Context, context, context

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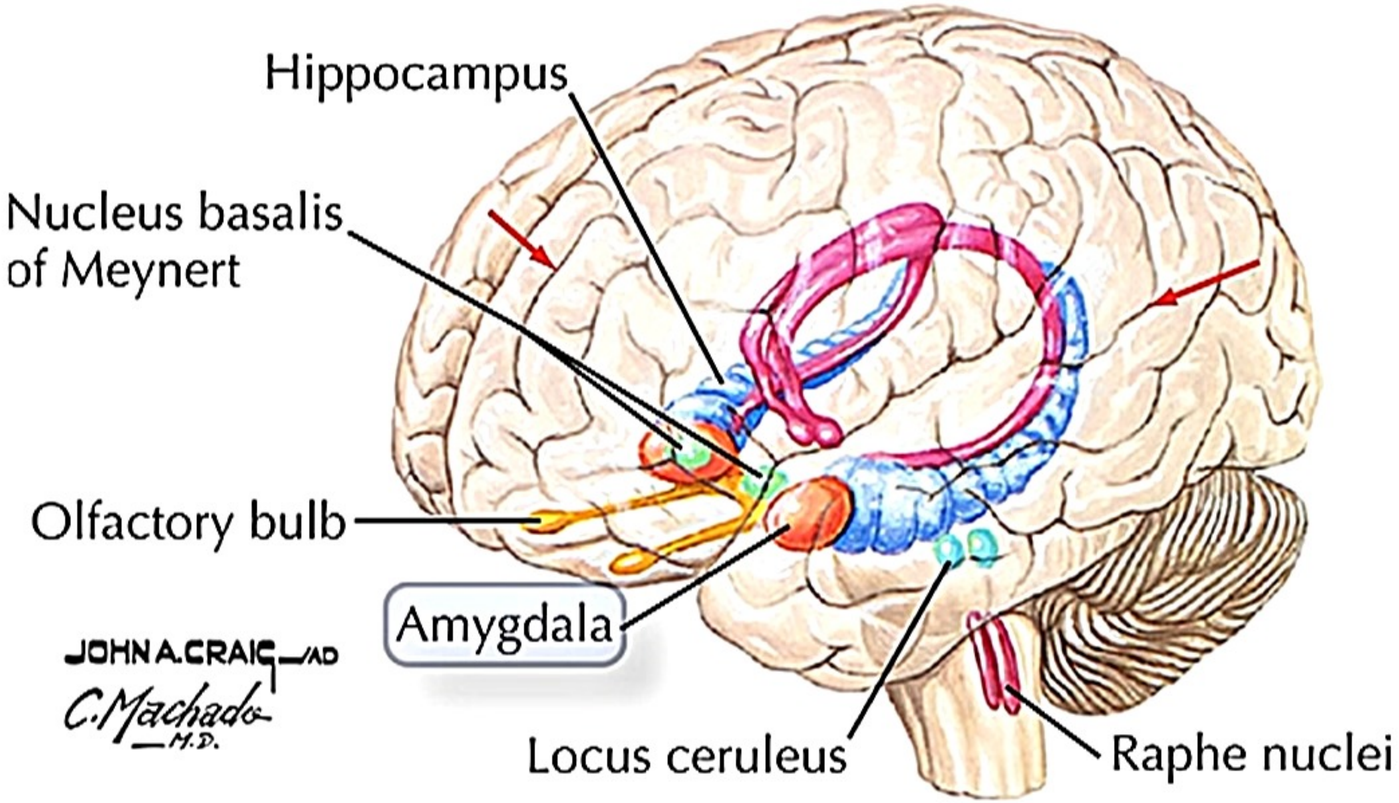
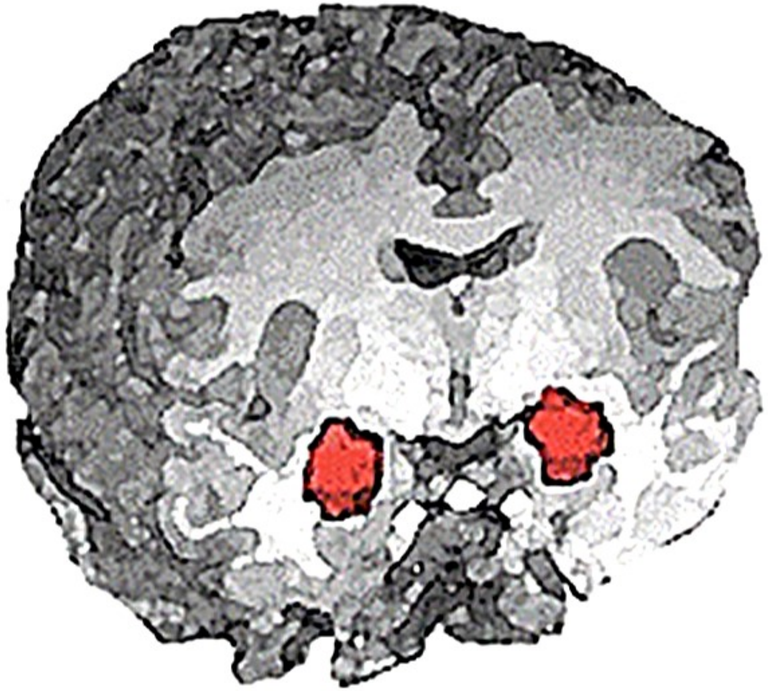
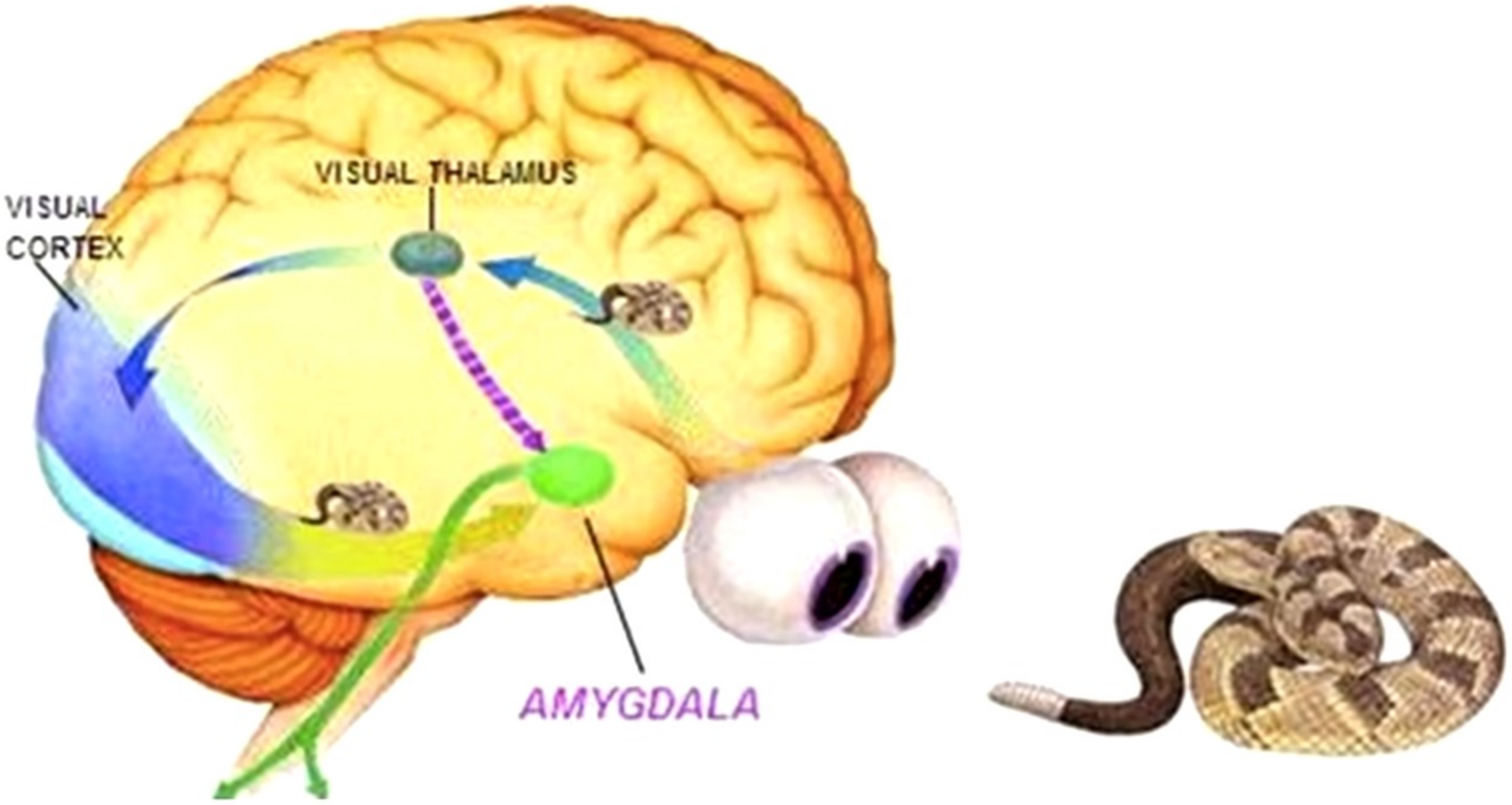
The Amygdala



