

The Evolution of Sentience and its relevance to Ethics

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- What is Sentience?
- Why does sentience matter?
- How does sentience arise?
- What we know about the Mind
- Theories of ethics
- An invented morality
- Quantitative measures
- Sentience in detail
- Ex 1: Euthanasia and end of life
- Ex 2: The fetus and abortion
- Ex 3: Animal welfare
- What evolution tells us

What is sentience?

Sentience

Synonyms:

Consciousness

Cognition

Intelligence

Alertness

Attention

Understanding

Sentience

What we mean here:

Capacity for *pleasure* and *pain*

Pleasure includes happiness,
wellbeing, comfort, gratification,
satisfaction etc

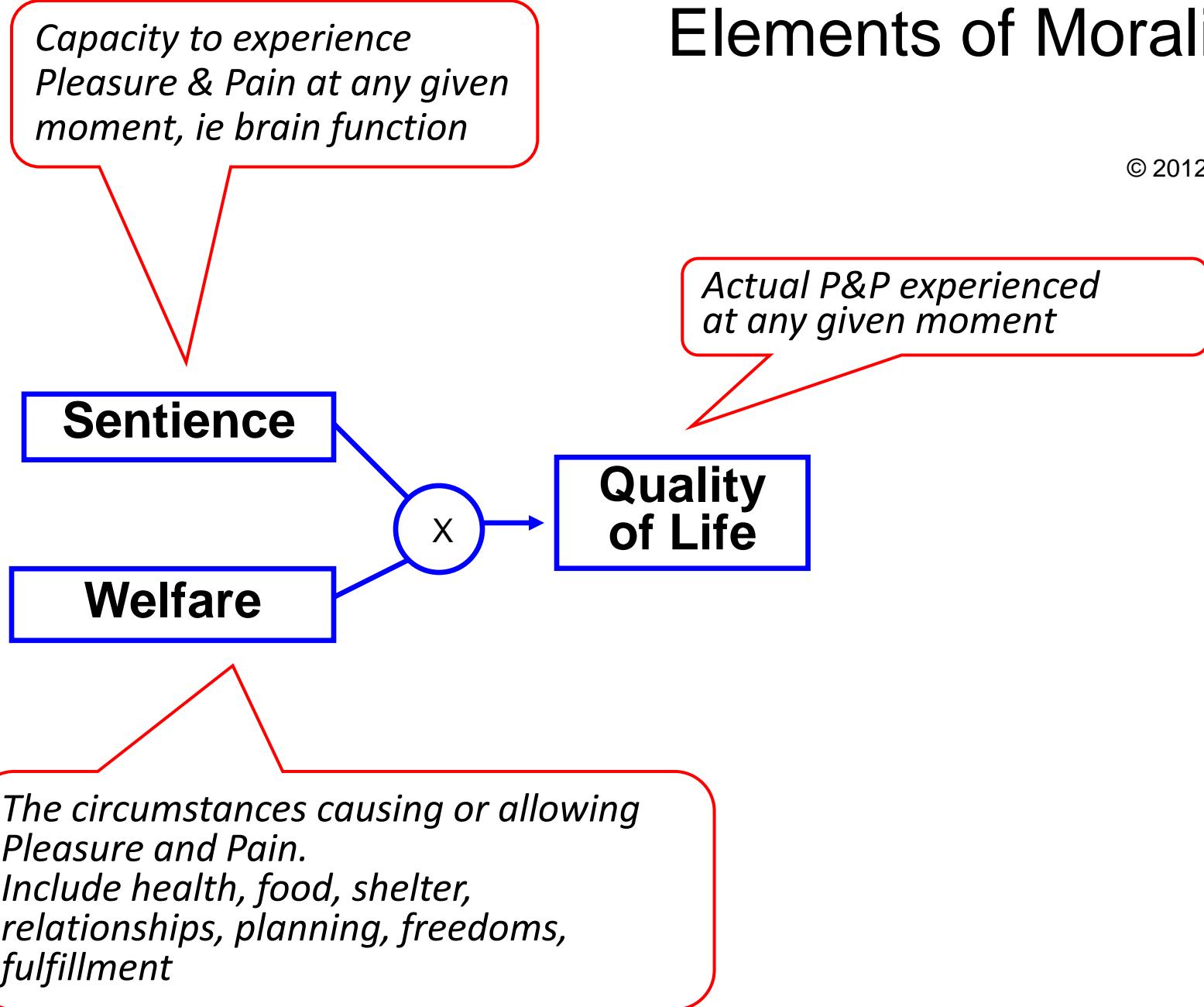
Pain includes, distress, worry,
sickness etc

Why do we care about sentience?

