Biology and psychology of evolutionary adaptations to famine in sports

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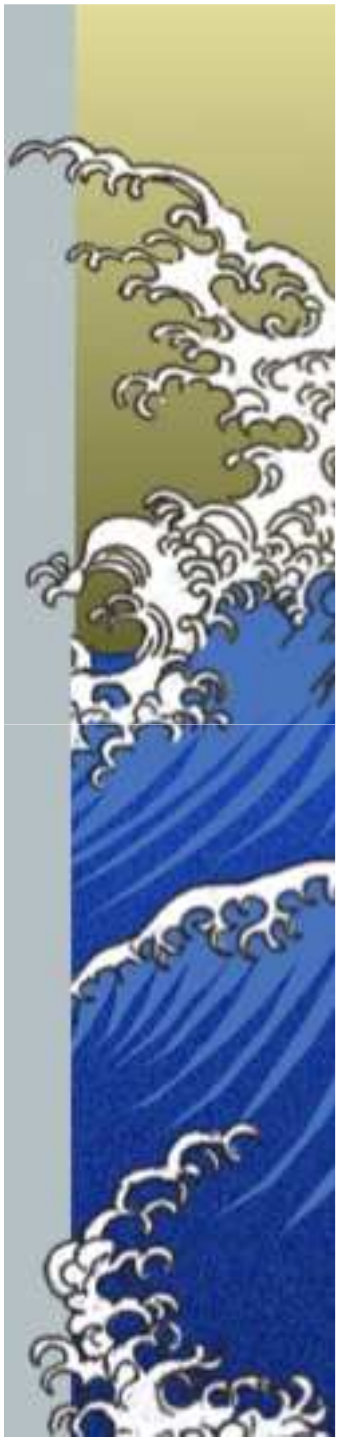
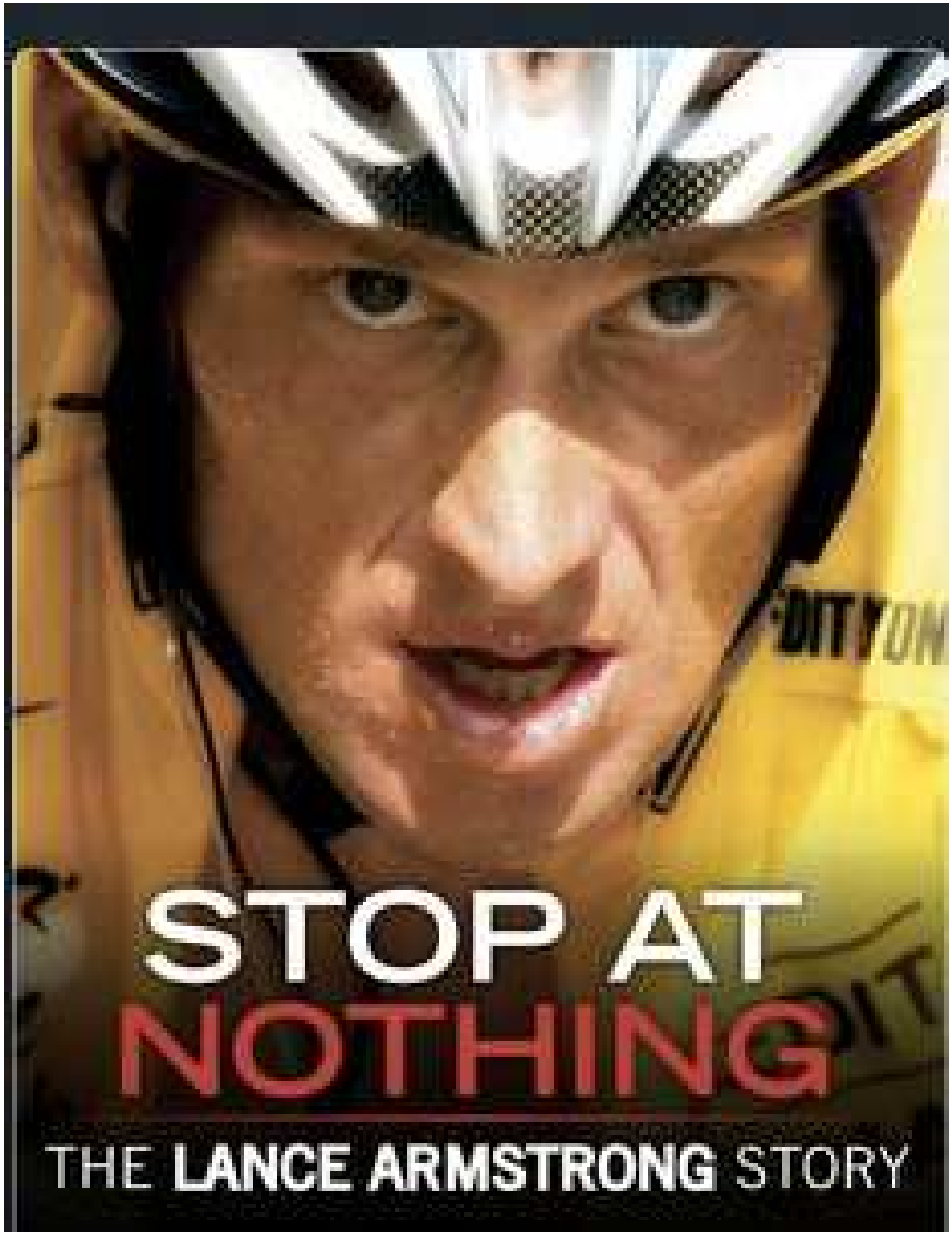
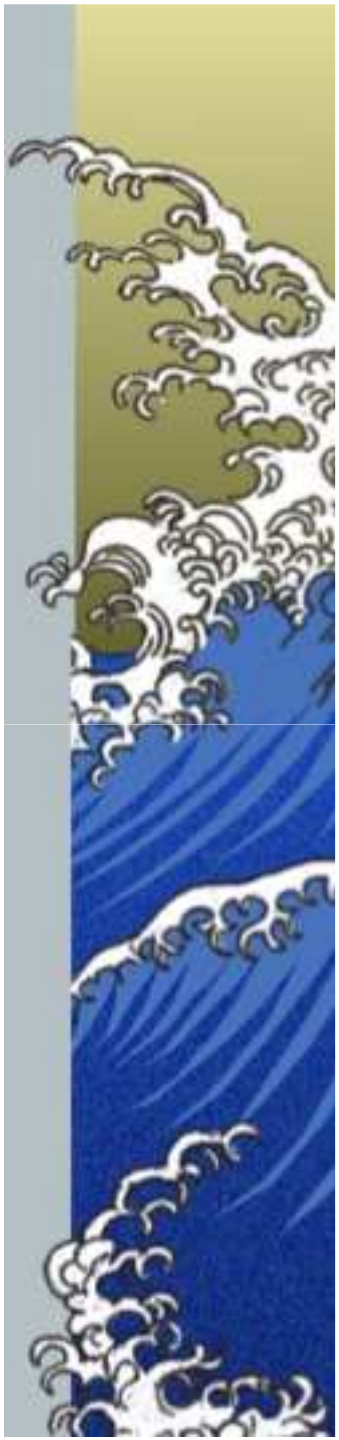