NO
AMYGDALA?
NO FEAR.

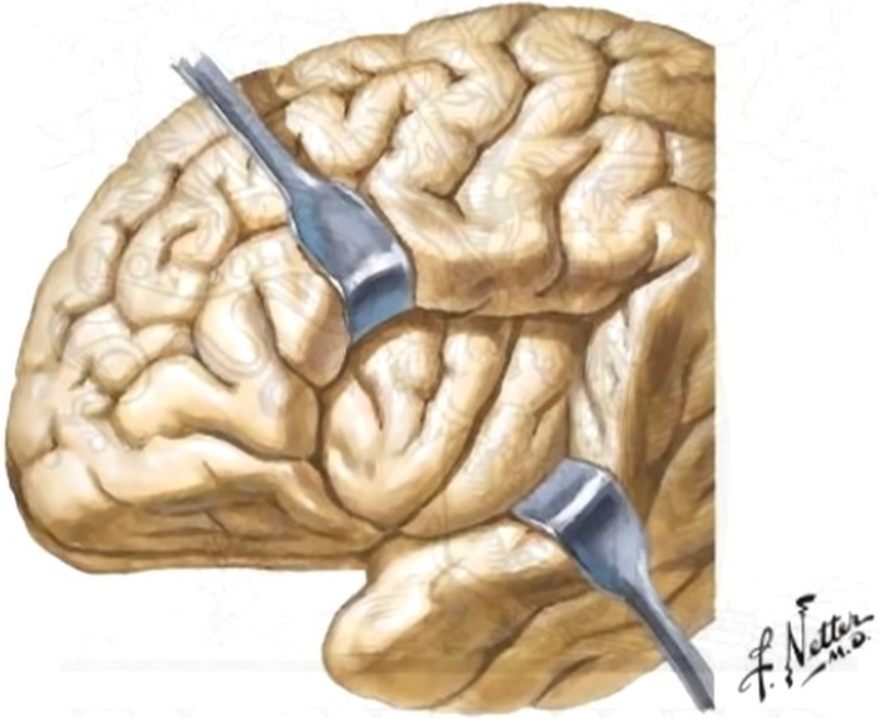



VISUAL THALAMUS
VISUAL
CORTEX
AMYGDALA

Thus:
You can't make sense of the neurobiology of aggression without considering the neurobiology of fear