Sentience is central to any study of ethics

Elements of Morality

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“Welfare of sentient beings”



Welfare

Food
Family
Friends
shelter



Sentience

Brain function

health

Combine to
give
Quality of Life

It is the aim of Humanism to increase human welfare.

- In this life - the only one we get.
- Animals too – all sentient beings.

We aim to provide circumstances which foster this, including:

- physical environment,
- freedoms,
- education,
- equality
- ability to plan for the future
- etc.

How do we learn
about sentience?

How do we learn about sentience?

- A: Observing behaviour
- B: Correlation with brain structure
- C: Studying evolution.

Science unifies all this data into a unified system of knowledge.

This enables us to assess sentience:

- Qualitatively, eg creature A > creature B
- Quantitatively, eg creature A = 0.7

What evolution tells us about sentience

Why did sentience evolve?

Like all characteristics: Survival value!

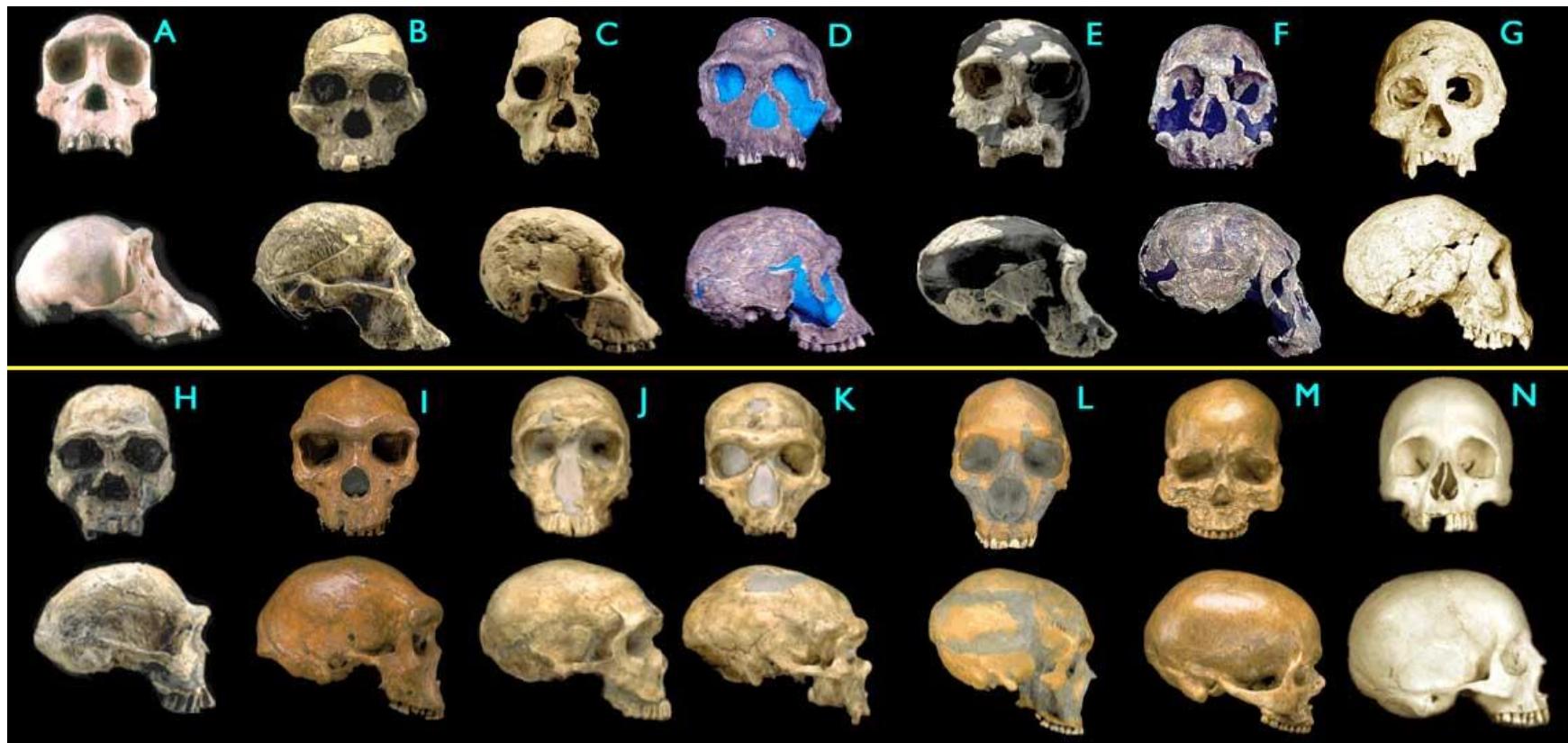
Creatures with greater sentience, were more able to analyse their environment.