STOP AT
NOTHING
THE LANCE ARMSTRONG STORY

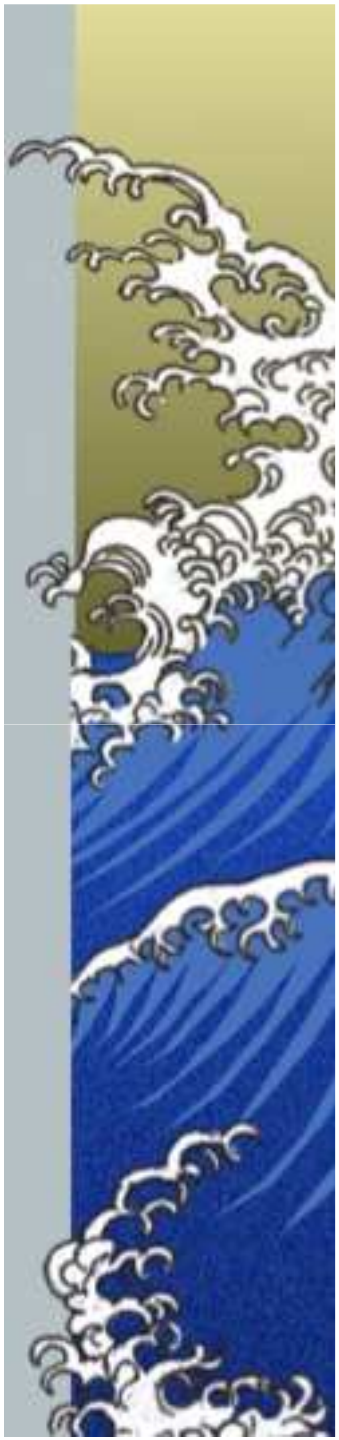
Elite endurance cyclers induce anorexia nervosa

- “Optimum” performance weight is different for training and competition
- First, build muscle
- Then, restrict calories



Athletics most vulnerable to developing anorexia nervosa

- Those that require low weight and endurance: running, x-c skiing
- Antigravity sports such as ski jumping
- Aesthetic evaluation requires particular body composition: gymnastics, diving
- Partners must lift: figure skating, ballet
- Competition weight is lower than training weight



Confessions Of An Anorexic Runner

https://minneapolisrunning.com/confessions-anorexic-runner/

Sport › Olympics › Winter Olympics

Pyeongchang 2018: Eating disorders still plague figure skating to a dangerous degree as we approach Winter Olympics

A sport known for grace and beauty has a dark, ugly side that people are only just beginning to talk about

Elaine Lies, Gabrielle Tetrault-Farber | Thursday 4 January 2018 15:54 GMT | 0 comments

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Akiki Suzuki, here competing at Sochi 2014, has opened up about her personal struggles *Getty*

rders-

Figure skater Yulia Lipnitskaya opens up about anorexia

'Not everyone can cope with it,' says retired Russian Olympic champ

The Associated Press · September 12, 2017

Retired Russian figure skater Yulia Lipnitskaya opened up about her treatment for anorexia on Tuesday. (Atsushi Tomura/Getty Images)

DSM-5 definition of anorexia nervosa

- *Persistent restriction of energy intake leading to significantly low body weight*

- *Either an intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain*

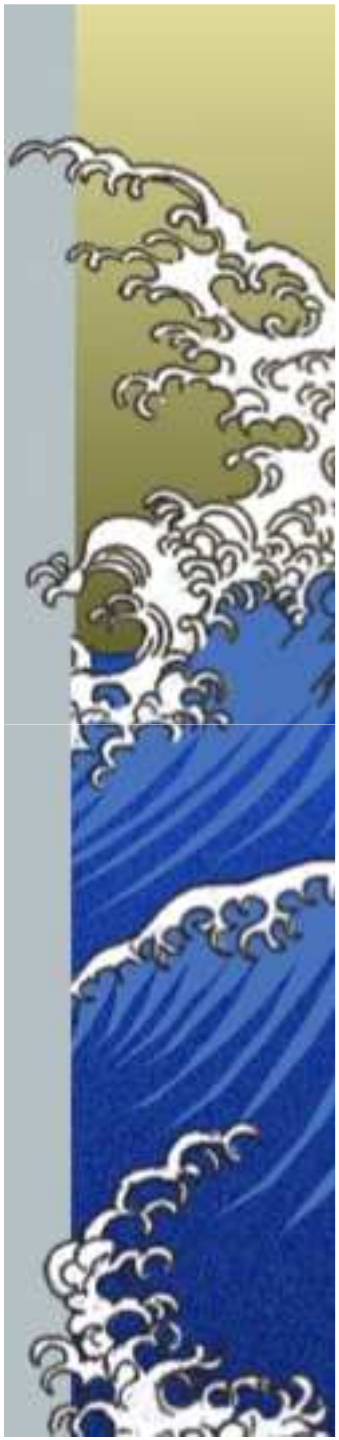
- *Disturbance in the way one's body weight or shape is experienced, undue influence of body shape and weight on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight*

DSM-5 biologically and psychologically flawed

- Implies conscious choice, ignores neuroscience research showing nonconscious biological changes that leads to restrictive eating.
- The first criterion is not true of those who lost weight accidentally from illness or from prepubescent height increase, nor of those who try to eat more but cannot.
- The second criteria ignores the long history of people NOT attributing their difficulty eating to fear of fat.
- Ignores hyperactivity, attributing it to fear of fat.

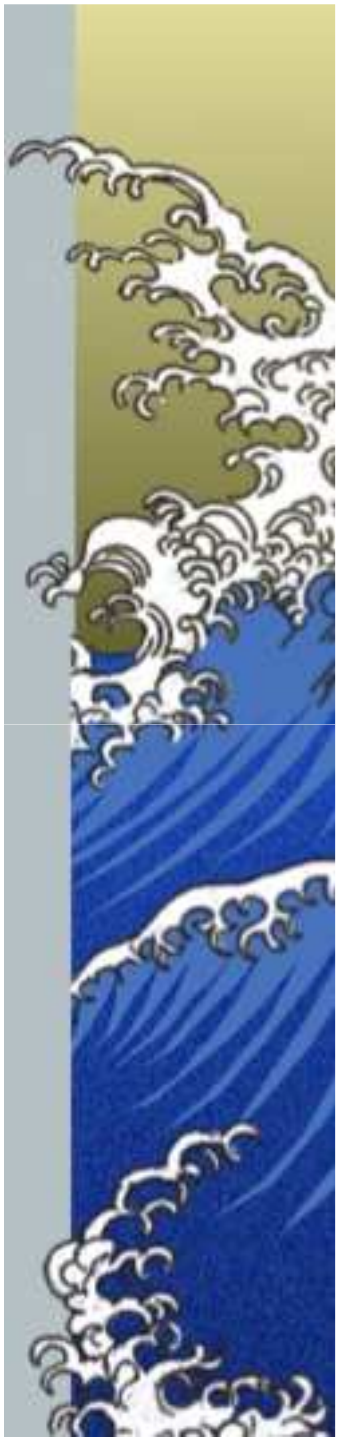
Gull (1873) on hyperactivty

"…the patient complained of no pain, but was restless and active. This was in fact a striking expression of the nervous state, for it seemed hardly possible, that a body so wasted could undergo the exercise which seemed agreeable."