The amygdala gets rapid, privileged access to sensory information…that is often inaccurate because of that speed

The Insular Cortex



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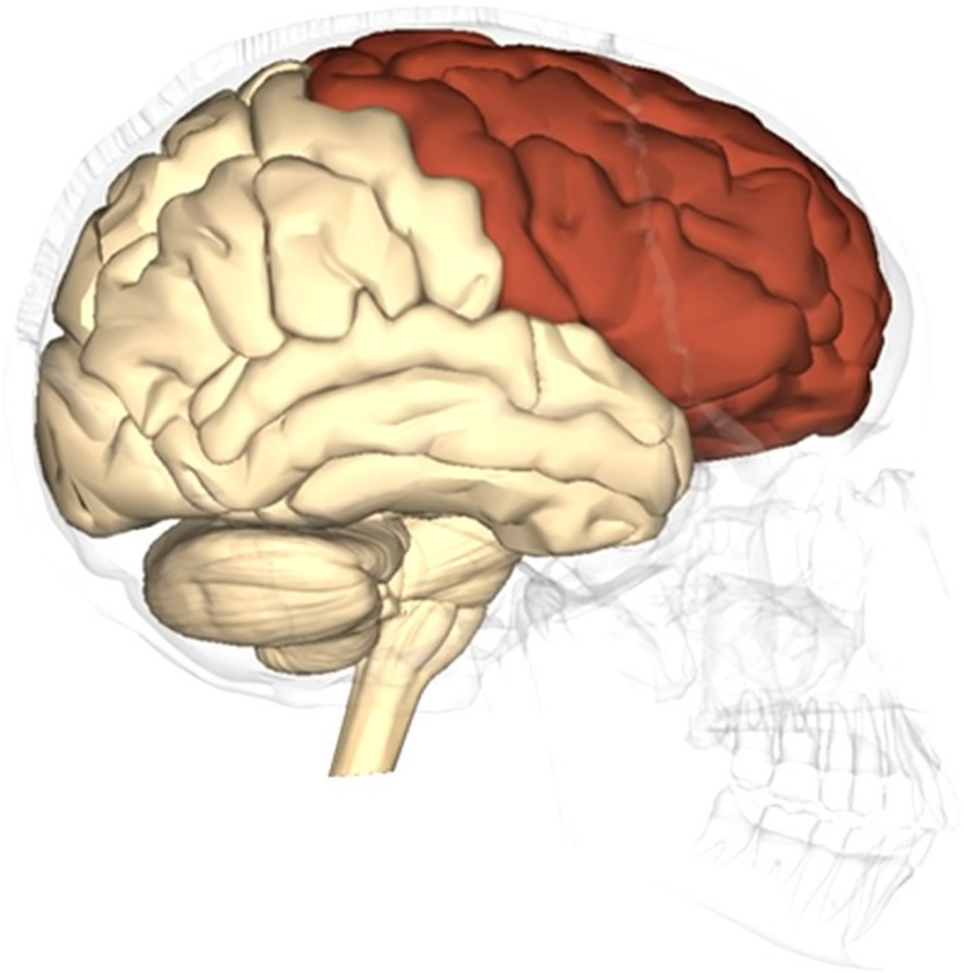
Thus:
In other animals, the insula is about sensory disgust

In a human, it's also about moral disgust… which is intensely context-dependent

And the insula is central to the human tendency to consider what is merely different to be disgustingly wrong… and to tell the amygdala about it

The Frontal Cortex



Things that can take self-discipline:

Practicing the violin

Never ever lying

Doing an effective job at lying

Pretending to be someone else (*"To be or not to be…"*)

