**Huberman Lab Podcast #19 Exercise Performance & Recovery:**

<https://youtu.be/xaE9XyMMAHY>

**4 Steps for Optimal Learning -A Protocol That Leverages Adrenaline:**

* Be calm and focused while trying to acquire or learn the skill
* Immediately after learning the skill/practicing have an adrenaline spike using cold or breathing/hyperventilation techniques demonstrated in previous podcasts
* Have a non-sleep deep rest period for 20min
* Optimize sleep later that same night.

**Pretext knowledge and Information: (you could probably skip this if it doesn’t make sense)**

Hyperthermia, getting too hot, causes cell death and tissue damage as well as neuron death. The human body has multiple processes for maintaining thermogenic homeostasis through the processes of vasoconstriction, vasodilation, and sweating. The two vascular processes either draw blood from the extremities to the core, or from the core to the extremities and sweating is an ablative measure to draw thermal energy out of the body. There are also enzymatic changes that occur as our internal body temperature changes such as with the enzyme MPK (Muscle Pyruvate Kinase). MPK is only active between a narrow temperature band of 102.2-104°F. The function of this enzyme is to catalyzes the conversion of phosphoenolpyruvate and ADP to pyruvate and ATP in glycolysis and plays a role in regulating cell metabolism. The significance of this is when a muscle is heated/cooled to a temperature outside of 102.2-104 °F MPK is deformed into an inactive state and the muscle cells will no longer catalyze ATP which is the fuel the cells will use to contract. This is why your hands stop working when you get cold and your body has the autonomic function to shiver –to raise resting thermogenesis and to allow MPK to function normally, preventing cell death. Another notable effect is that when vasoconstriction/vasodilation occurs, heat shock proteins are manufactured some of these proteins are good and some are bad, however there are many types and the research into these would fill hundreds more studies and papers. Generally, cryotherapy and saunas are useful for the production and downstream effects of the “heat shock proteins” that are generated from thermal exposure.

The perception of willpower and endurance is linked physiologically to cardiac drift. What this means is you feel more tired and “less able” to perform an exhausting task the higher your heart rate is. Higher environmental temperatures are also sensed subconsciously by neurons in the skin and by the brain and raise the heart rate proportionally to temperature which in turn leads to a higher heart rate for the same amount of effort applied to a task. This means that there exists a set of environmental conditions (relative temperature, wind, and humidity) at which a person’s individual biology can function at its peak energy output. From studies there is also a notable effect where a person can still experience a significant decrease in physiological performance yet subjective reports will say they did not feel overheated or stressed to complete their sets/reps.

The human body has 5 compartments that regulate temperatures but only 3 have the most drastic effects when heating and cooling rates are considered.

* Core organs –heart lungs pancreas liver kidneys
* Periphery –arms, legs, tops of feet, tops of hands
* Face, Palms of your hands, Bottom of your feet. (MOST IMPORTANT 3)

The face, palms of your hands, and bottoms of your feet, are comprised of glabrous tissues that contain a unique vascular arrangement known as ‘AVA’ or arteriovenous anastomoses. This type of vasculature bypasses the capillaries in the artery-capillary-vein format that tissues normally have and instead use a small-artery to small-vein vascular arrangement. This allows much more blood to flow through these tissues due to there being less restricted flow from the small capillaries. These short vascular segments have a large inner diameter, thick muscular wall, and take sensory input from adrenergic neurons in the skin that release epinephrine or norepinephrine to control vasoconstriction and vasodilation within the tissues.

A note; vasoconstriction reduces inflammation that occurs from muscle exertion but in the same hand, vasoconstriction also blocks the function of mTOR (mammalian target of rapamycin) which will lead to reduced healing, insulin sensitivity, and reduce hypertrophy -the growth of muscle tissue. To rephrase; cryotherapy as a post-workout or pre-workout practice will reduce gains but will make you less sore.

**An Abstract:**

“Body core cooling via the palm of a hand increases work volume during resistive exercise. We asked: (a) "Is there a correlation between elevated core temperatures and fatigue onset during resistive exercise?" and (b) "Does palm cooling between sets of resistive exercise affect strength and work volume training responses?" Core temperature was manipulated by 30-45 minutes of fixed load and duration treadmill exercise in the heat with or without palm cooling. Work volume was then assessed by 4 sets of fixed load bench press exercises. Core temperatures were reduced and work volumes increased after palm cooling (Control: Tes = 39.0 ± 0.1° C, 36 ± 7 reps vs. Cooling: Tes = 38.4 ± 0.2° C, 42 ± 7 reps, mean ± SD, n = 8, p < 0.001). In separate experiments, the impact of palm cooling on work volume and strength training responses were assessed. The participants completed biweekly bench press or pull-up exercises for multiple successive weeks. Palm cooling was applied for 3 minutes between sets of exercise. Over 3 weeks of bench press training, palm cooling increased work volume by 40% (vs. 13% with no treatment; n = 8, p < 0.05). Over 6 weeks of pull-up training, palm cooling increased work volume by 144% in pull-up experienced subjects (vs. 5% over 2 weeks with no treatment; n = 7, p < 0.001) and by 80% in pull-up naïve subjects (vs. 20% with no treatment; n = 11, p < 0.01). Strength (1 repetition maximum) increased 22% over 10 weeks of pyramid bench press training (4 weeks with no treatment followed by 6 weeks with palm cooling; n = 10, p < 0.001). These results verify previous observations about the effects of palm cooling on work volume, demonstrate a link between core temperature and fatigue onset during resistive exercise, and suggest a novel means for improving strength and work volume training responses.”