Lasègue (1873) on hyperactivty

"…far from muscular power being diminished, this abstinence tends to increase the aptitude for movement. The patient feels more light and active…. She is never tired "

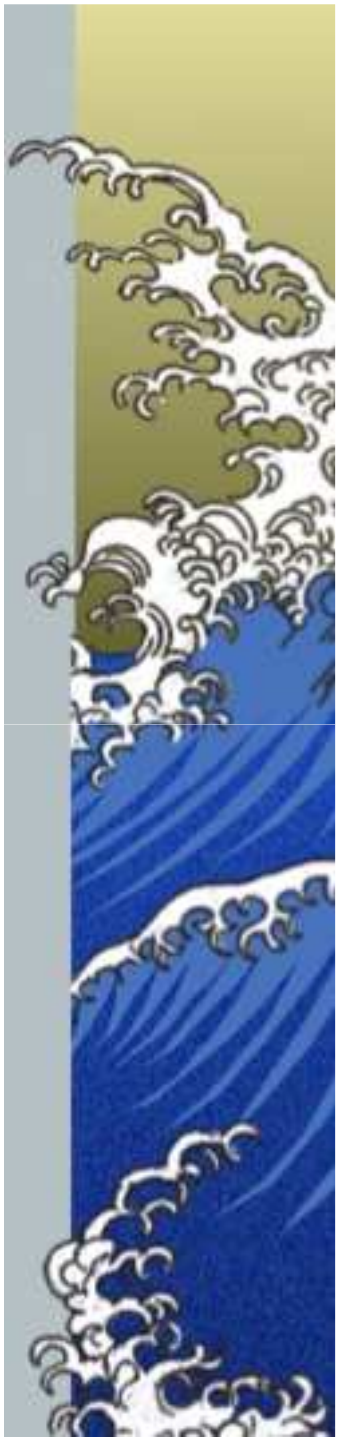


20th century paradigm of psychological causation

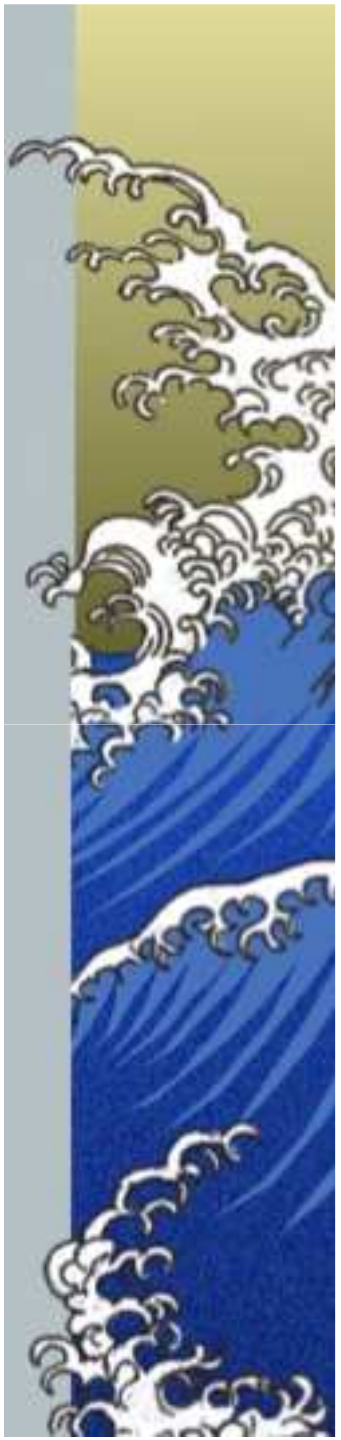
DSM considers hyperactivity secondary to desire to lose weight

Both science and history support hyperactivity as a primary symptom of AN

We hope the DSM-6 will correct this error



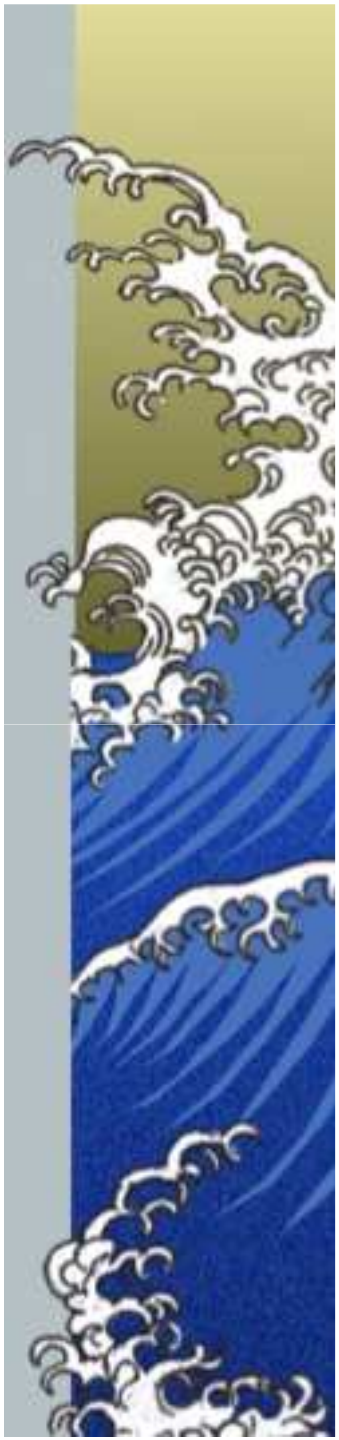
Adapted-to-Flee-Famine Hypothesis



Human ancestors have dealt with famine for over a million years

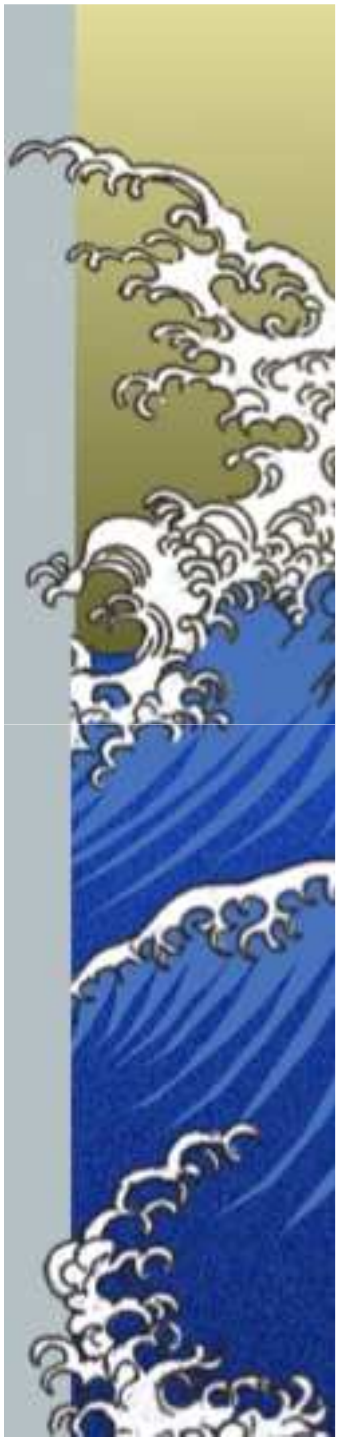
Some ancient adaptations to famine today lead to eating disorders