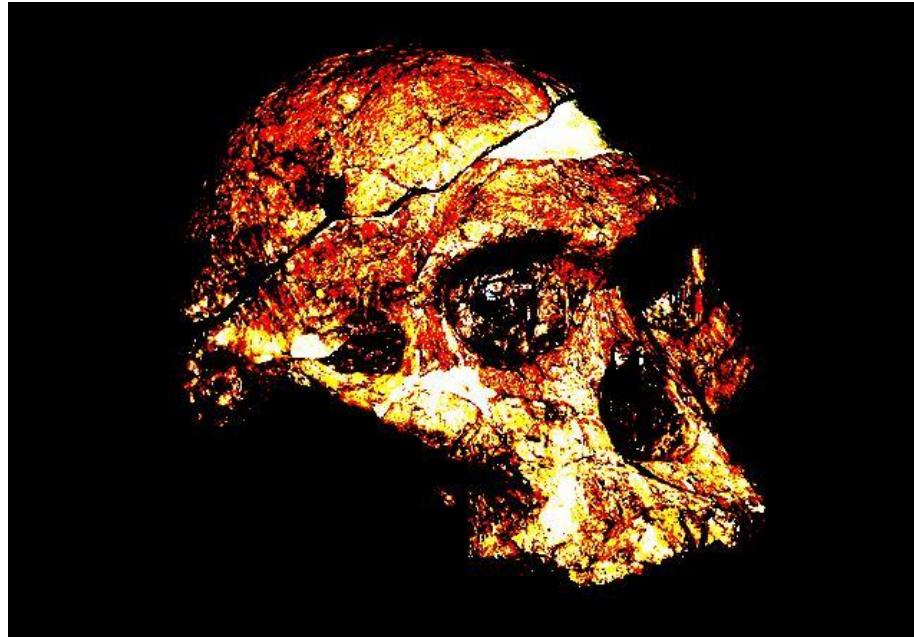
Pleasure provides motivation for beneficial activities, eg eating, mating, raising young

Pain provides motivation for avoiding harmful things, eg falling, getting hurt, getting eaten.

Darwin knew this in *Origin of Species*

Where does sentience reside?





- The record of fossil skulls shows that nature invested a lot in providing brains
- All sentient creatures possess a brain.
- No sign at all of a mind without a brain (in nature).
- ALL MINDS REQUIRE BRAINS!

Sentience through the evolutionary chain

We can roughly estimate the sentience of our ancestors through:

- behaviour revealed by archeology
- Brain size and features from fossils.

This enables us to estimate a scale:

- Mammals 0.2
- Primates
- Monkeys
- *Homo habilis* 0.5
- *Homo erectus*
- *Australopithecus*
- Recently extinct homo sapiens (neanderthal, Flores "hobbit")
- Current humans 1.0

