Animal Behavior

What is a behavior?

Know hypotheses that try to explain it

Proximate vs ultimate causes

Fixed-action patterns
- What they are
- How they work

Some bad ideas in history of ethology (behaviorism)

- Nature vs Nurture

  Genes are everything … Environment is everything

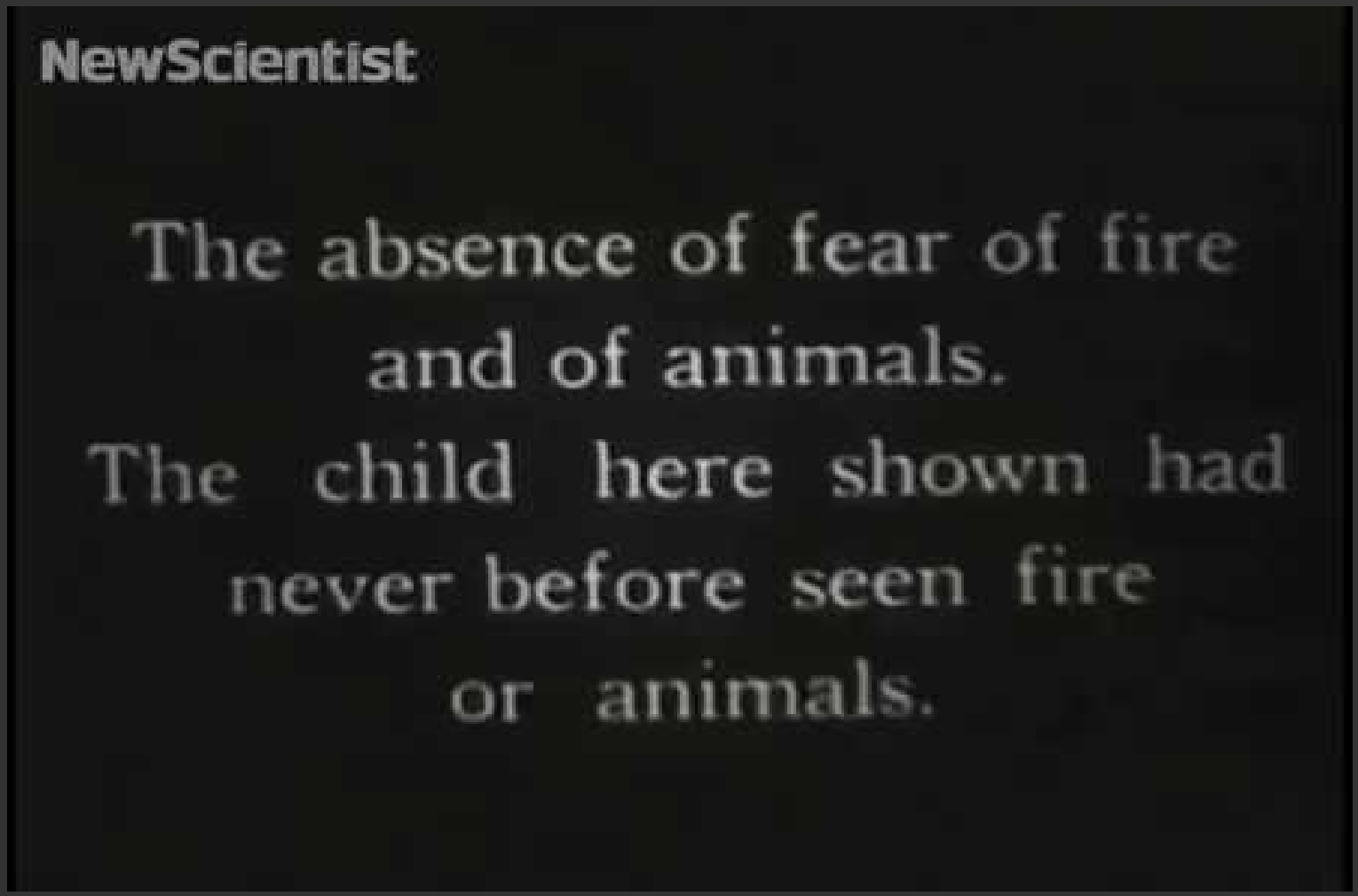
- Reinforcement theory

  Positive/Negative reinforcement is all that shapes behavior

- Universality

  Works the same in every species

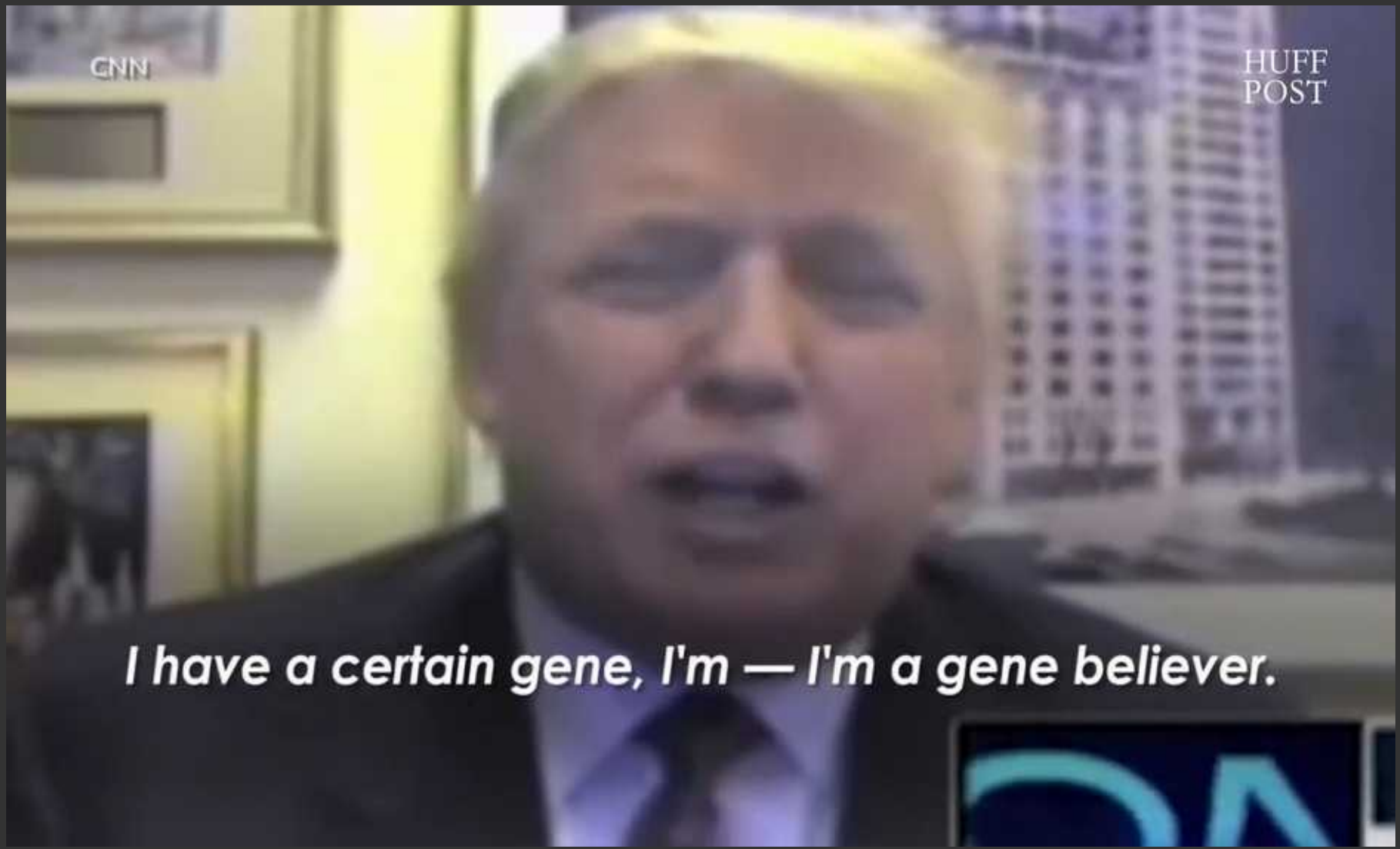
Nature vs Nurture



“Genes don’t matter!”

