



POWER

THE FORGOTTEN
COMPONENT

Power

- An attitude
- A lifestyle (e.g. tennis, cycling)
- You can sense power even in a handshake
- Pete Pensyres - Use it or lose it
- Do we lose fast twitch fibers with age?



- Power = Speed X Force



- Force = Mass X Acceleration



- Weight = Mass X Gravity



- Anaerobic power can be defined as the exertion of force through a given distance in as short a time as possible.



- Power is the variable on which extension of the limits of performance depends.
- Every time you move, velocity is involved.



- Power can be increased by:

- Increasing speed (rate of force production) - How fast a muscle can shorten under a given load.
- Increasing strength



II. RATE OF FORCE PRODUCTION

- Mike Powell can do 7 reps on a squat in 5 seconds using 650 pounds.
- Sharon Couch a long jumper can do 7 reps on a squat in 5 seconds using 415
- 16 lb. shot putt vs. snatch of 150 kgs. - which is more powerful? 6.9 HP vs. 4.3
- Lance Armstrong

SPORTS



- Movement in performance usually has the least angle and no mechanical advantage (e.g. jab).
- 2" punch: Develop speed at the short ranges of motion.
- Football player gains weight but doesn't increase the speed of his muscular contraction may actually lose power.

Function



- Pushing a lawn mower,
Throwing your kid.
- Playing tennis – you can choose to play
for power or leisure.
- Power training improves agility, gait
speed, and reach (Signorile).


Function





- The key is to develop force at speeds that the athlete will use in real life or sport. Therefore, lift with maximum available velocity. Choose the amount of weight that will be comparable to the sports specific speed of movement.

Function

- Accentuation is training a muscle group at speeds and range of motion that is valuable for the sport. Therefore, full range of motion may be unnecessary.
- For example, a ski jumper would do full squats and a volleyball player would do $\frac{1}{2}$ squats at speeds appropriate to their activity.


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- The burst of muscle action should be performed as fast as possible with maximum voluntary effort. These exercises are done in a rested state, usually, immediately after a warm-up. Do this 4 times a week to improve, twice for maintenance.

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- High speed training with moderate resistance is the key. Gradually you want to increase the resistance so that you are lifting your maximum amount of weight with maximum speed; similar to a cyclist pedaling in the biggest gears with the fastest cadence.

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- Increased EMG activity noted during maximal contraction was the result of a combination of recruitment of an increased number of motor units and an increased firing rate of each unit. More research is needed, but maybe the faster you contract a muscle with the most force, the more fibers that are recruited.

- Another study showed that subjects had an enhanced ability to recruit additional motor units or discharge the motor units at a faster rate. Therefore more motor units were available to participate in the reflex response.



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- Working at 30 –50% of one's 1 repetition max. was shown to be a great way to increase the speed to power ratio.
 - A lighter load can be lifted more rapidly.
 - The key is to maximize the load and the speed of movement.

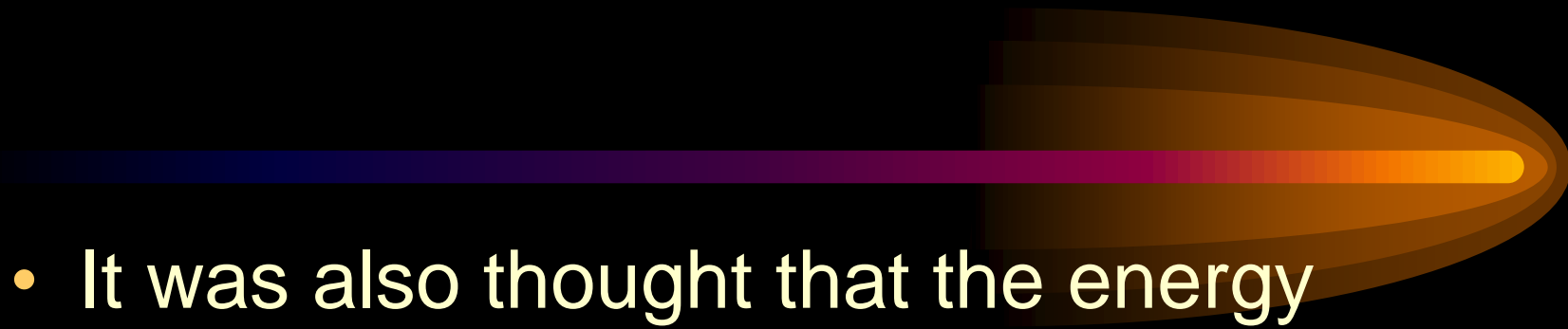
- A baseball player won't necessarily choose a heavier bat to increase power.
- The bat needs to be heavy enough to maximize velocity and muscular force.





SPONTANEITY





- An acute decrease in strength and high speed torque occurred when resistance training was preceded by a regime of 25 minutes of mixed, high intensity aerobic and anaerobic conditioning. Aerobics may decrease power, but you can try to maximize both through cross-training and eating properly.