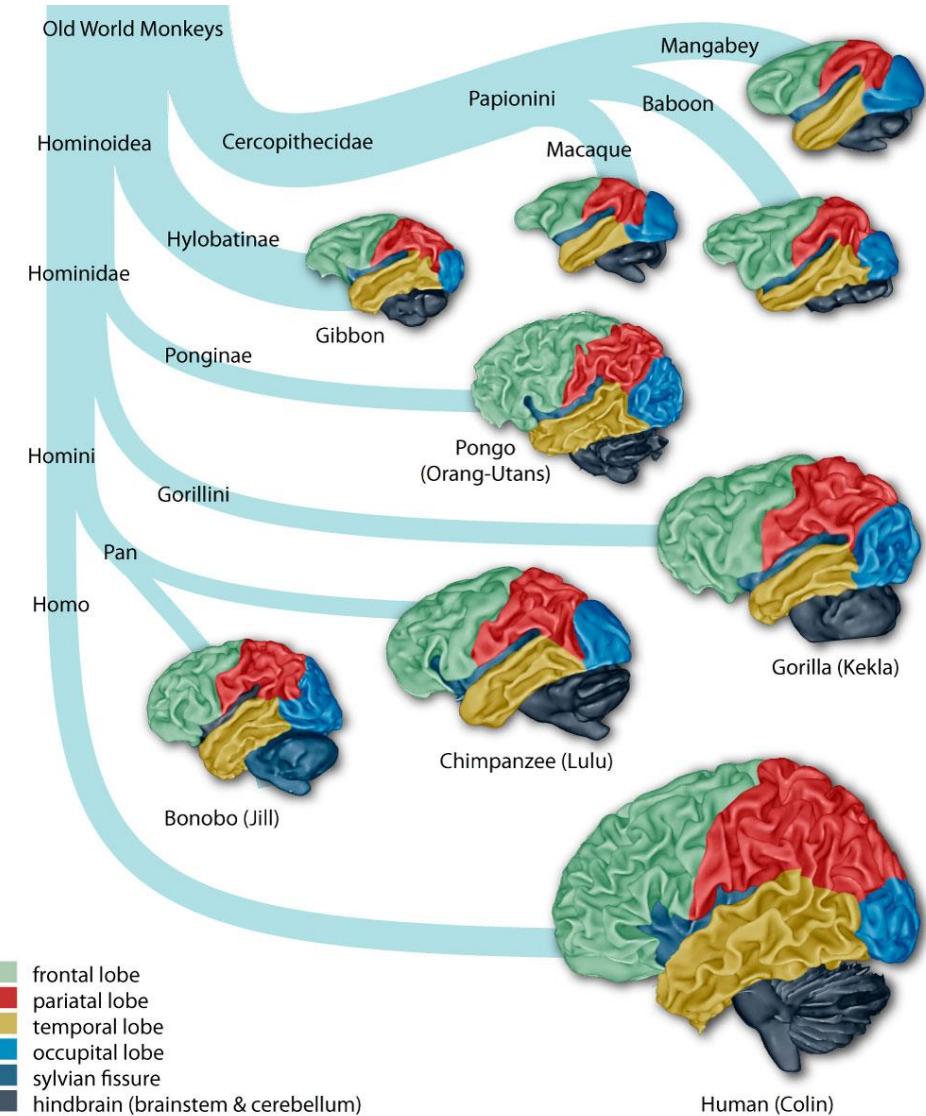


Fig. HE: Visualization of evolution of brains in primates based on the inner surface. The lobes, the sylvian fissure and the hindbrain (brainstem and cerebellum) are colorized for better orientation.

SKIP THE FOLLOWING



What we know about the Mind

What does physics tell us about the mind?

Ref: Fundamental Physics and the Big
Questions of Philosophy – I Bryce

What has science told us about the brain?



Physics has shown
that the brain
obeys
the Law of
Conservation of
Mass

If you buy a lamb's
brain from the
butcher...



What has science told us about the brain?