Anorexia nervosa
Bulimia nervosa
Binge Eating Disorder



Ipotesi di adattamento per fuggire la carestia

(Adapted-to-Flee-Famine Hypothesis)



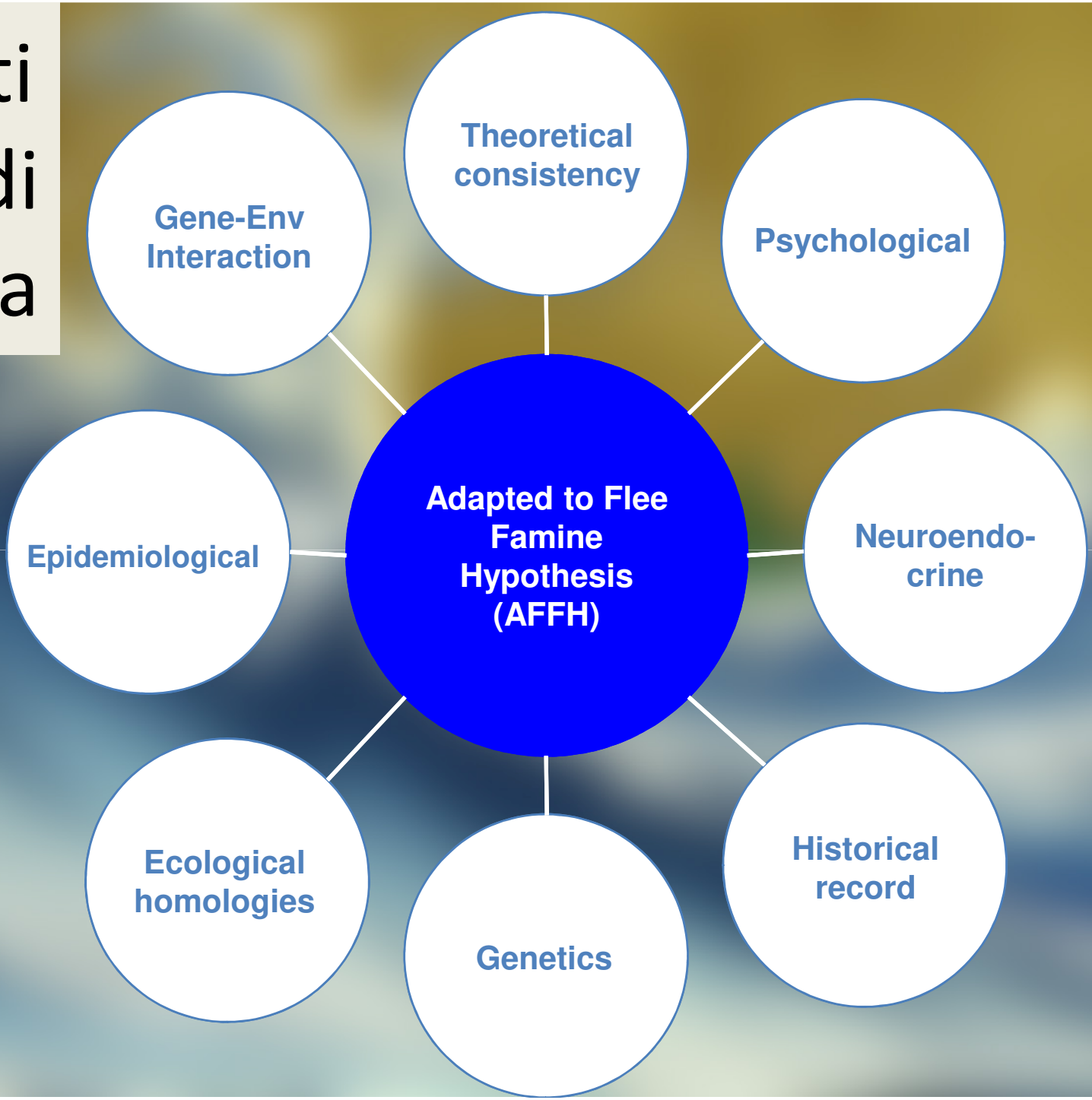
Pensate alla vita degli uomini nel Pleistocene, se voi foste un raccoglitore che sta morendo di fame

Consider life in the Pleistocene, if you were a starving forager

- **Potreste scegliere di rimanere dove siete, aspettando la fine della carestia**
- **Potreste cercare terre migliori**
- **Ma, per viaggiare, il vostro corpo deve:**
  - **Non distrarsi dalla ricerca del cibo**
  - **Aumentare l'energia per muoversi**
  - **Ingannarsi riguardo al proprio stato fisico**

- ***You could stay put and wait out the famine***
- ***Or, you could search for better lands***
- ***In order to travel your body would need to:***
  - ***Turn down distracting eating***
  - ***Turn up energy to move***
  - ***Deceive itself about physical state***

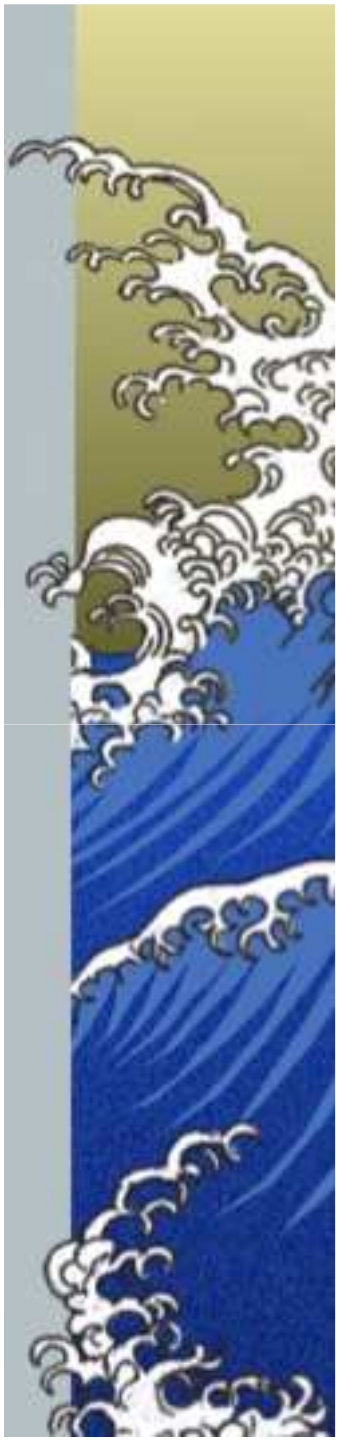
Molti tipi di prova



La diminuzione del peso causa l'AN (Anoressia Nervosa)

AN is caused by weight loss

- La diminuzione della leptina è il segnale nei topi e negli uomini
- Provoca cambiamenti neuroendocrini
- Somministrare la leptina cura iperattività
- *Falling leptin is the signal in mice and humans*
- *Triggers neuroendocrine changes*
- *Leptin administration cures hyperactivity*