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- It was also thought that the energy system demands of practice and games may partly be responsible for reduced strength levels. Conflicted neural patterns, fiber recruitment, and hormonal outputs that arise from high volume energy system training may also be detrimental to strength and power development.

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- Studies have shown that athletes performing concurrent energy system and strength training become accustomed to training such that strength is not always significantly affected. Maybe an effective periodization of the total stress of combined training enables the athlete to better adapt to this training scenario.

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- Therefore, a diminished relationship between changes in strength and changes in power must occur with increased training experience. It's interesting to note advanced athletes who've increased power even though they have been training with a variety of energy systems.


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- The key to maintaining strength and power during the in-season: The prioritization, sequencing and timing of training; and utilizing an appropriate periodization model that allows for periods of high, medium, and low training volumes and intensities.

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- With increased training age, there seems to be a decreasing transfer between changes in maximum strength and maximum power. This may be due to a plateau affect of strength and neuromuscular system seeking other avenues (e.g. velocity) to increase power.

SAFE POWER



- A. TOOLS: :
- Dumbbells and barbells – variable resistance. Nautilus – must move slowly (2 sec. Up, 4 sec. Down) in order to keep the resistance constant.
- Keiser allows you to push fast and hard without factors such as gravity or inertia.

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- Training at high speed causes injury, right? Only with the wrong equipment. Jumping out of an airplane's okay if you have a parachute. The parachute is the tool that allows you to jump out of the plane safely. So jumping out of an airplane is okay if you have a parachute. And power training is okay too; if you do it safely.

BALANCE


- Balance is power – see how quick your muscles must respond when you're standing on one foot. Postural muscles can move fast too!



SEQUENTIAL FIRING

- Relax your antagonist muscles to take away barriers for performance to increase your concentric contraction and your speed.



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- Power increase by going from higher weight to lower weight may be a function of: increased synchronization of motor unit firing, reduced peripheral inhibition from the golgi tendon organ, enhanced reciprocal inhibition of the antagonist musculature.

POWER CHAIN


- Reverse Punch
- Relaxed Power on the knife hand block
- Reaction time vs. movement time





PROGRESSIVE POWER TRAINING

- Increasing strength **BEYOND** a certain point doesn't help. For example, if it's a **REAL FAST** movement, you don't have enough time to recruit **ALL** muscle fibers anyway, so it's more a function of speed than strength. **EXPLOSIVE STRENGTH IS THE ABILITY TO EXERT MAXIMAL FORCES IN MINIMAL TIME.**



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- Lifting maximal weight has a number of effects on motor units. A maximum number of motor units are activated, the fastest motor units are recruited, the discharge frequency of motoneurons is at its highest, and the activity of motor units is synchronous.


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- Maximal force exertion is a skilled act in which many muscles must be appropriately activated. This coordinated activation of many muscle groups is called intermuscular coordination. As a result of neural adaptation, superior athletes can better coordinate the activation of fibers in single muscles and in muscle groups.

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- In other words, they have better intramuscular and intermuscular coordination. Thus, the entire movement pattern, rather than the strength of individual muscles or single joint movements should be the primary training objective.

FORM FIRST:




- Squat your body weight and jump 40 cm.
- Squat twice your body weight and jump 80 cm.
- Squat three times your body weight but continue to jump 80 cm.

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- Power lifters may only perform 6 lifts in comparison to the 100's of lifts in a training session. But these athletes need about 1 week of rest before training again, and an entire month before competition. It's not just physical, its' emotional.

READY, GO



- By alternating heavy and light load from set to set, the neural system is “super stimulated”, making the lighter power load “feel lighter”. The presumed effect of this is that more power may be generated with this lighter load than would normally be the case.

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- Examples of this type of training have been the grouping of heavy squats and jump squats and bench presses and bench press throws. It is also widely seen in baseball when bat donuts and weighted balls are commonly used.

MIND/BODY: PREPARE FOR POWER



- EFFORTLESS POWER
- We recruit muscle fibers by thought (lifting a book). The woman who lifted the car off her child **KNEW** she **HAD** to do it. Go from point A to point B as fast as you can.

- Knowing you have to slow down limits your power. For example when you're at the end range of motion on your lift, or you're afraid to hurt your hand when you hit a heavy bag, you limit your power.




- Think about doing a heavy squat. Just by imagining you're about to lift the weight, your heart rate increases. A lifter mentally preparing to squat a personal best demonstrated a heart rate of 180 bpm.




FOCUS: NEURAL FACTORS



- CNS is paramount in development of strength and power.
- Rate coding: changing the firing rate of motor units. In general, the firing rate rises with increased force and power production.
- Synchronization: activating motor units in a synchronized way.


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- Muscle fibers are activated ALL OR NONE.
 - Slow twitch fibers are recruited first, then fast twitch. Advanced athletes who train for strength and power are able to recruit more motor units than beginners.