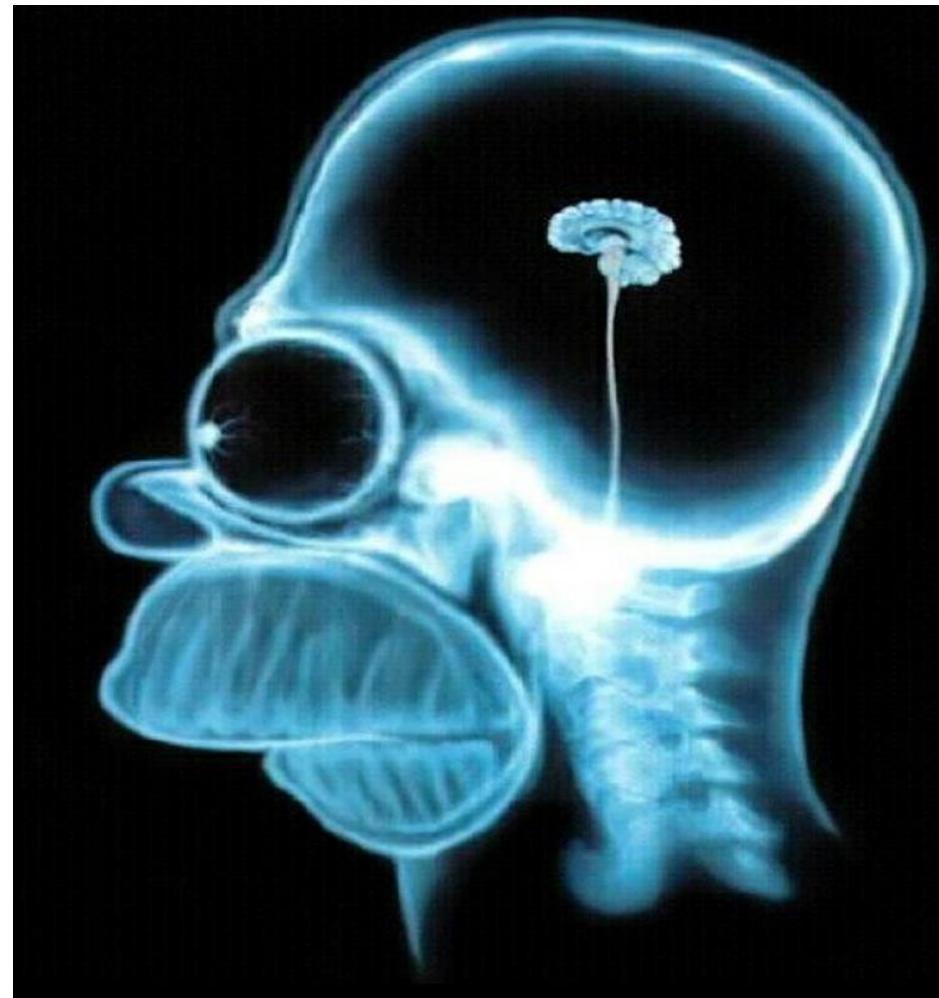


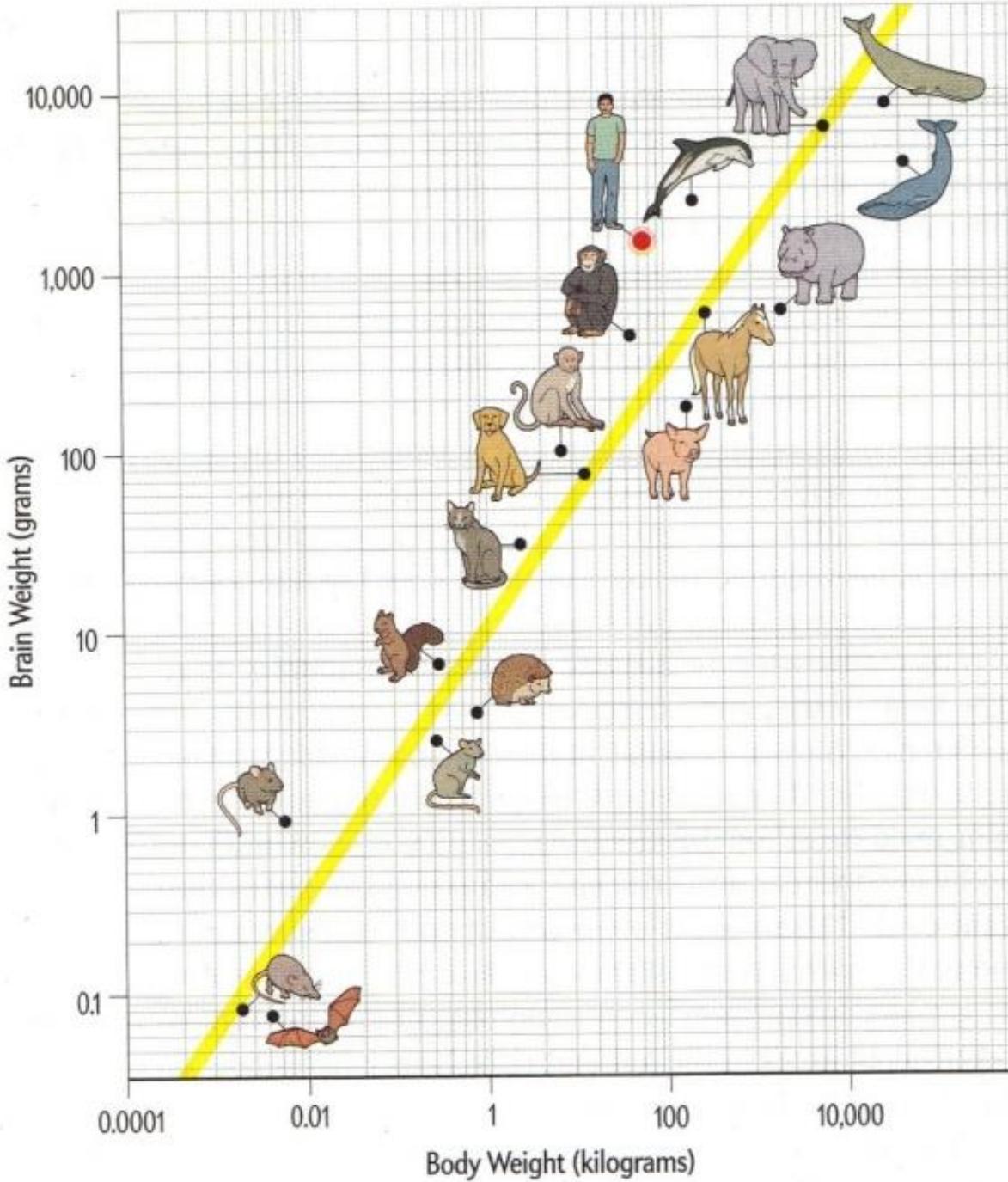
Physics has shown that the brain obeys
the Laws of Motion

What has science told us about the Brain?