John Watson – Johns Hopkins University

Nature vs Nurture



“Genes are all that matter!”

Reinforcement theory

Ethology = study of animal behavior

Unattached to the archetypes of behaviorism

Animal behavior is based on physiological systems and processes.

*A **behavior** is the nervous system's response to a stimulus and is carried out by the muscular or the hormonal system*.

How and Why?

Proximate causation, or “how” explanations, focus on

Environmental stimuli that trigger a behavior

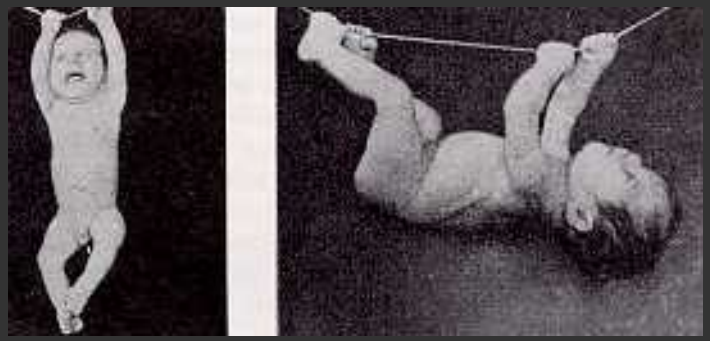
Genetic, physiological, and anatomical mechanisms underlying a behavior.

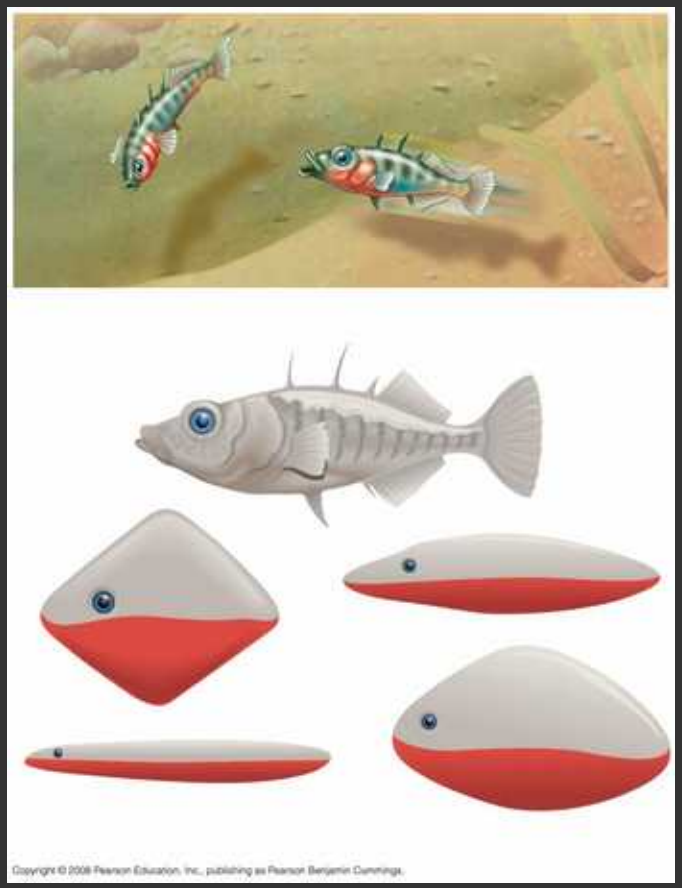
Ultimate causation, or “why” explanations, focus on

Evolutionary significance of a behavior.

Fixed-action patterns

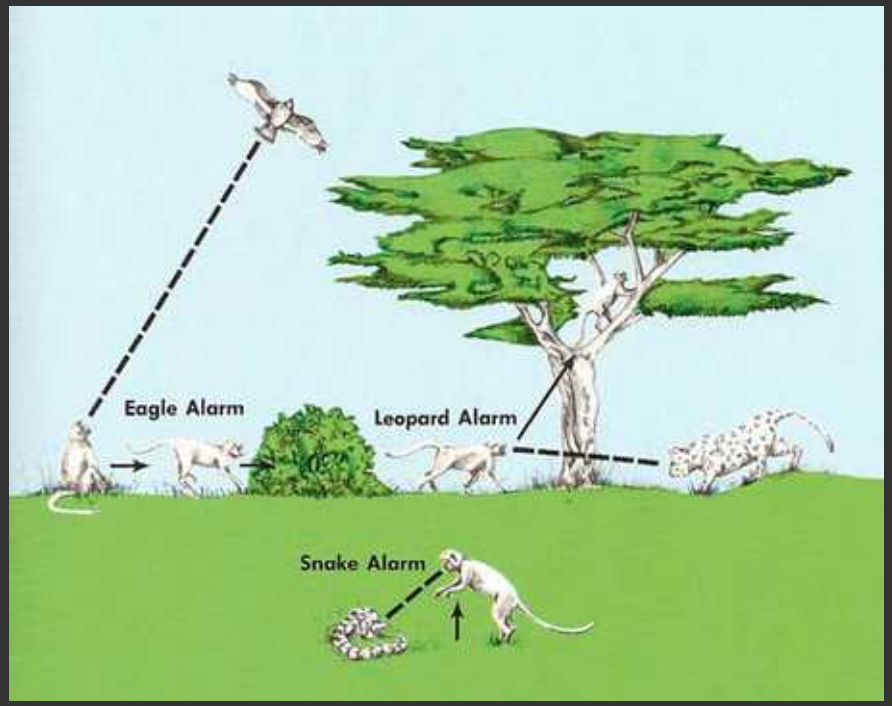
A **fixed action pattern** is a sequence of unlearned, innate behaviors that is unchangeable.