NEUROPEPTIDI, ORMONI E NEUROTRASMETTITORI ALTERATI

ALTERED NEUROPEPTIDES, HORMONES AND NEUROTRANSMITTERS

Regulator	Effects on appetite or activity	Normal change with starvation	Underweight anorectics
Leptin	Falling levels make eating more rewarding	Falls out of proportion to loss of fat mass	Falls but rebounds before weight is fully restored
CCK	Satiety & delays gastric emptying	Stays low to allow starving animals to gorge	Strong peripheral basal and postprandial increases
Ghrelin	Increases reward of food and activity	Elevated	Elevated
PP	Satiety proportional to amount of calories	Decreased	Elevated and increased postprandia
PYY	Satiety in proportion to amount and kinds of food	Decreased	Elevated, may cause conditioned taste aversion
5-HT	Anorexigenic, activates POMC neurons	Decreased	Some alleles increase activity
CRH	Appetite suppression & hyperactivity	Decreased	Elevated
Galanin	Stimulates fat consumption	Elevated	Decreased
Endocannabinoid AEA	Increases palatability, overcomes satiety	Inversely correlated with leptin	Decreased
β-endorphin	Increases appetite	Increased	Decreased
Cytokine IL-1	Suppresses eating, has catabolic effect	Decreased	Elevated
TNF-α	Anorexigenic, alters neurons in hypothalamus	Decreased	Increased plasma concentrations
α-MSH autoAbs	Hi levels correlated with scores on EDI-2	Unknown	Increased in AN
Somato-statin	Counteracts CRH-induced anorexia & activity	Unknown	Reduced activity in AN
Sirtuins	Increase efficiency & activity of muscle fibers	Can be activated in anorexic mice	Not yet examined in AN patients

Behavioral Ecological Evidence

Anorexia-like syndromes in omnivorous, opportunistic foragers

Sirt1: gene that turns on hyperactivity in starving mice and rats

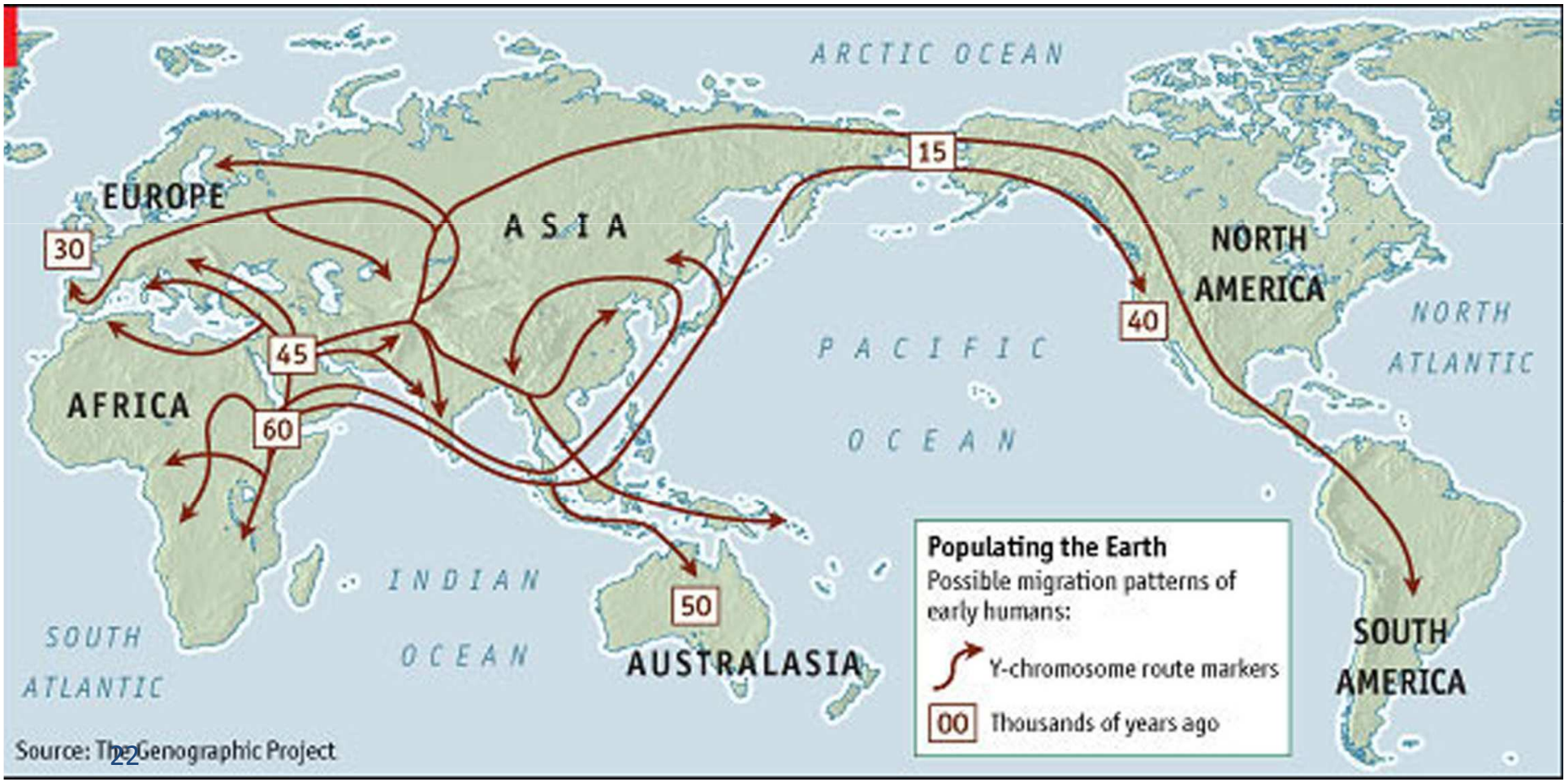
Founder events

- Genetic bottlenecks where populations are reduced to a small number of individuals result in high frequencies of founder genes when the population expands.

- The pattern of genetic data as humans dispersed around the world is consistent with a long series of founder events.

GLI UOMINI FURONO CACCIATORI COSI EFFICIENTI CHE PORTARANO MOLTE SPECIE ALL'ESTINZIONE, POI FURONO COSTRETTI A MIGRARE

HUMANS WERE SUCH EFFECTIVE HUNTERS THAT THEY HUNTED MANY SPECIES TO EXTINCTION AND THEN MOVED ON

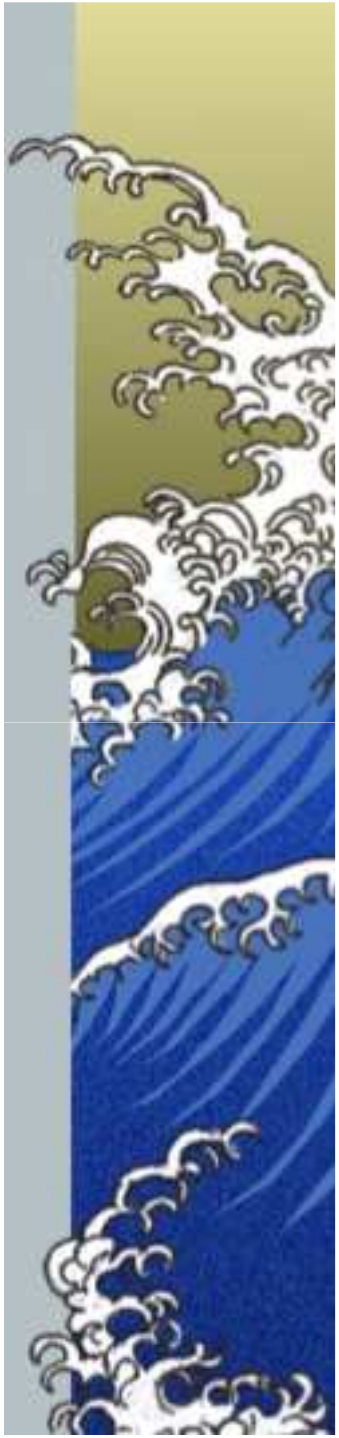


Super-atleti

Super athletes

- Maggiore tolleranza al dolore (come “Estasi”)
- Maggiore forza dei muscoli
- Miglioramento della abilità esecutiva per inibire gli impulsi e desideri
- Diminuzione dell’angoscia riguardo alla fame e al piacere del cibo (l’attività della insula)
- Rilascio alterato di dopamina per il cibo