Science has shown
that the brain has
capabilities in
proportion to its
size!

X-ray of Homer Simpson

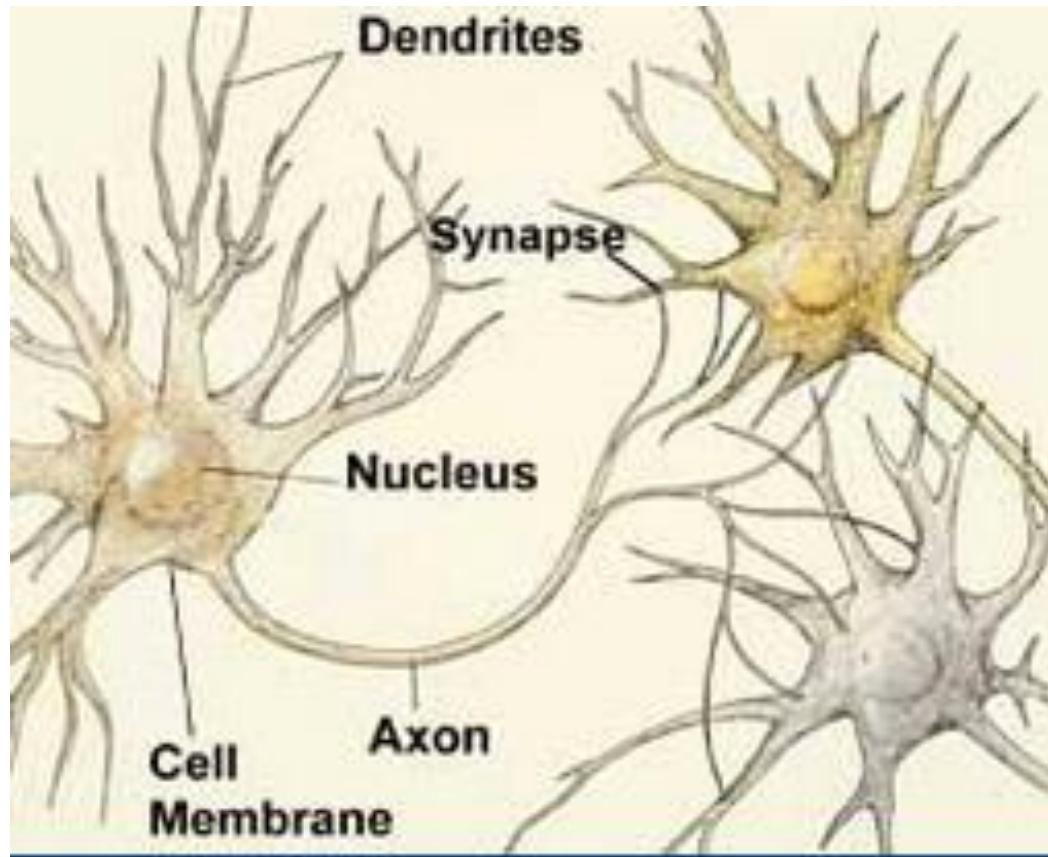




Brain mass
(corrected for
body mass)
correlates well
with
intelligence

What has science told us about the Brain?

The
electrochemistry
is largely
understood... at
a fundamental
level



What has science told us about the Brain?

- THUS the brain obeys ALL the laws of physics
- Its operation is based on the four forces of nature.

What has science told us about the Mind?

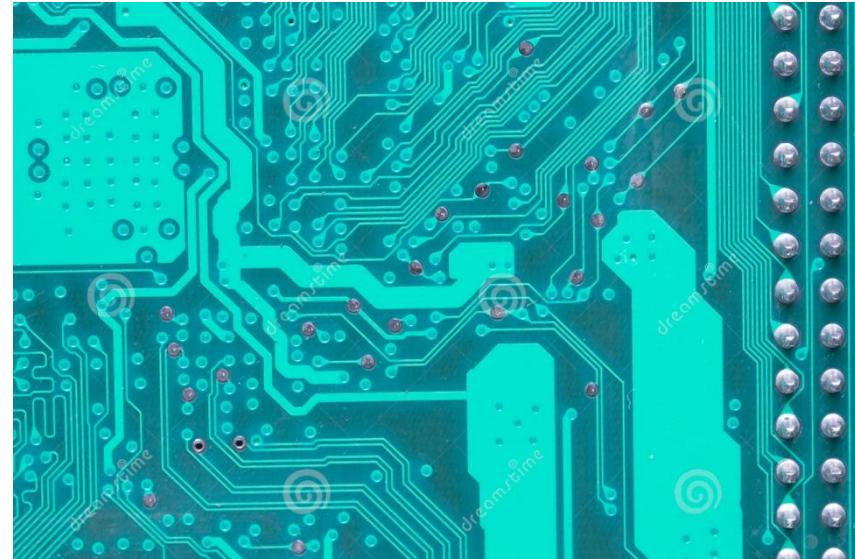
The mind is what the brain does.