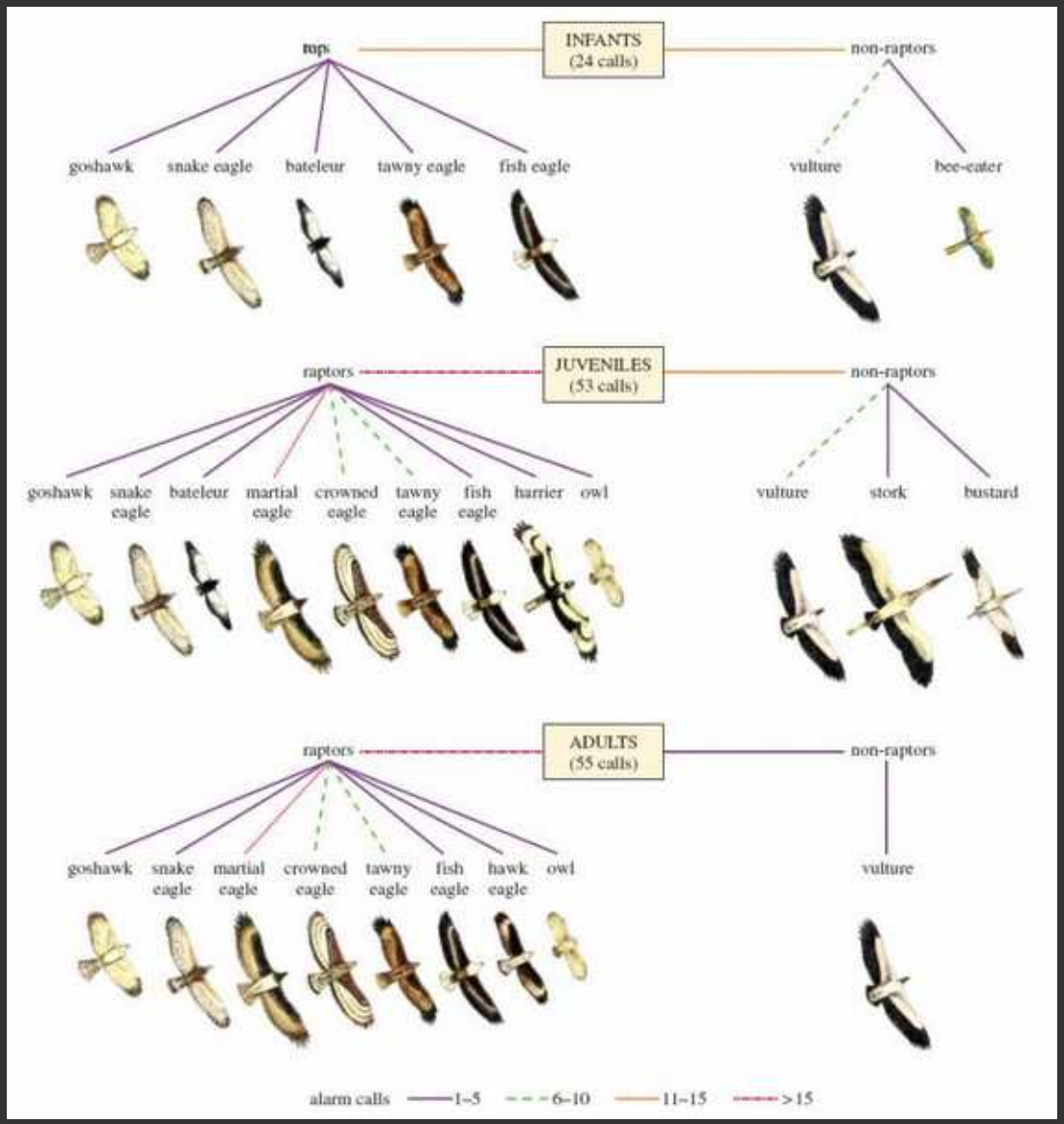




Interconnected neurons and muscle tissue
Does <u>not</u> have to be learned
<u>Does</u> have to be improved

Relatively tractable behavior…
Not what people used to call "instinct"
Shaped by experience

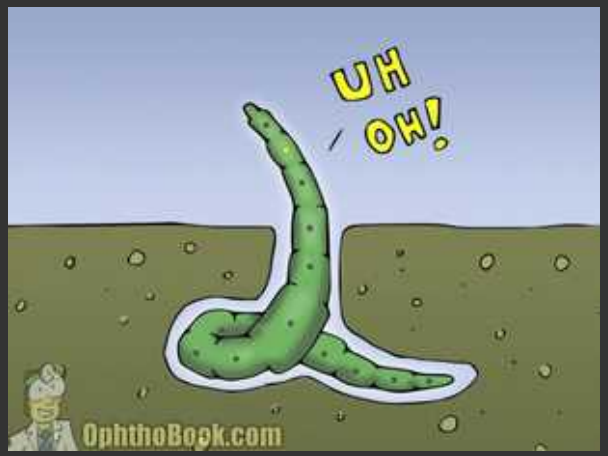


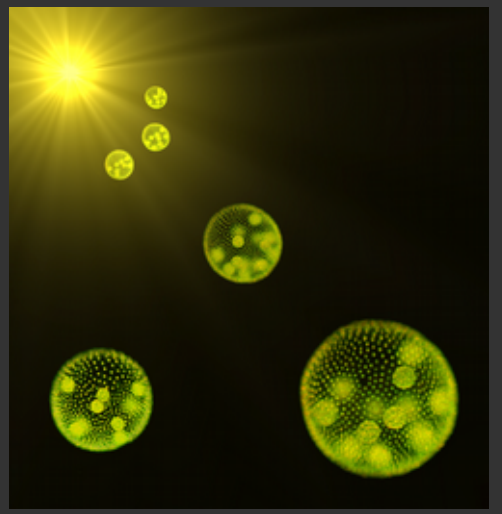


Fixed action patterns are shaped by experience

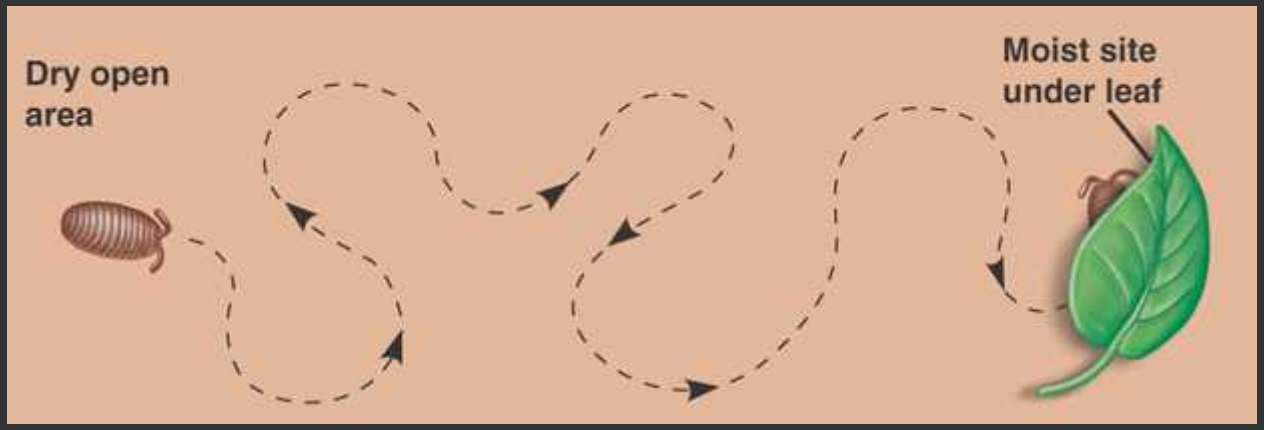
Directional movement (taxis)

Toward or away from a stimulus





Kinesis (non-directional change)



Increase or decrease in random movement in response to stimuli

Kinesis or taxis?