Manipulating the stock market

Suppressing that burp during the eulogy

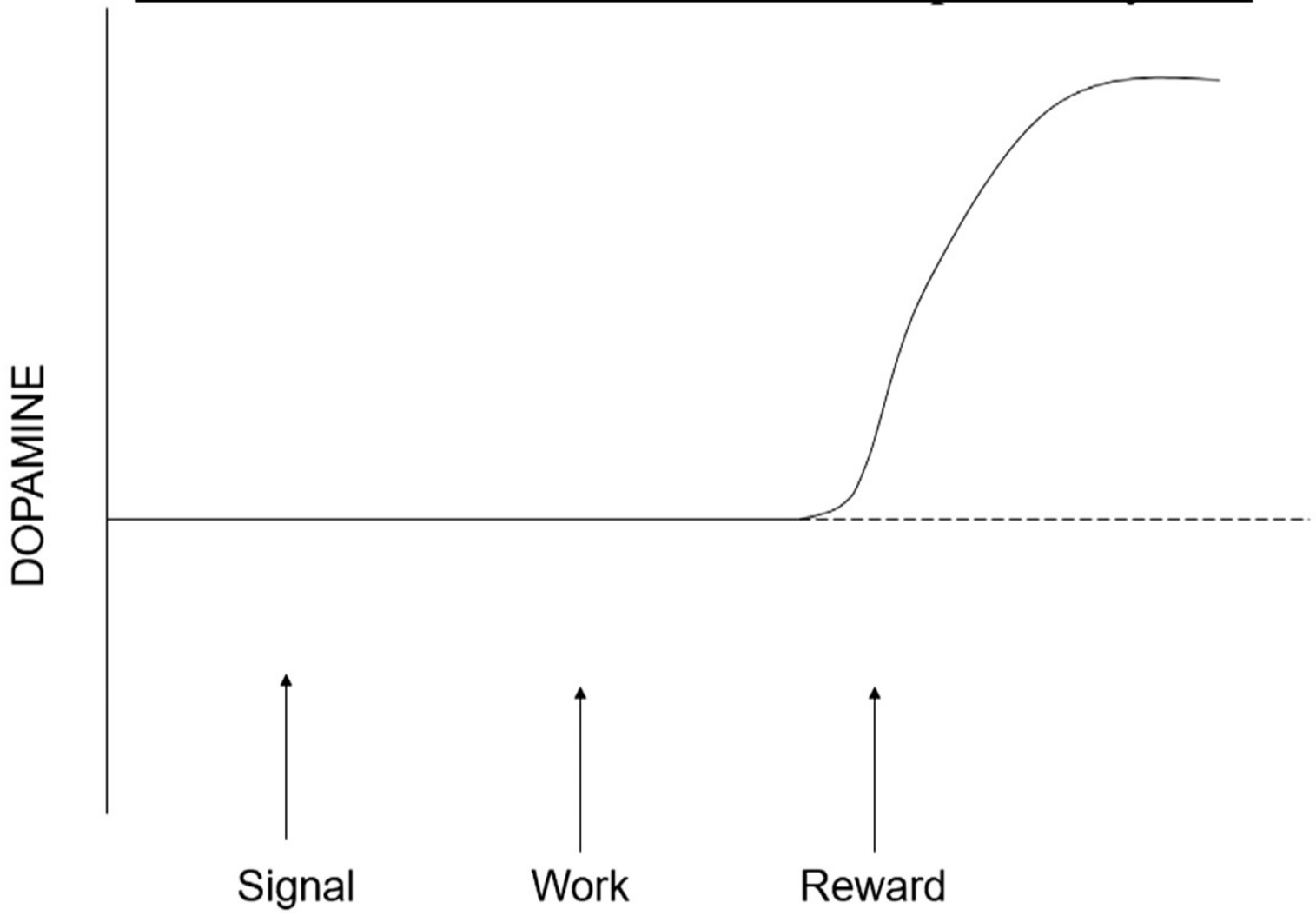
Successfully ethnically cleansing a village of civilians

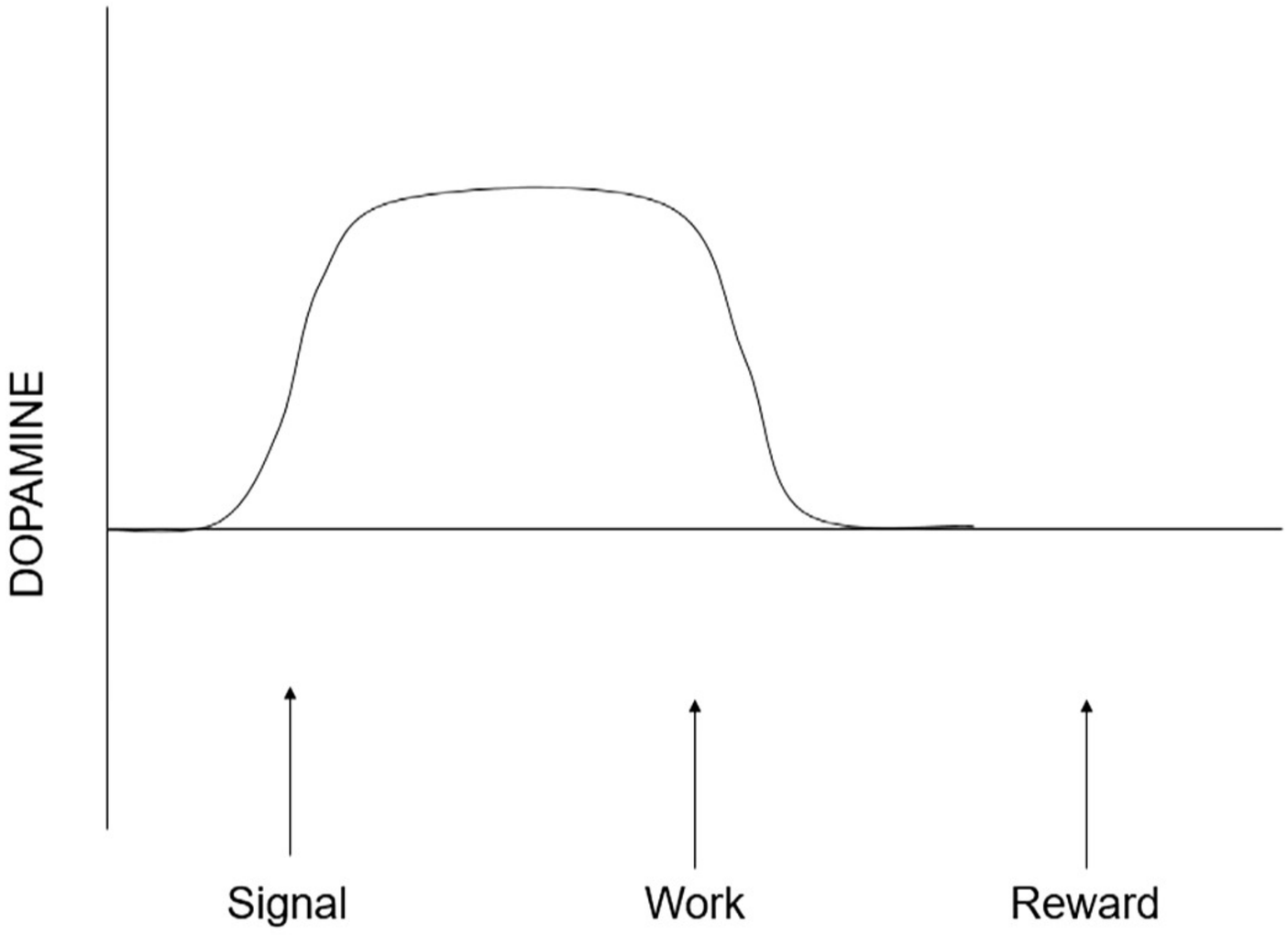
Thus:
The frontal cortex makes you do the harder thing when it's the right thing to do