Your computer runs an
Operation system

eg Windows 7.0

Which supports **Applications**

- Word, Excel, Google, printer,
Skype etc.

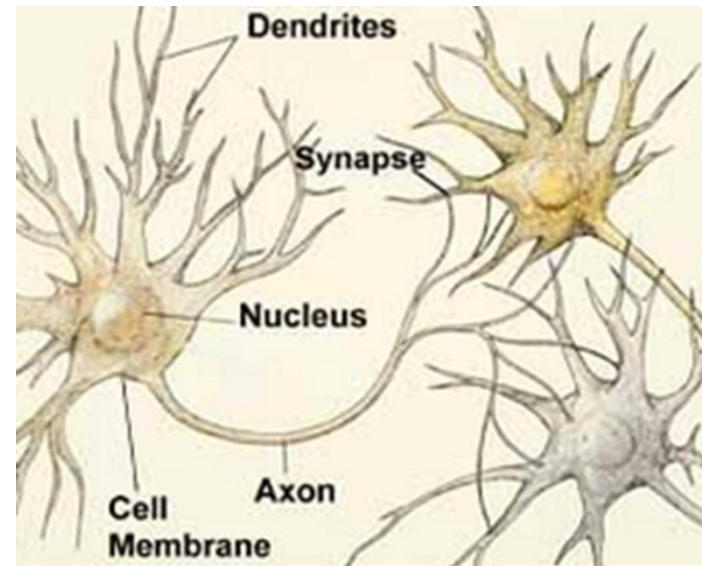


Your brain runs an Operating
System

Ie – **Mind 2.0**

Which supports Applications -

- thinking, tennis, eating,
dating etc



- What happens if your brain is starved of oxygen?
 - Or of energy (ATP)?
 - You faint!
-
- ALL MINDS DEPEND TOTALLY ON A PHYSICAL LIFE SUPPORT SYSTEM



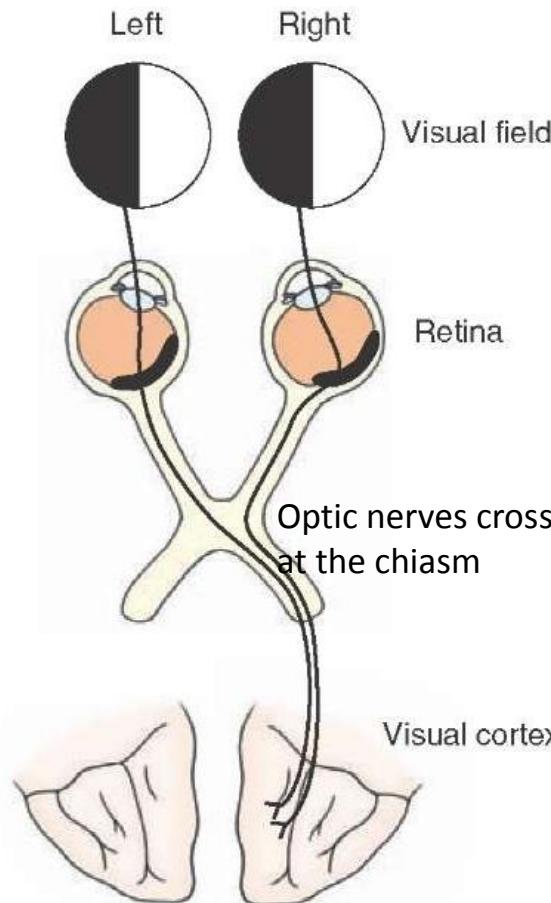
- What happens if your brain is infused with alcohol?
- - Your Honour, I might have been over the 0.05% limit, but my mind is separate and was not affected.



