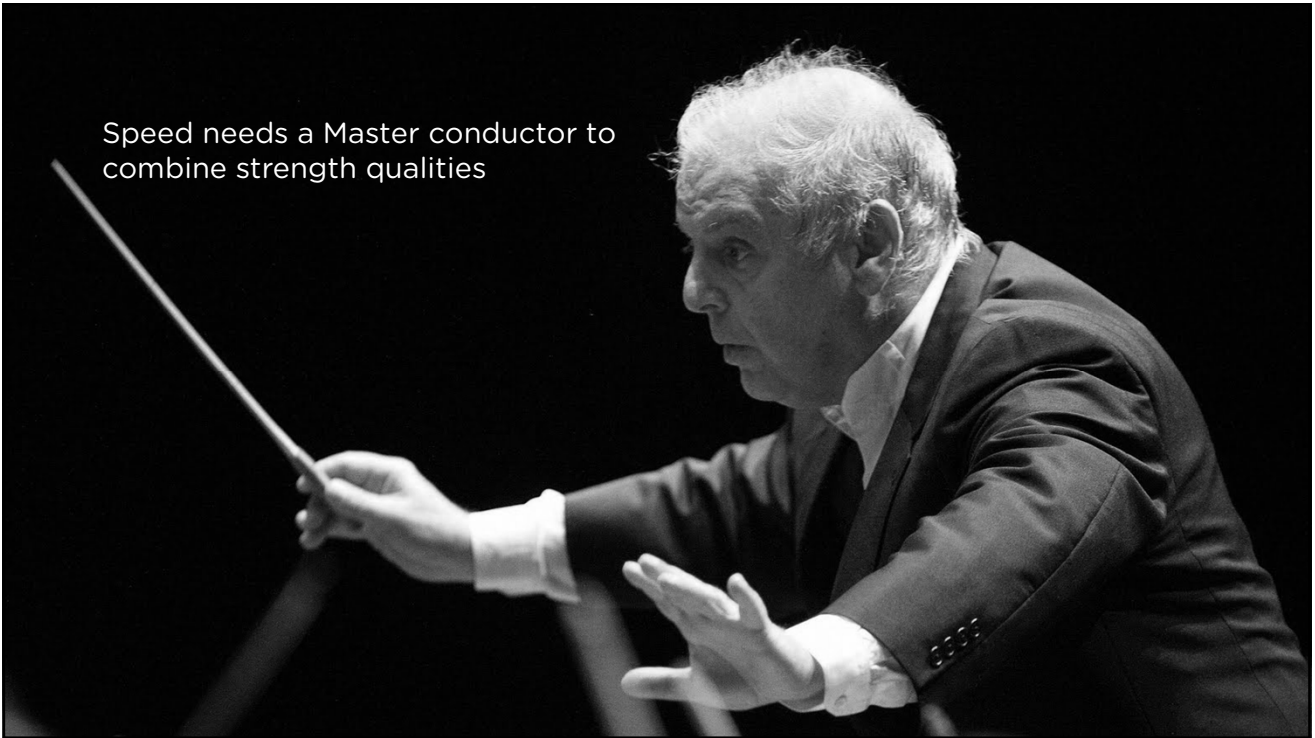
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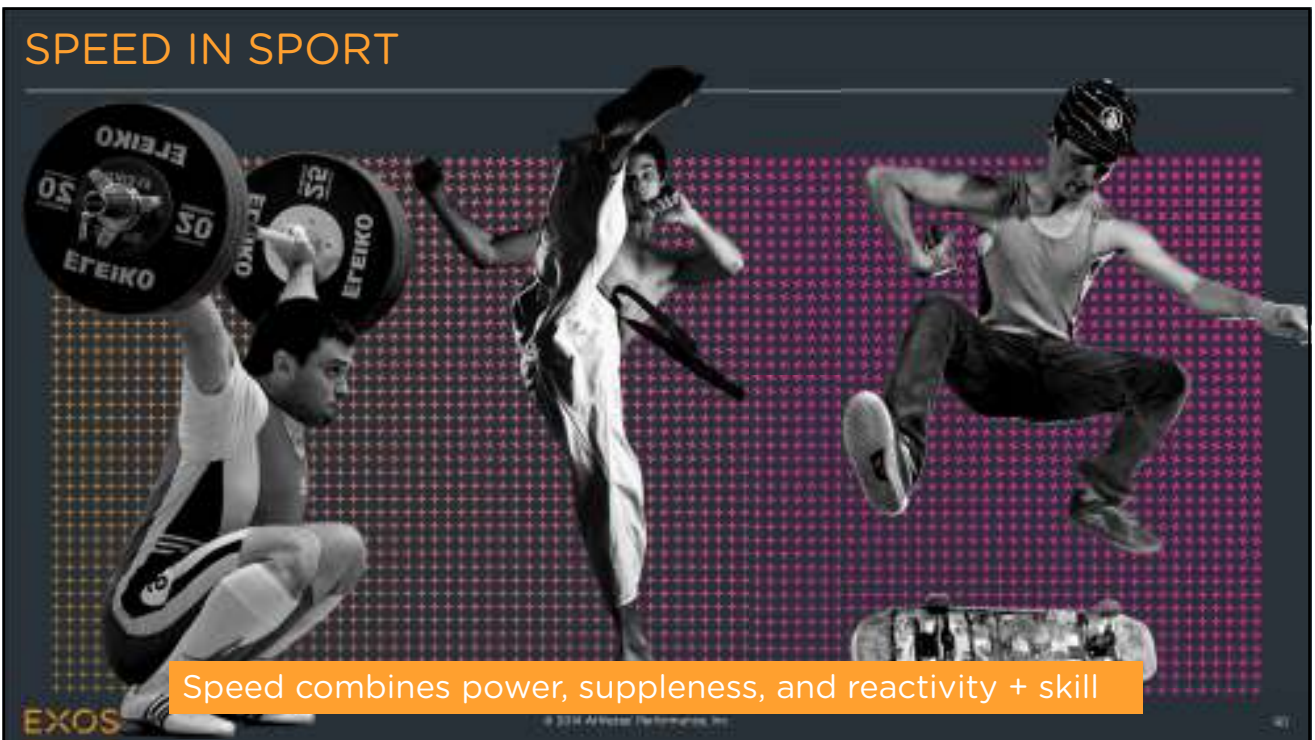
87