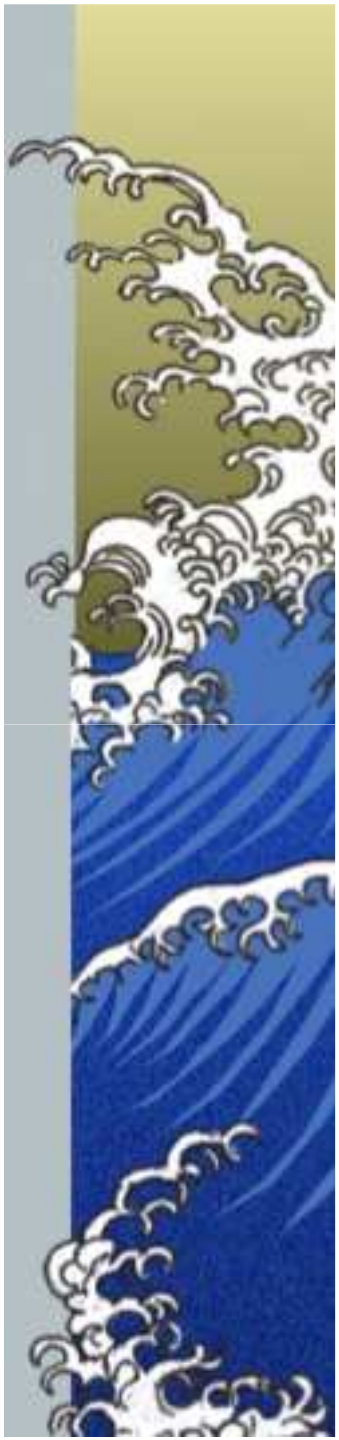
- *Increased pain tolerance (Ecstasy-like)*
- *Increased muscle capacity*
- *Enhanced executive ability to inhibit incentive motivational drives*
- *Decreased distress about hunger and liking of food (insula activity)*
- *Altered dopamine reward to food*



Insula: Pain tolerance

- Responsible for literal and metaphorical “gut” feelings; interprets body sensations into emotional meaning. Consciousness.

- An underactive insula spares people with AN the emotional distress of their hunger and fatigue

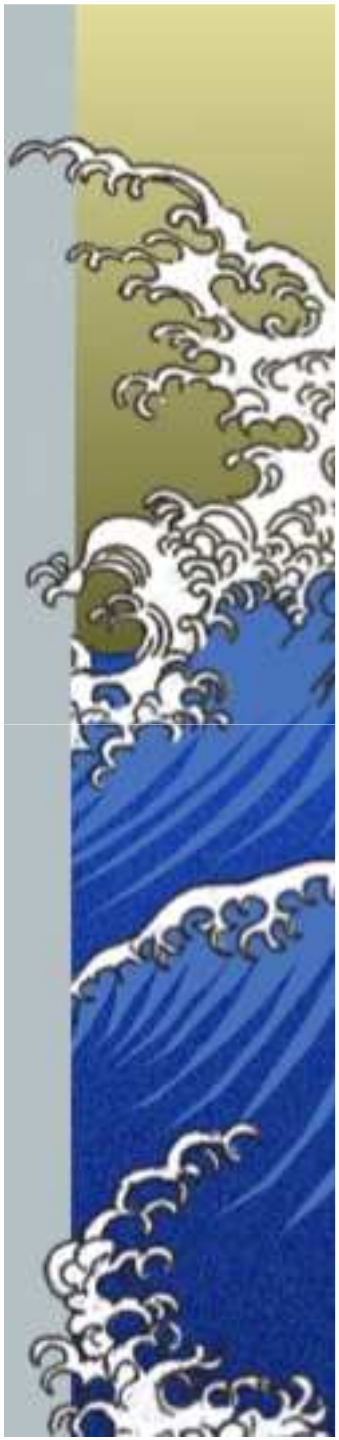


Executive control

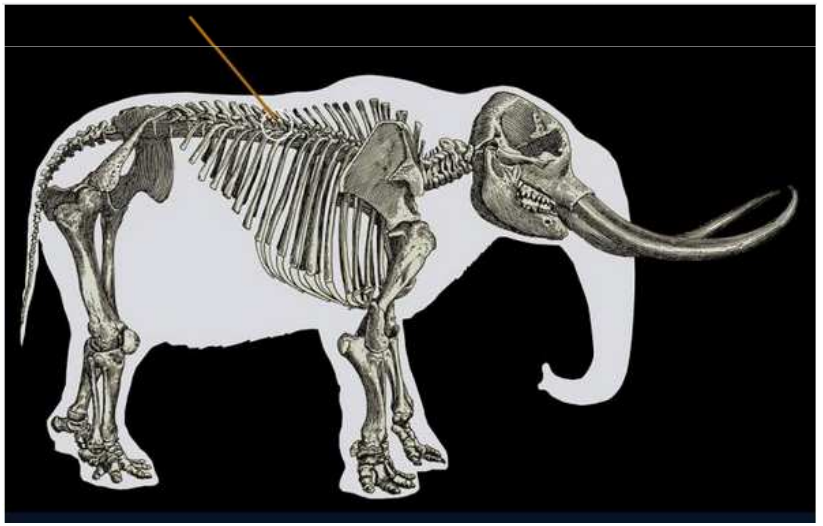
- Mammals have an executive cortical area sending “top-down” instructions to more primitive deep-brain centers.

- The prefrontal cortex is responsible for identifying and carrying out one’s goals; it provides executive control over incentive motivational drives.

- During migration it helps direct the committed behavior required to stay with the goal.