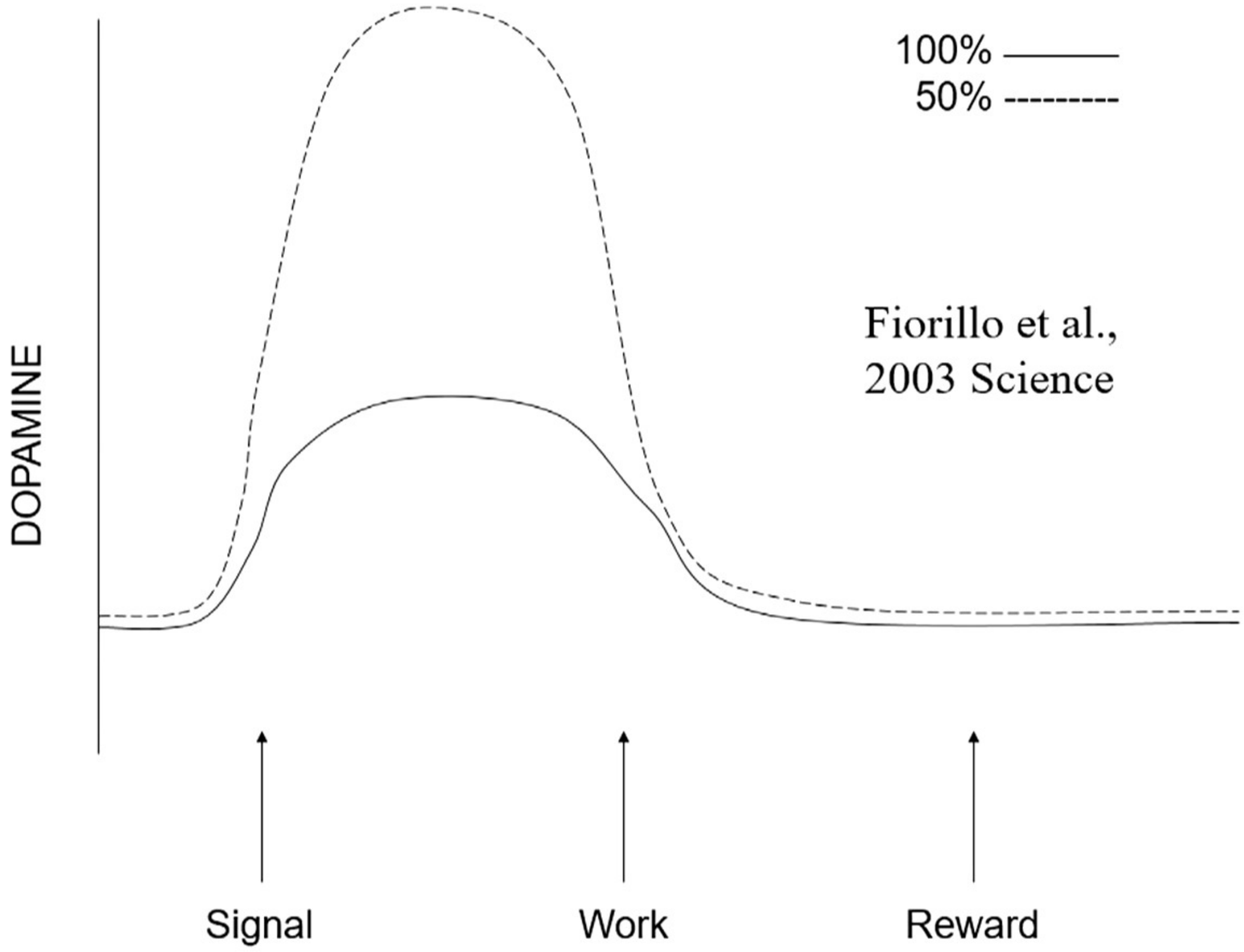
But "the right thing" is value free

And the frontal cortex isn't cerebral, lofty and aloof; instead, it's constantly influenced by emotions and viscera

The mesolimbic and mesocortical dopamine system




DOPAMINE
Signal
Work
Reward


100%
50%
Fiorillo et al.,
2003 Science
DOPAMINE
Signal
Work
Reward

Thus:
Dopamine is somewhat about reward…but
even more so about the anticipation of reward…
and even more so about the motivation to
get that reward

Nothing activates the system like inserting
"maybe" into the mix.

Few things activate the dopamine system more
Than the prospects of righteous punishment

Fusiform cortex: face recognition
Anterior cingulate: empathy

But whose face, and whose pain?

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Decades to millennia before: how did culture shape the social environment in which he lives, and how did ecological factors shape his culture?

Millions of years back: how did the behavior evolve?