**Best Practice for Performance Gains:**

The main goal of the methodology is to cool or reheat the bodies core temperature back to ‘at or slightly below’ its original resting core temperature state after a period of exertion without causing vasoconstriction/vasodilation in the glabrous tissues of the face, palms, and bottoms of the feet. Vasoconstriction will temporarily reduce the body’s ability to expend heat due to restricted blood flow in the extremities. This will make you get hotter faster and reduce the body’s ability to do work.

BETWEEN SETS: cool your core temperature down using cool towels/water/air/metal by applying in 10-30sec increments taking breaks in between to allow neurons in the skin to rest (reducing vasoconstriction). Repeat for 1-5min until fatigue is reduced.

Note: in some tests 30min cooling breaks between sets were performed (an experiment that increased pull ups per workout from 10 sets, 30min breaks between, totaling 180 reps to 10 sets, 30min breaks between, totaling 670 reps). All research is experimental and should be treated as such for you to discover your optimal application of the science.

**Best Practices for Optimal Recovery Times:**

Best seen in combat sports, athletes will have icepacks and cooling vests strapped to them between rounds. This is ideal for their use case. But, because of vasoconstriction caused by rapid cooling, they will not see increases in physiological performance from their fight in the octagon. This is useful to note however because they will feel better after the fight due to decreased inflammation but they will heal slower from inhibition of mTOR from vasoconstriction.

The goal of this methodology is to cool or reheat the bodies core temperature back to ‘at or slightly below’ its original resting core temperature state after a period of exertion without causing vasoconstriction/vasodilation in the glabrous tissues of the face, palms, and bottoms of the feet.

This heating/cooling needs to be done immediately or as soon as possible post-workout without vasoconstriction or dilation. The process reduces the amount of time a cell requires to begin repairing cellular damage and begin other cellular functions that are ultimately beneficial for healing and growth. To rephrase - the faster you can cool the body back to its resting temperature –before any exertion- the faster the body will begin recovery and heal the muscles and tendons. This allows a person to maximize the amount of time a one can perform weight training without injury or plateauing effects.

POST WORKOUT: Apply a cool bath, cool shower, cooling method to the palms, bottoms of the feet, and face until your core temperature stabilizes back to its resting temperature.

**Clarifications On Best Practices for Optimal Performance and Recovery:**

DO’S: (lowering core temperature in hot environments)

Do use cool air, cool water, cool towels, cool metal, etc… to cool your palms, face, bottoms of feet off.

Do apply cooling to face, palms, bottoms of feet for 10-30sec increments until fatigue is reduced

DO’S: (increasing core temperature in cold environments)

Do use warm air, cool water, cool towels, cool metal, etc… to cool your palms, face, bottoms of feet off.

Do apply warming to face, palms, bottoms of feet for 10-30sec increments until fatigue is reduced

DON’Ts: (for lowering core temperature in hot environments)

Don’t use COLD air/water/towels/metal that is so cold it causes vasoconstriction –the tingly feeling + skin color change (white or red)

Don’t use ice packs except for VERY short periods on the face (10-30sec increments or less)

DON’Ts: (for increasing core temperature in cold environments)

Don’t use HOT air/water/towels/metal that is so hot it causes vasodilation –the tingly feeling + skin color change (white or red)

Don’t use hot packs except for VERY short periods on the face (10-30sec increments or less)

COLD baths are effective to deliberately increase brown fat thermogenesis and also practice and train mental resilience.

**Foods that effect physiological performance:**

Is it worth taking something that energizes you to work out, or is it better to perform longer?

Is your performance enhancing dietary choices a hindrance to recovery time and optimization?

Caffeine/pre-workout increases body temperature and reduces the amount of work you can do. Caffeine for non-caffeine adapted people will have a vasoconstriction effect. While caffeine adapted people will experience vasodilation during usage and vasoconstriction when it wears off. In general no caffeine usage will be ideal however for caffeine addicted people may experience a 3-week adaptation period where one will experience withdraw.

Ephedrine increases core thermogenesis and reduces performance

Alcohol is a vasodilator which cools the body down (could be a tool to cool down after an exercise)

NSAIDs reduce body temperature –can be a pharmacological tool for endurance athletes to lower body temperature over time. However, water and salt balance are necessary to maintain and NSAIDs have an effect on the liver and kidneys. Therefore, caution is required.

Eating does increase thermogenesis however the effects are marginal at best and shouldn’t be considered unless there are extraneous circumstances at play.

Clenbuterol and Epinephrine heat the body up and can cause heat stroke deaths if used to increase physical performance during exercise, in the same hand they do increase fat loss. But with the usage there is an inherent danger.

**Citations & References:**

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Stanford researchers' cooling glove 'better than steroids'

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Effect of wrist cooling on aerobic and anaerobic performance in elite sportsmen

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Thermoregulation and Human Performance: Physiological and Biological Aspects

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