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- Therefore: Maximal force occurs when
 - A maximal number of both ST and FT motor units are recruited.
 - The motor units work synchronously over the short period of maximal voluntary effort.

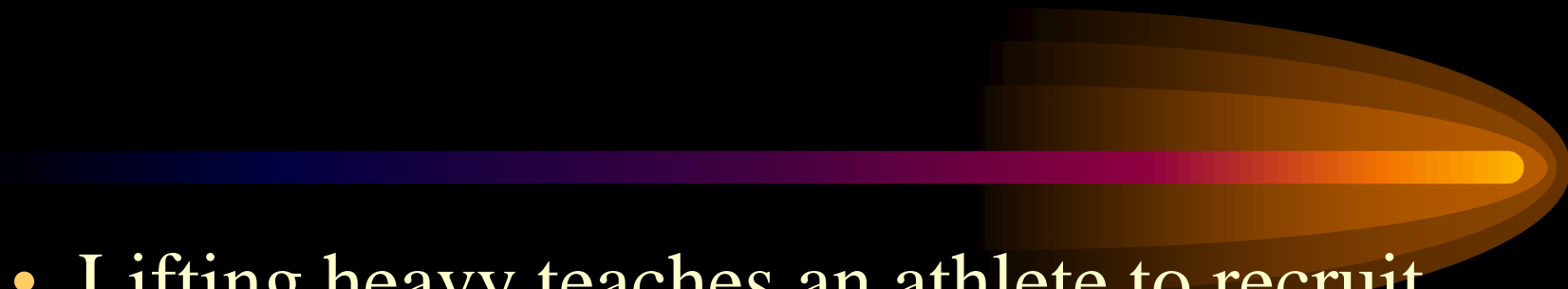
INTEGRATION:



- Picking a car off a child, hypnosis, etc. can definitely influence motor unit recruitment and power. (hypnosis can also decrease strength with negative suggestions). It is thought that, a reduction in neural inhibition occurs with a concomitant expansion of the recruitable motoneuron pool and an increase in strength.

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- Hypnosis both increases and decreases strength depending upon the suggestions. That means the CNS in extraordinary situations either increases the flow of excitatory stimuli, decreases the inhibitory influence to the motoneurons, or both.

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- The “hidden potential” of a human muscle to develop higher forces can also be demonstrated by electrostimulation. This demonstrates that the human body has “hidden reserves” for maximal force production that is not used during voluntary efforts. This hidden reserves is termed muscle strength deficit (MSD).


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- Lifting heavy teaches an athlete to recruit all available motor units at a firing rate that is optimal for producing a fused tetanus in each motor fiber. When light weight is used, an intermediate number of motor units are activated; the fastest motor units are not recruited; the discharge frequency of the motoneurons is submaximal, and motor unit activity is asynchronous.


FLEXIBLE POWER

- MARTIAL ARTIST INCREASES HIS RANGE OF MOTION TO WHIP HIS ATTACKS TO ENHANCE SPEED AND POWER.
- Train fast, get fast.
- Train slow, get slow.
- Level of arousal and rest are two huge factors for optimal power.

- You don't have to move fast to increase velocity, just **ATTEMPT** to move fast.
- Movement before muscle; function first.



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- Electro stimulation of muscle proves there is a muscle strength deficit (MSD). That is there is a hidden potential for VOLUNTARY muscular action to produce greater force than it does. MSD generally falls between 5-35%.

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- What we want to do is **TEACH** the athlete to use **ALL** motor units. **LEVEL OF AROUSAL** and **INCREASED REST** before a contest are 2 factors that can help stimulate more motor units. **LIFTING HEAVY DOES RECRUIT MORE FAST TWITCH FIBERS AND HELPS TRAINING PROGRESS.**

SPECIAL DRILLS

INTERNAL DRILLS

- Body Punch – Keep other muscles relaxed.
- Relax the body to increase concentric contraction.




EXTERNAL DRILLS


- 1. Rowing – the bigger the diameter of the blade, the slower the cadence
- 2. Throwing – the heavier the object the slower the velocity.
- 3. Jump – the heavier the person the lower the velocity.
- 4. Cycling - gears vs. cadence.


PLYOMETRICS

- JUMP WITHOUT BENDING KNEES (STRETCH SHORTENING CYCLE STORES ELASTIC ENERGY).



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- Plyometrics takes advantage of the stretch-recoil effect in your muscles. That means when you apply a stretch to your muscles a little bit beyond resting length, the stretch reflex kicks in causing a myotatic response. This allows you to explode through a movement at a faster, more powerful rate of acceleration than normal.

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- Medicine ball plyometrics help you train your entire body. Mimic sport-specific movements of your choice. Unlike a bench press, medicine balls work a variety of muscle groups at different angles, as your body works to stabilize in space under varying conditions, throwing, catching, etc.

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- SAFE POWER “THE WARRIOR”
Dennis Keiser, Randy Huntington
 - Science and Practice of Strength
Training - Vladimir M. Zatsiorsky 1995
Human Kinetics Publishing.