Thus:
We are constantly buffeted and swayed by sensory information that seems irrelevant and hardly noticeable…

…as well as by sensory information that is entirely subliminal

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Thus:

Our brain and sensory systems are constantly marinating in hormones

The problem isn't testosterone's effects on aggression; it's that we often reward aggression so abundantly

Oxytocin promotes being pro-social only to in-group members; if it's a Them, oxytocin does the opposite

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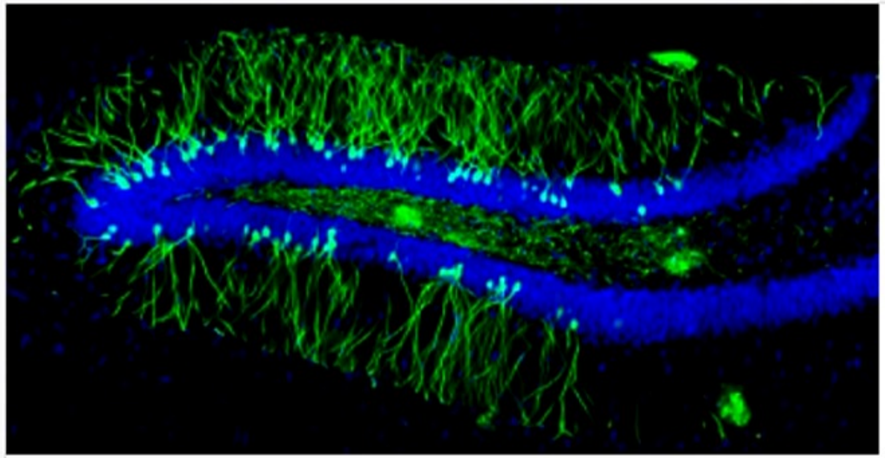

New-born neurons (green) in the adult hippocampus

<u>Neuroplasticity in action</u>:
The amygdala is enlarged by stress, PTSD
The hippocampus is enlarged by extensive spatial learning (in cab drivers)
The hippocampus is atrophied by stress, depression and PTSD
Learning an instrument expands the percentage of auditory cortex responding to its sound
Rewiring occurs in American Sign Language signers from the eyes to the auditory cortex
Rewiring occurs in Braille readers from fingertips to the visual cortex
Juggling expands the size of the motor cortex coding for hands

Thus:

The brain has the potential for enormous amounts of neuroplasticity

But it has its limits: no amount of practicing and rewiring of your brain will make you a Yo-Yo Ma, or allow you to completely recover from certain injuries

Neural plasticity is value free: brains can change to make you better at being saintly or at being vile

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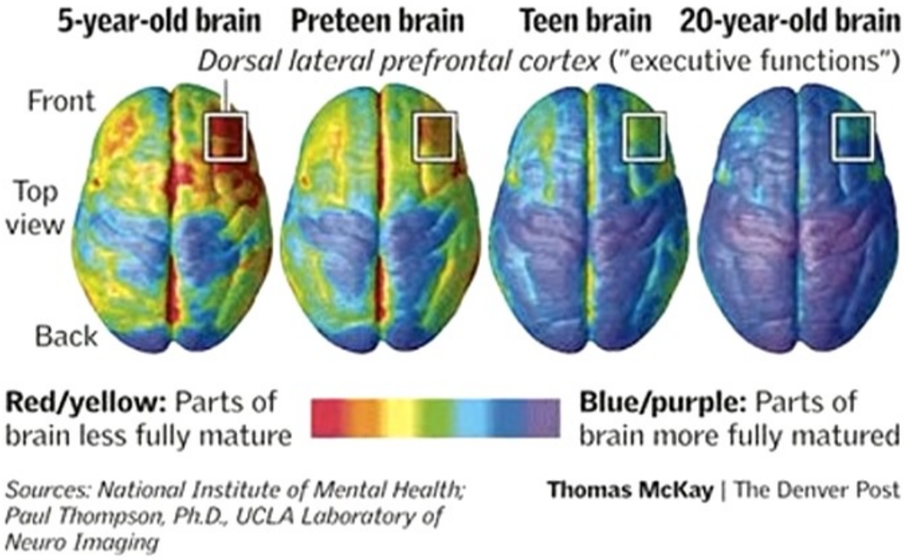
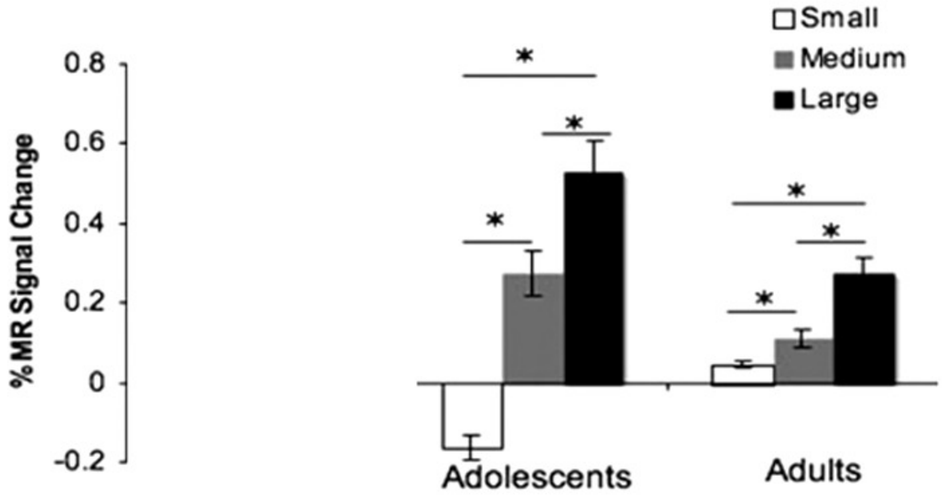
Gyroscopes of emotional and behavioral lability



The frontal cortex is still Half-baked

Resulting in a dopamine reward system that is hyper-responsive



Thus:

Adolescence is all about the dopaminergic maturity and frontocortical immaturity

If the frontal cortex is the last region to mature, it is the part of the brain least determined by genes and most sculpted by experience

Delayed frontocortical maturation probably evolved **precisely** for that reason.