Speed needs a Master conductor to combine strength qualities



SPEED IN SPORT



Slide 89

J30 Speed combines power, suppleness, reactivity, and skill

That is in direct response to the environment

John, 6/13/2014

IN SUMMARY

- + Speed and power may seem the same but they are actually very different.
- + Power being a singular expression of Work/Time with speed being the coordination of various S-factors needed to answer the demands of a specific task.

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CHECK FOR LEARNING



- + The S-Factors are Critical...developing each can be very challenging but ultimately should be done.
 - List 2-3 ways you're developing local muscular endurance and not just general stamina.
 - List ONE way in which you can train Speed-Strength, Strength-Speed, Max Strength and Dynamic Strength Endurance
 - List TWO ways that you can train for speed, focusing on how the environment plays a role (think Power + Reacting to something)

04

CLOSING

S-FACTORS

HYPERTROPHY

SPECIFICITY

SPORT

- + Sport requires specific factors for excellence and competition.
 - Strength, speed, power, stamina, suppleness, skill, & spirit round out the complete athlete.
 - Each of these strength qualities have a powerful effect to an athlete's athletic ability and usefulness in sport.



- + While hypertrophy alone is not a strength quality in athletic ability, lean body mass will enhance expression of the strength qualities.
- + There are two types of hypertrophy, both different in outward appearance and functionality
 - Sarcoplasmic hypertrophy – affects the sarcoplasm (fluid between muscle fibers).
 - Non-functional
 - Myofibrillar hypertrophy – affects strength relative to bodyweight.
 - Accrued through accumulation of time under high intensities in training.
 - Functional hypertrophy



- + Classic measures of success within strength qualities may not always be most appropriate when dealing with specific athletes and roles.
- + Understand the impact of the training and performance environments to notice what factors matter, and what will have no impact on sport performance.



S-FACTORS

HYPERTROPHY

SPECIFICITY

SPORT

- + Each sport requires programming a thoughtful combination of the strength qualities that best prepare an athlete to succeed.
 - Taking an accurate assessment of the needs of an athlete's sport and role will help the coach identify goals within these strength qualities.

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GAME DAY™

APPENDIX

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