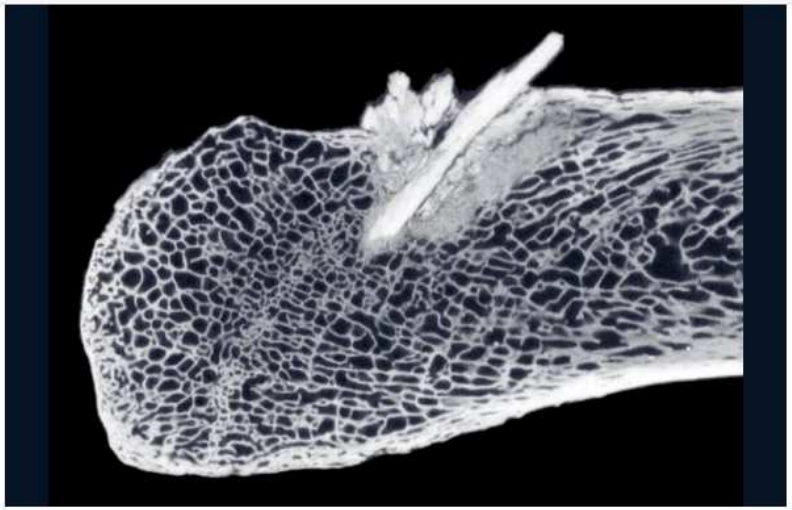
Hunting



https://news.nationalgeographic.com/news/2011/10/pictures/111021-mastodon-bone-spear-north-american-clovis-hunting-science/

Sports

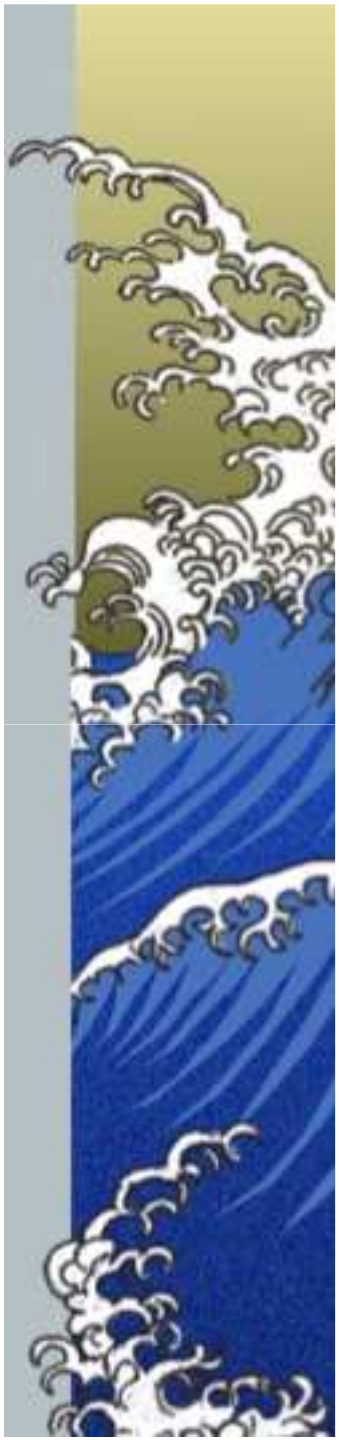
http://i.eurosport.com/2015/06/29/1625885.jpg



Mental toughness

- In sport, athletes who persist in the face of adversities, and come from behind to win are often described as possessing *mental toughness*.

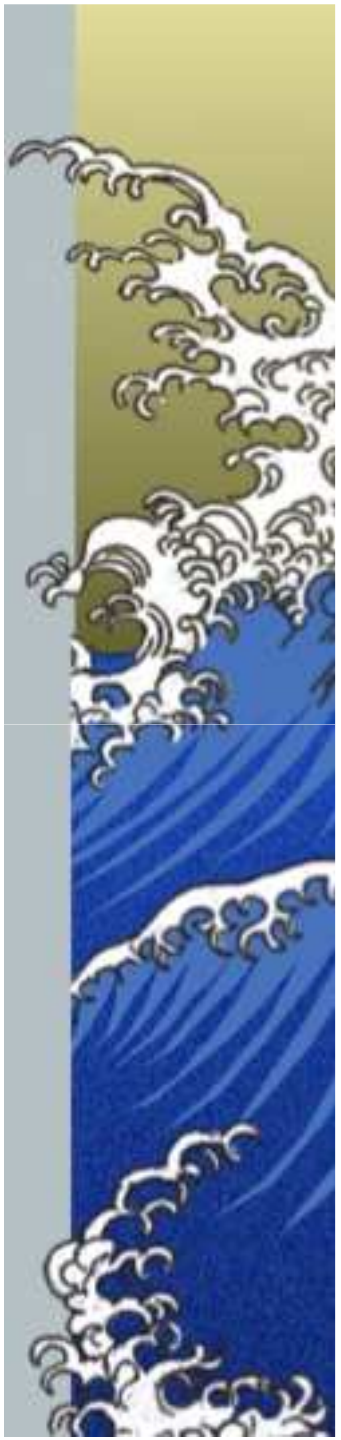
- Mental toughness is how athletes strive, survive, and thrive in their ongoing pursuits of performance standards (Mahoney, 2014)



Sirt1

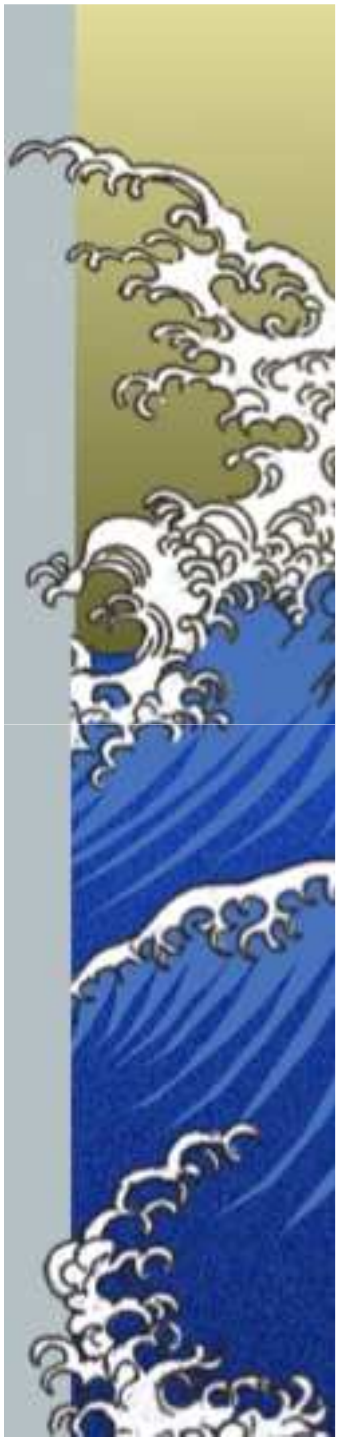
The gene that makes starving rats hyperactive

- SIRT1, is responsible for the increased activity in calorie-restricted mice.
- Running increases from 1km to 12 km per day
- Sirtuin researcher Leonard Guarente believes sirtuin-mediated changes allow an organism to live through famines by postponing breeding



Sirtuins

- Guarante: During famine sirtuins switch the body's resources from reproduction to tissue maintenance
- Sirtuins appear to alter muscle cells to make them more efficient and effective
- Activates PGC1-α, which stimulates cells to produce more mitochondria