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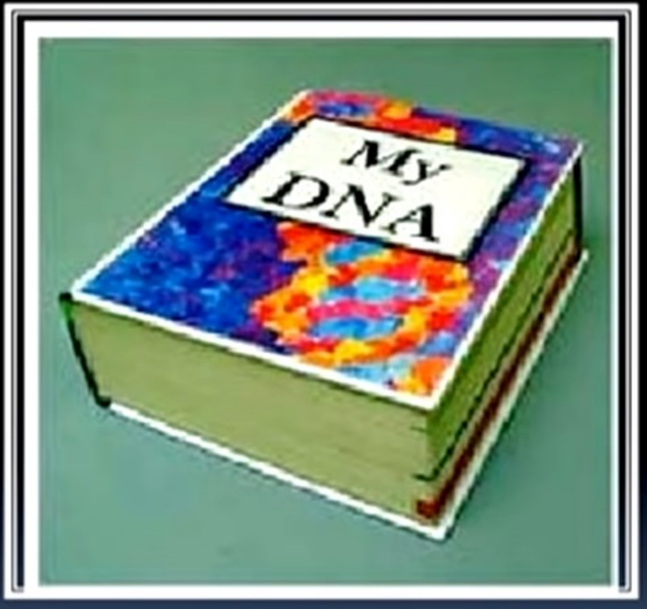
GENETICS VERSUS EPIGENETICS



GENETICS

EPIGENETICS

Thus:

Early environmental experience sculpts the construction of the brain and endocrine systems

This can involve epigenetic changes in gene regulation that can be life-long

Some of these acquired traits will influence the next generation's fetal environment

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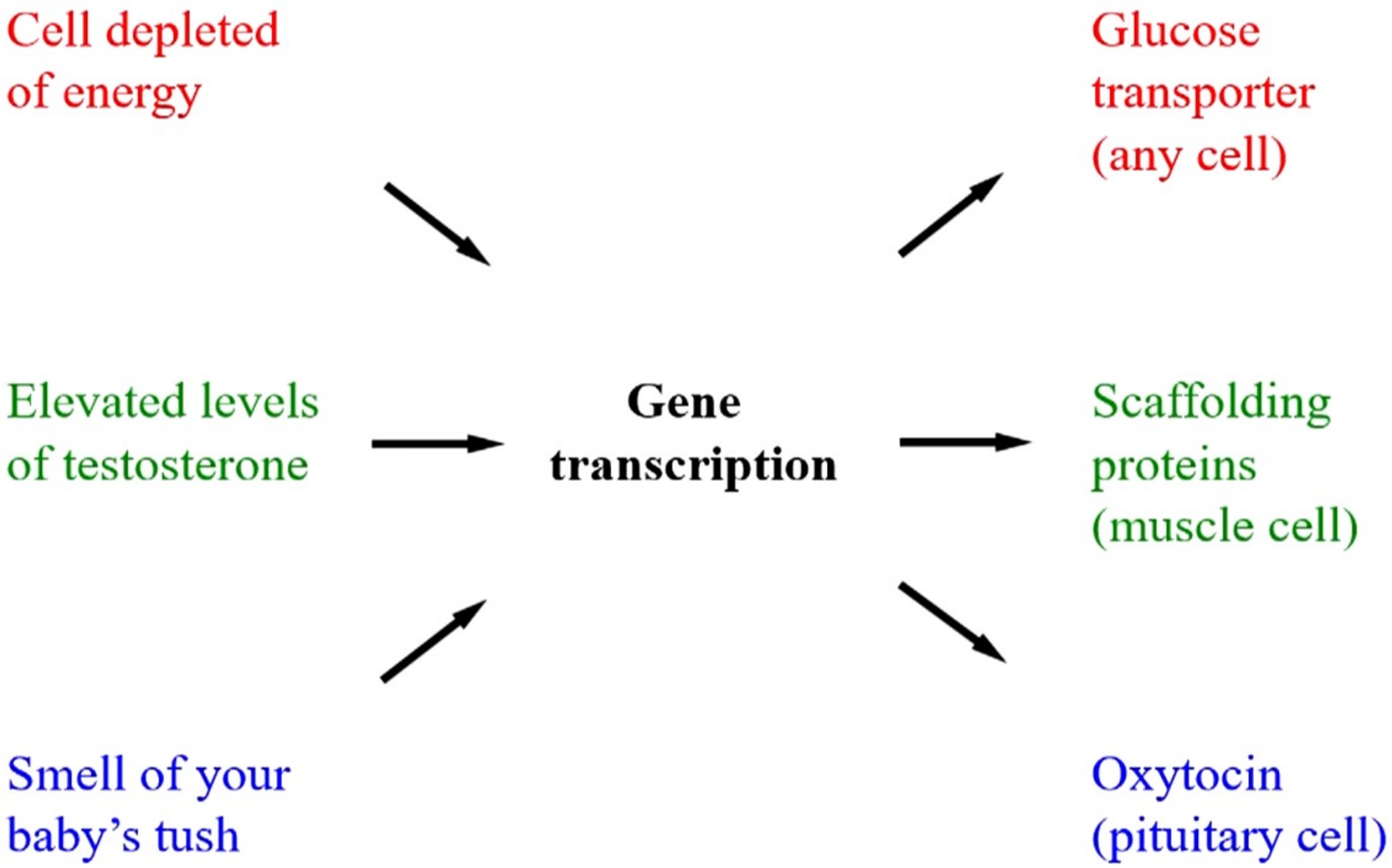
Cell depleted of energy
Elevated levels of testosterone
Smell of your baby's tush
Gene transcription
Glucose transporter (any cell)
Scaffolding proteins (muscle cell)
Oxytocin (pituitary cell)