Migration

Regular, long-distance change in location

Animals can orient themselves using

- The position of the sun and their circadian clock
- The position of the North Star
- The Earth’s magnetic field
- And other ways

Innate vs Learned Behaviors

Learning

Habituation

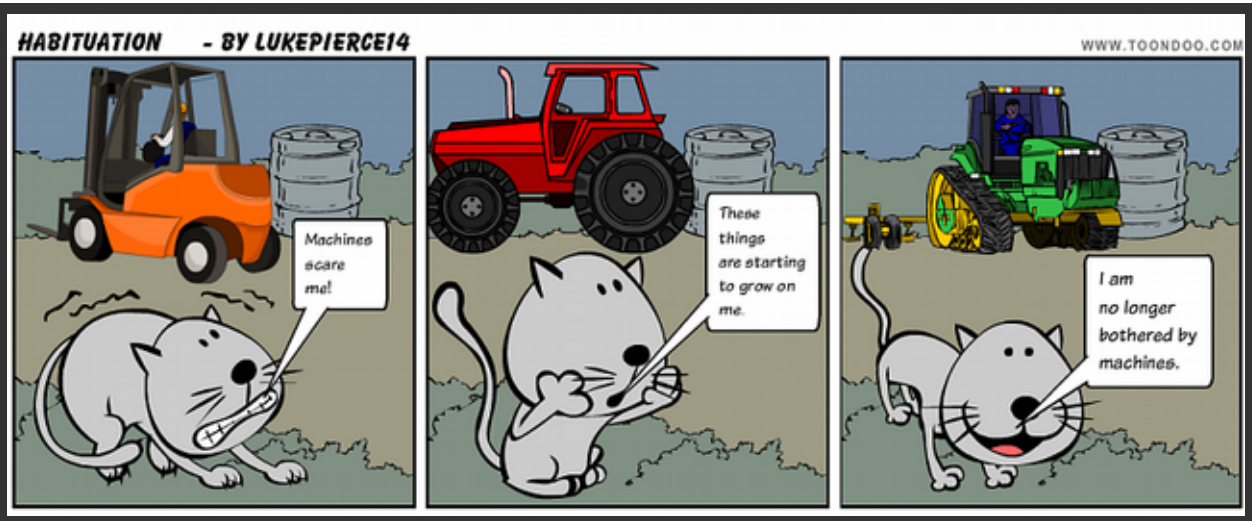
Imprinting

Spatial learning

Associative learning

- Classical conditioning
- Operant conditioning
- Cognition

Habituation



Loss of responsiveness to stimuli that convey little or no information

Imprinting

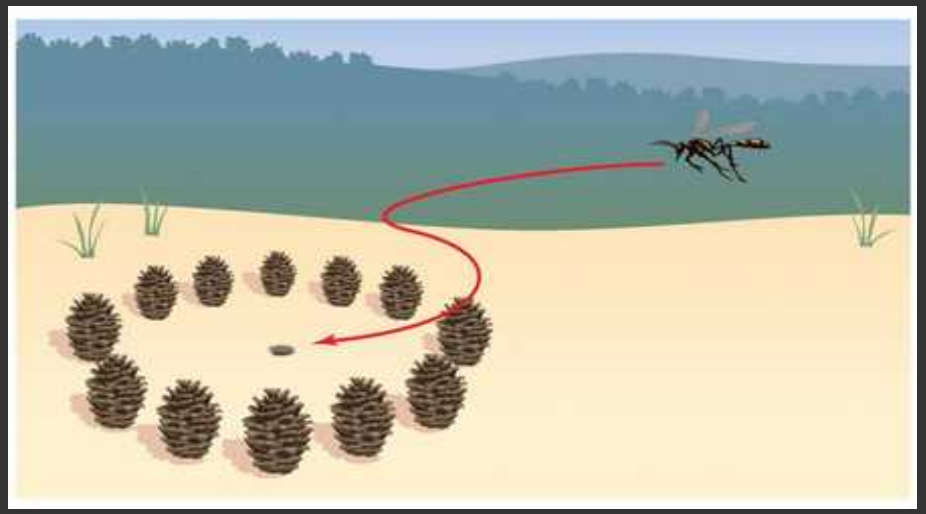
Konrad Lorenz = Good ethologist and evil Nazi scum

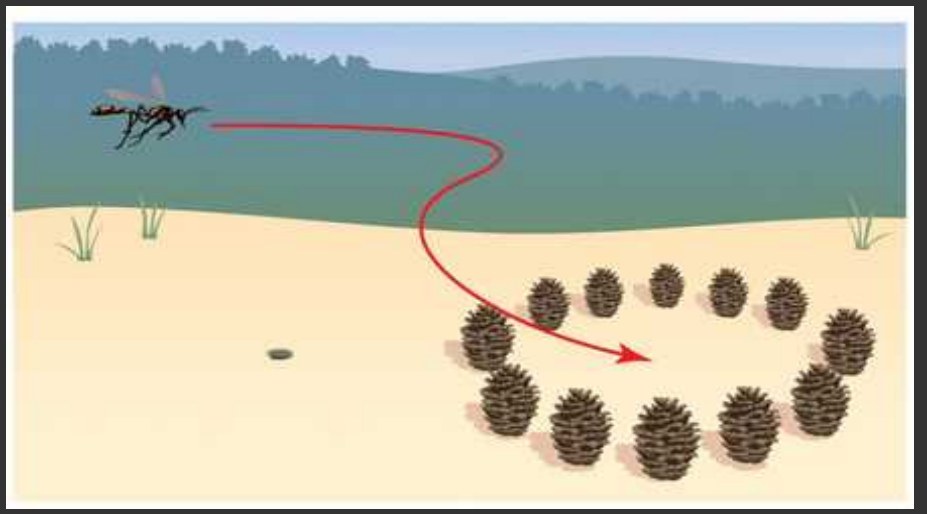
A behavior that includes a specific critical period learning and innate components and is generally irreversible.

It is distinguished from other learning by a limited developmental phase that is the only time when certain behaviors can be learned.

Spatial learning

A more complex modification of behavior based on experience with the spatial structure of the environment.