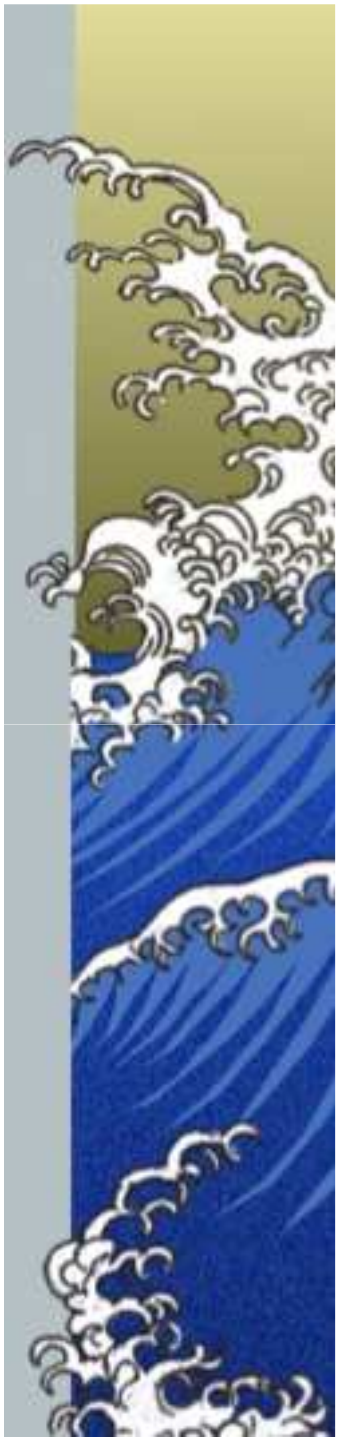


Sirtuins

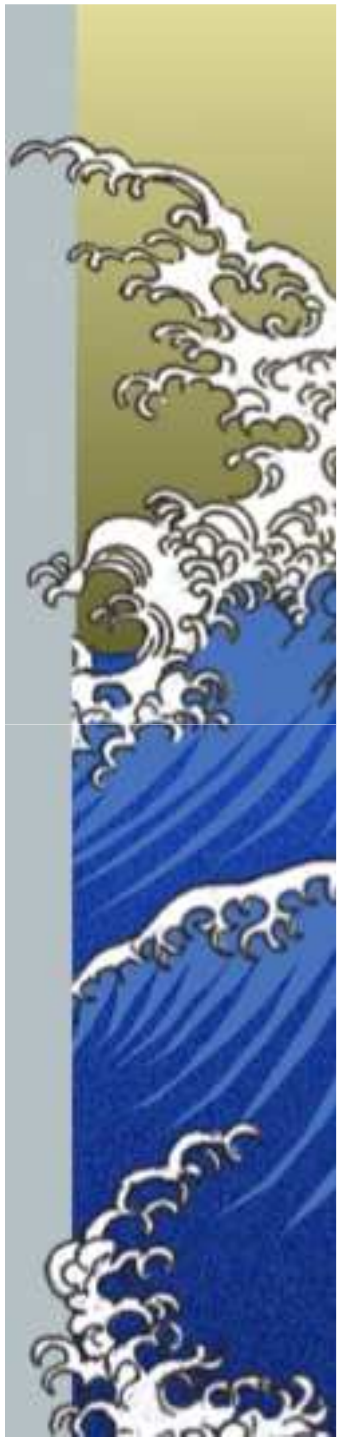
- In beta cells SIRT1 leads to increase in ATP synthesis and insulin secretion in *response* to glucose.

- SIRT1 also protects beta cells against stress-induced cell death.

- SIRT1 alters mitochondrial enzyme allowing the use of dietary acetate for central metabolism.



- *How this happens among athletes*
- *How they use this to win*
- *Public health and prevention*



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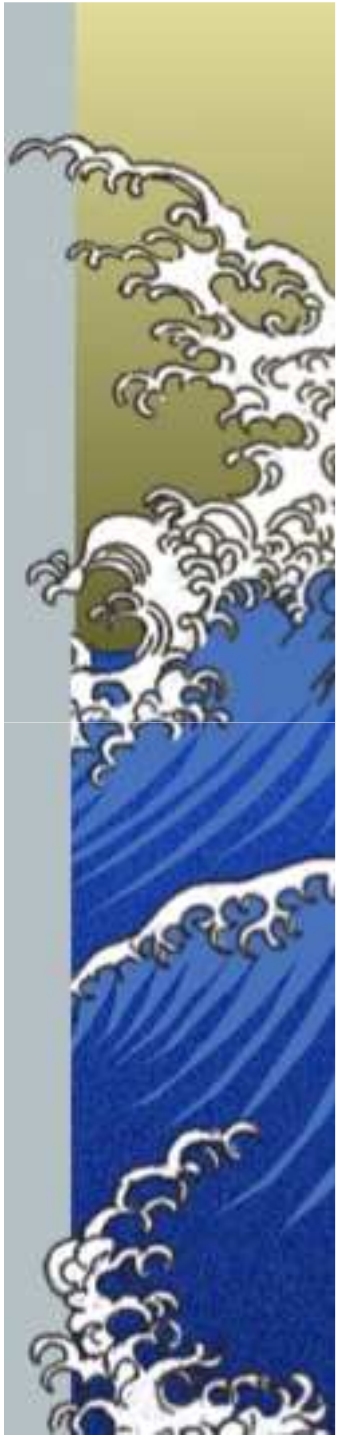


È solo nei fumetti che gli eventi casuali o gli incidenti possono produrre i super poteri!

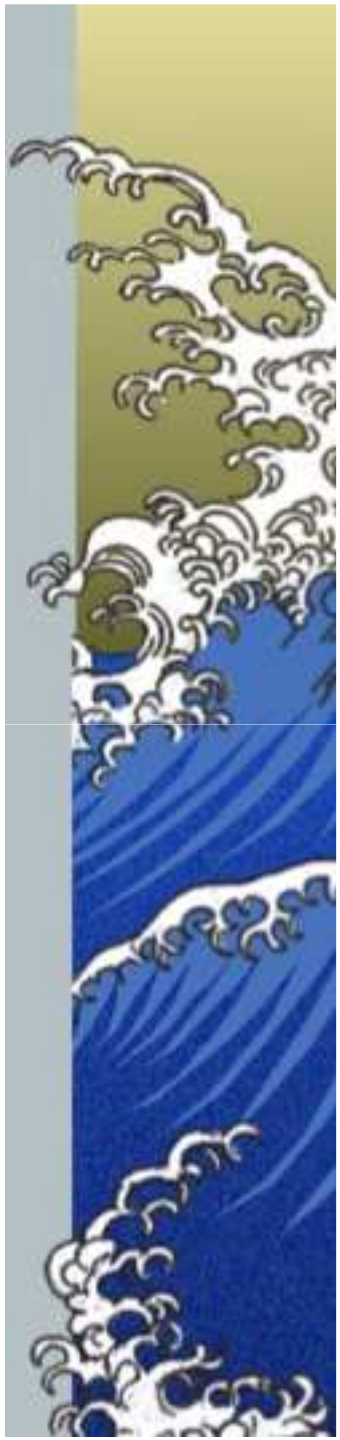
Only in comics do accidents result in super powers

When you have anorexia

- Life is hell because AN runs you
- 40% increased suicide risk
- Your body breaks down
- Increased risk of fractures, heart, kidney, GI problems

Risk of bulimia and binge eating in sports where lower weight is an advantage

- Wrestling, dance, martial arts, bicycle racing
- Gymnastics, diving, figure skating.
- Lightweight rowing (crew), skiing,
- Synchronized swimming, running
- Gymnastics, judo



Bodies adapted to famine: Purging

- Begins as a weight loss strategy
- Simulates famine and thus leads to bingeing
- Can become addictive

We need to be aware of the risk to athletes

- They are under-treated
- Not recognized until too late because
  - Not expressing fear of fat
  - Want to be more athletic
  - Because BMI of athletes is high
- Hyperactivity is not listed as a primary symptom in DSM

Grazie!

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adaptedtofamine.com