Variant of gene:	Associated with:	But only if:
5HTT	Depression	Childhood trauma
FADS2	Higher IQ	Breast fed
NR2Bko (mouse)	Poor cognition	Boring environment
MAO-alpha	**Antisocial, violent behavior** Criminality Economic competitiveness	**Childhood abuse** High testosterone levels High stakes
COMT	Angry temperament	Childhood sexual abuse
OT-R	Aggression	Drinking
DRD4	Poor gratification postponement Most pro-social Least pro-social	Raised in poverty Religious prime Lack of religious prime

Thus:

Genes decide nothing

The environment directs genes when to make particular proteins

Don't ask what a gene does; ask what it does in a particular environment

Greenland, the Sahara, the Amazon, Brooklyn: No other species lives in as wide of a variety of environments. Thus, no species is freer from "genetic determinism."

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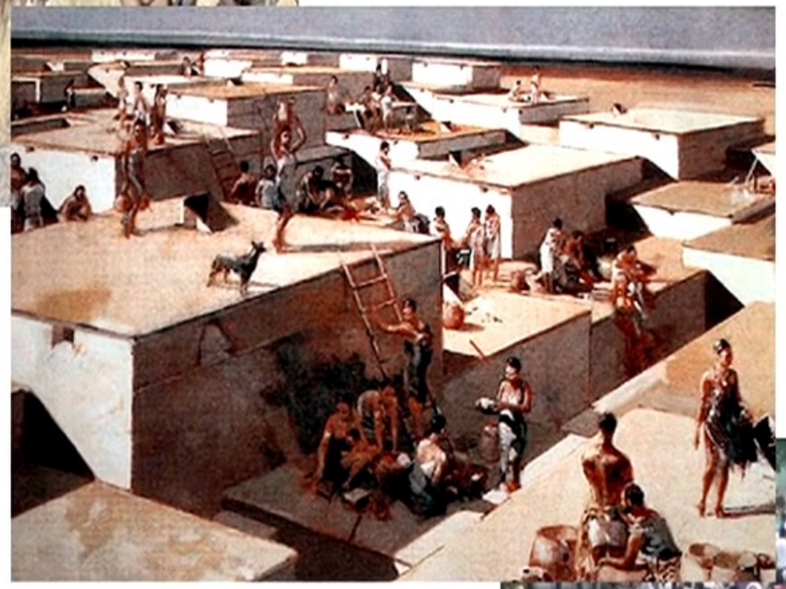
Desert dwellers
Monotheistic
Belief in an afterlife
Top-down hierarchical
Warrior age-classes

Rainforest dwellers
Polytheistic
No afterlife
Egalitarian
No such classes

Stable hunter-gatherer bands



Megalopolis

Indifferent gods

Moralizing gods

Indifferent gods
Moralizing gods

How easy is it for people to steal all your wealth?

<u>Pastoralist cultures of honor:</u>

High rates of retributive violence

Endocrine hyper-reactivity to challenge

Clan-based feuds and vendettas

Warrior classes

Honor killings

Thus:

Different types of ecosystems….produce different ways of making a living…systematically producing radically different cultures

Within seconds of birth, culture shapes everything from what we view as the purpose of life, whether we are intrinsically beautiful or sinful, what happens after we die….to where our eyes track over the course of milliseconds

Brains, genes and cultures co-evolve

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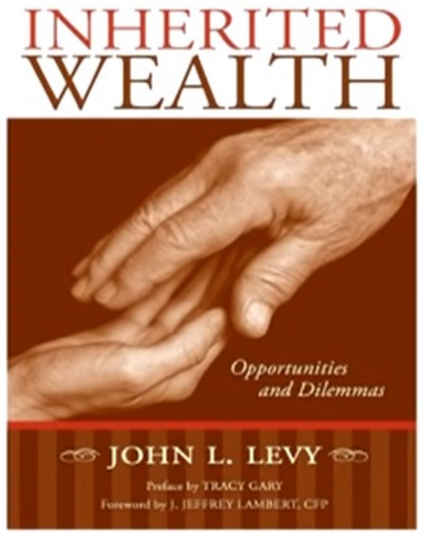
Individual
Selection



Kin
Selection

Reciprocal
Altruism

Individual selection?

Kin selection?

Reciprocal altruism?

<u>Thus</u>:
The evolution of behavior is built around individual selection, kin selection, and reciprocal altruism (plus something called "neo-group selection," that we're going to ignore…)

All of which explains a ton about human social behavior…

…as long as you don't look too closely

Will he pull the trigger?

What's the level of activity in his amygdala?

Was there a bad smell at the time?

What were his testosterone levels?

Had his amygdala expanded because of trauma the previous months?

How much frontal cortical maturation was there during his adolescence?

What were prenatal stress hormone levels?

What variant of the MAO-alpha gene does he have?

Was he raised in a culture of honor?

Is his species prone towards highly sexually dimorphic behavior?