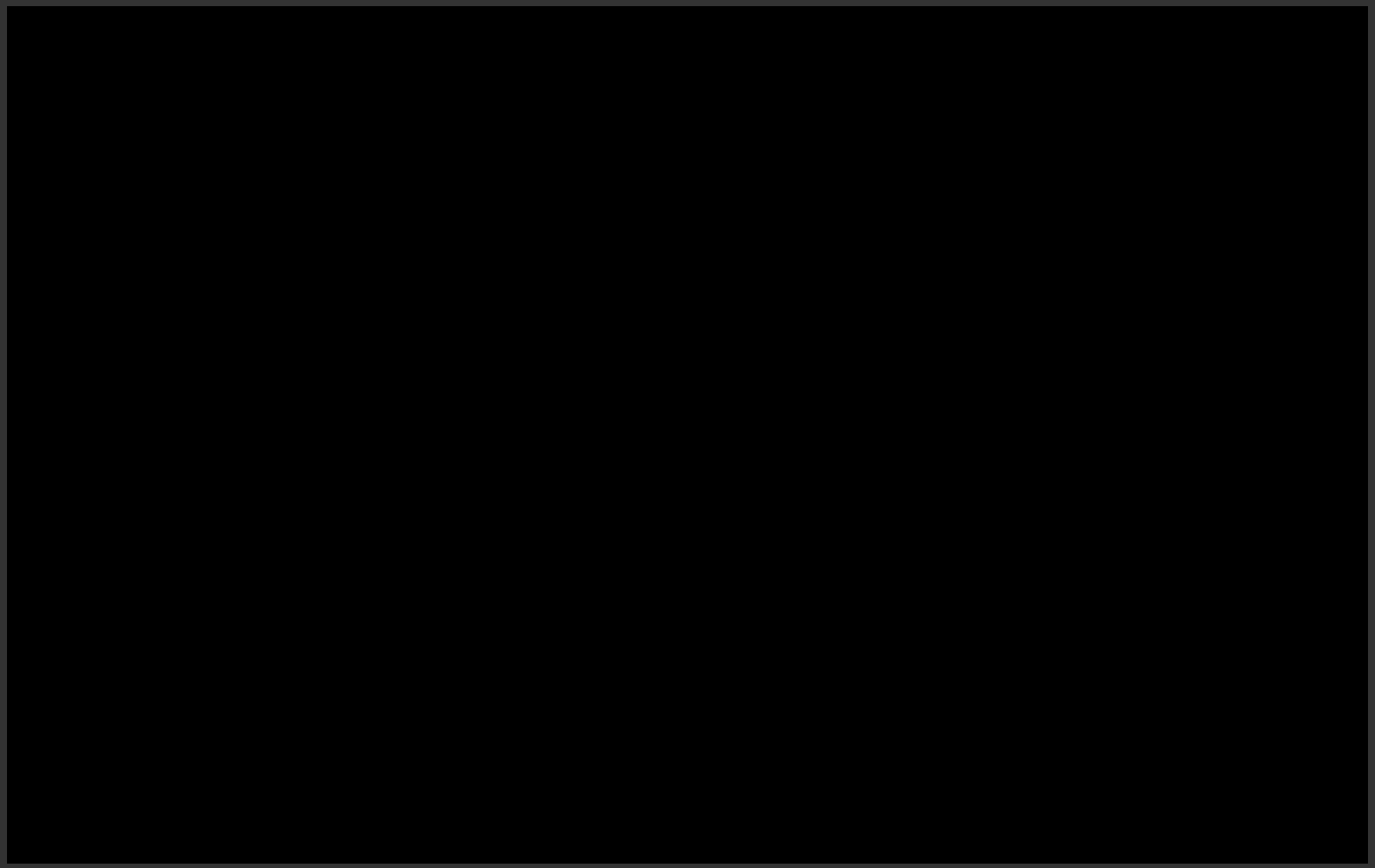




A **cognitive map** is an internal representation of spatial relationships between objects in an animal's surroundings often using particular landmarks.

Associative learning:

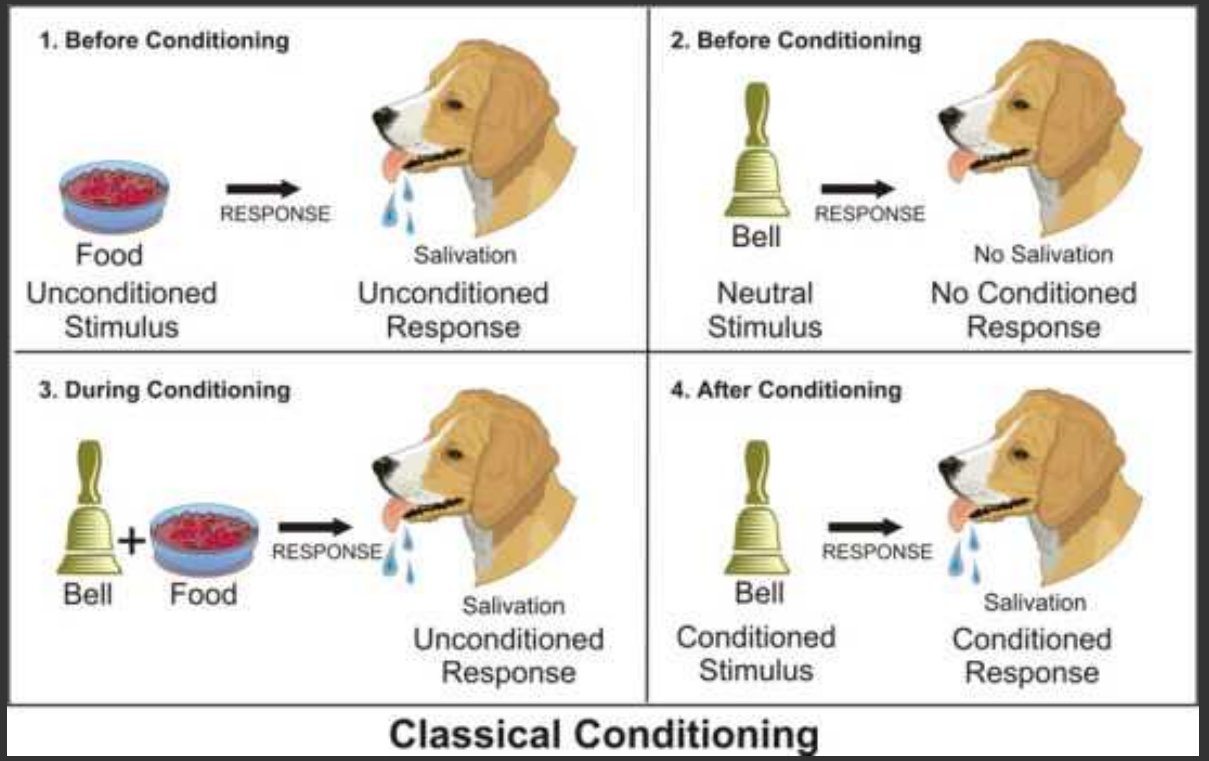
Associating one feature of environment with another



Classical conditioning: associating arbitrary stimulus with punishment or reward

Associative learning:

Associating one feature of environment with another



Classical conditioning: associating arbitrary stimulus with punishment or reward

Associative learning:

Associating one feature of environment with another

Operant conditioning: associating a behavior with punishment or reward

Associative learning:

Associating one feature of environment with another

Operant conditioning: associating a behavior with punishment or reward

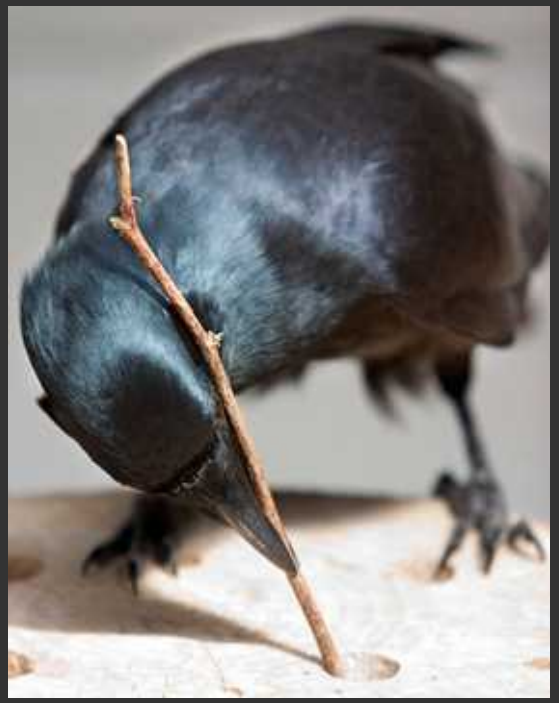
Superstition?

Associative learning:

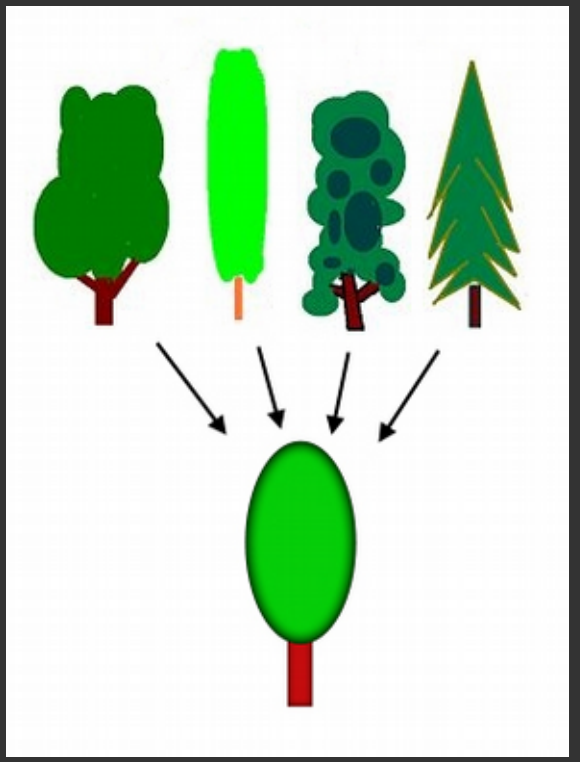
Associating one feature of environment with another

Cognition is a process of knowing that may include awareness, reasoning, recollection, and judgment.

Cognition



Problem solving



Generalization = abstract cognition

Cognition

Genetic basis for behavior

Single “master regulatory genes” can control a behavior

More often, multiple genes contribute to complex behaviors

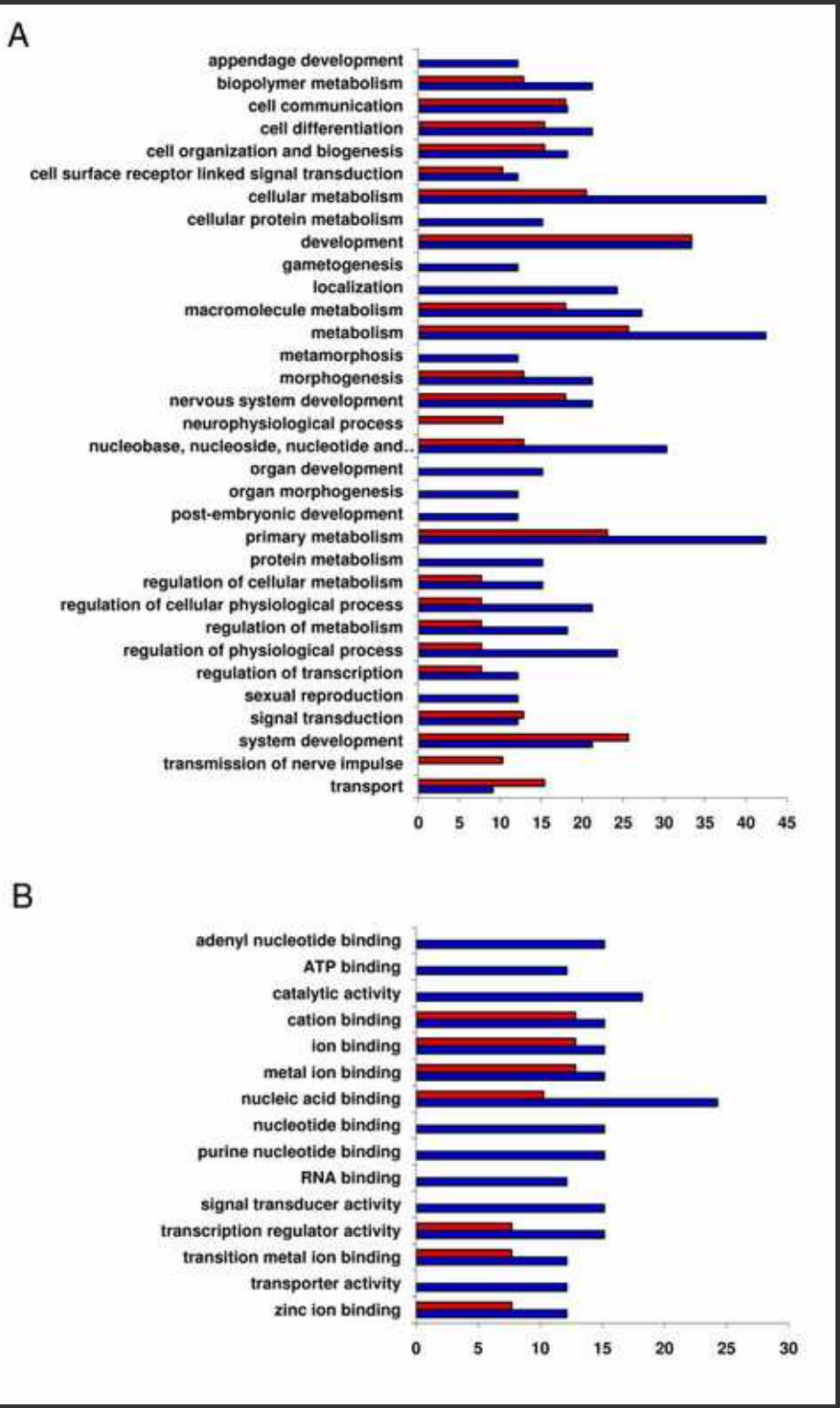
Gene variants for behavior are selected by natural and/or sexual selection
… just like other phenotypic traits

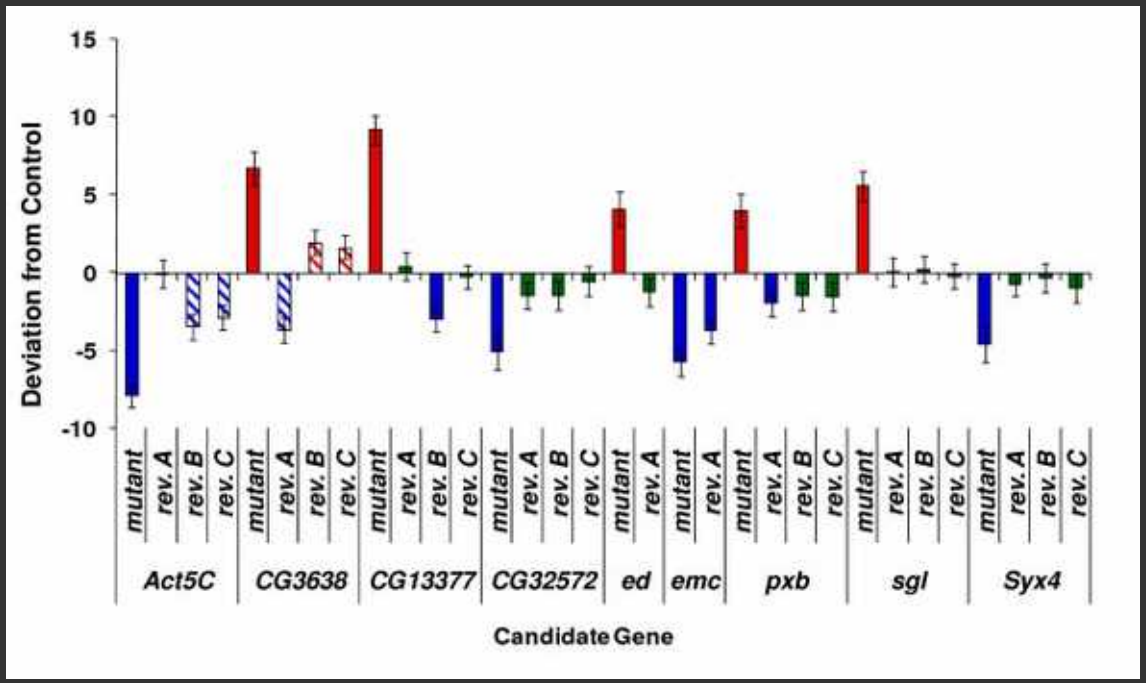
Behaviors influence fitness

“Nature vs nurture? No. Nature *via* nurture.”

Genes that influence behavior are highly complex and inter-related.

Genes that influence fruit fly aggression:

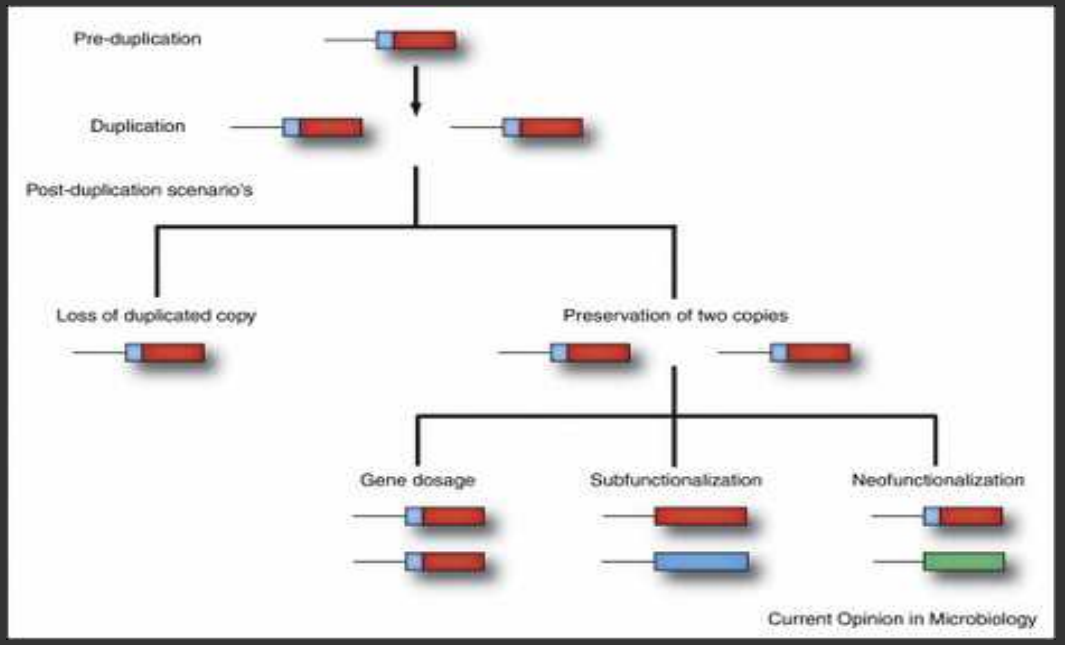




Natural selection carves away at the gene pool of each species to make it fit what the environment requires

In a way, the gene pool of a camel, for example, is a kind of description of ancestral deserts

Mostly all the genes in a gene pool of a species share the same “experience”



This applies to genes that control behavior as well…

But what if we could find a place where some genes have a different historical “experience” than others?

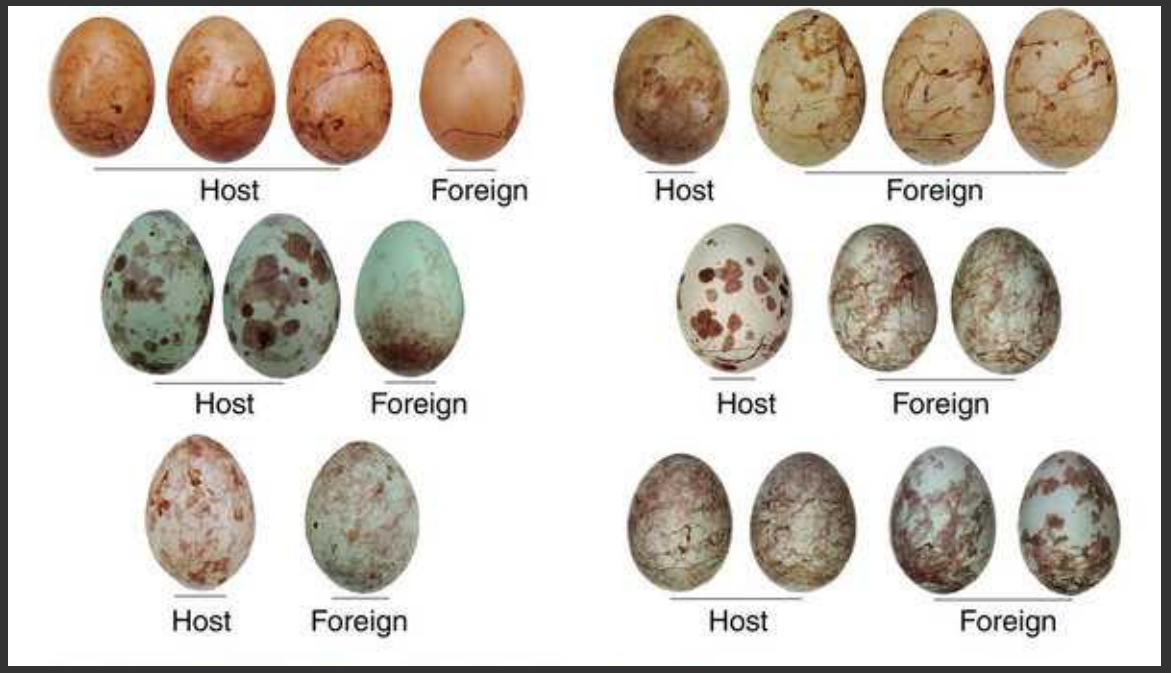
Common Cuckoo

Nest parasite of a great number of other birds

Fixed-action patterns explain these behaviors

When a female cuckoo lays an egg in a host nest, her egg mimics the eggs of the host species.

But how can this happen?! How can one species (Cuckoo) lay different colored eggs depending on the host nest it lays them in?

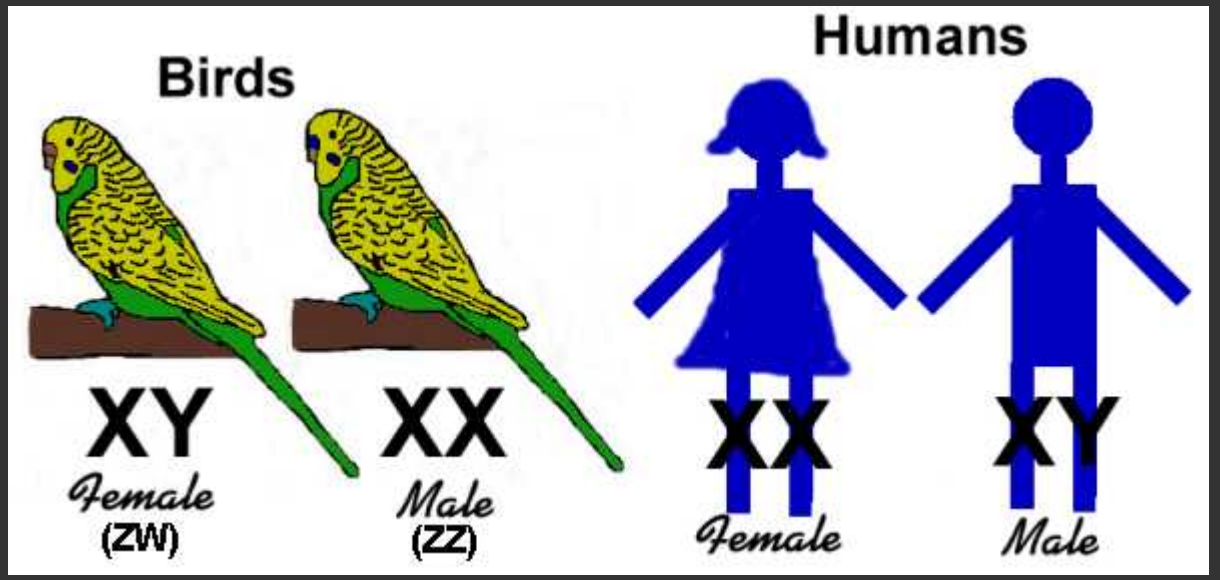


Each female cuckoo learns the nature of the nest in which she was born

(Imprinting)

If she was born in a Meadow Pippit nest, she will return to one to lay her own eggs

There is a stretch of the gene pool which has only ever experienced female bodies (in birds)

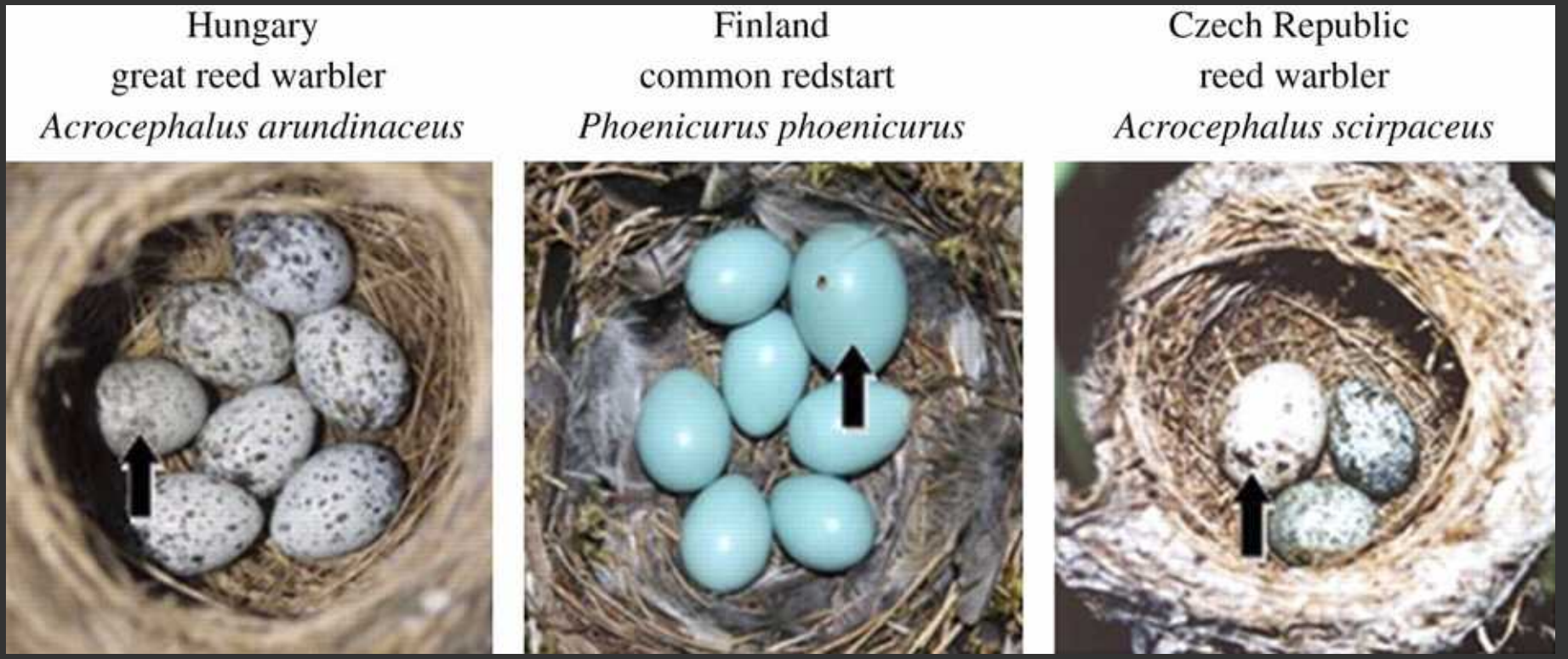


A “robin” cuckoo’s Y-chromosome can look back on a long history of nothing but robin nests

A “crow” cuckoo’s Y-chromosome can look back on a long history of nothing but crow nests

All the other genes in the genome can look back on a mixed history of many different nests

So the whole thing is explained on the hypothesis that egg-coloration genes are carried on the Y-chromosome



Sometimes a female makes a mistake in choosing a nest to parasitize

Evolutionary arms race between cuckoo’s Y-chromosome and behavioral genes in host birds

Meadow Pippit nest with Cuckoo egg

Robin nest with Cuckoo egg

Behavioral ecology

Ecological and evolutionary basis for, and consequences of, behavior