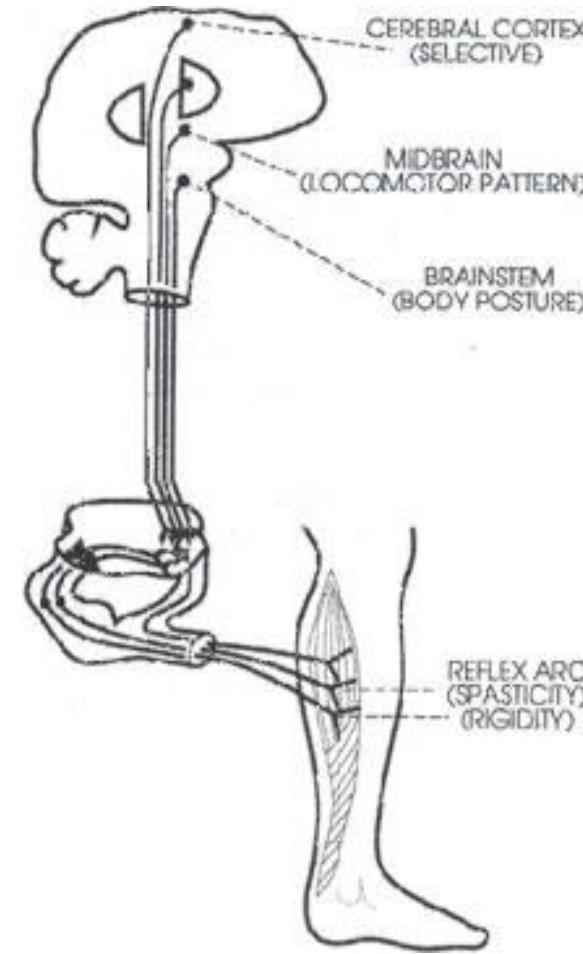
- ALL MINDS ARE AT THE MERCY OF CHEMICALS!

How does the mind interface with the world?

Inputs: senses

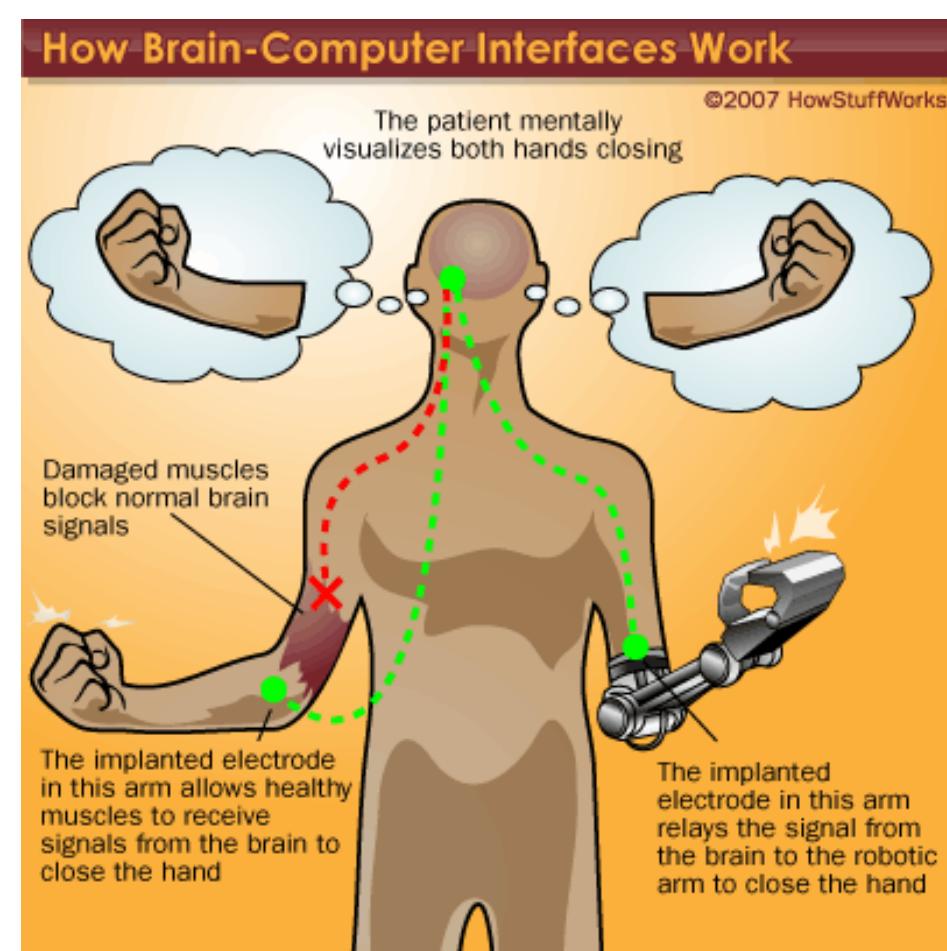
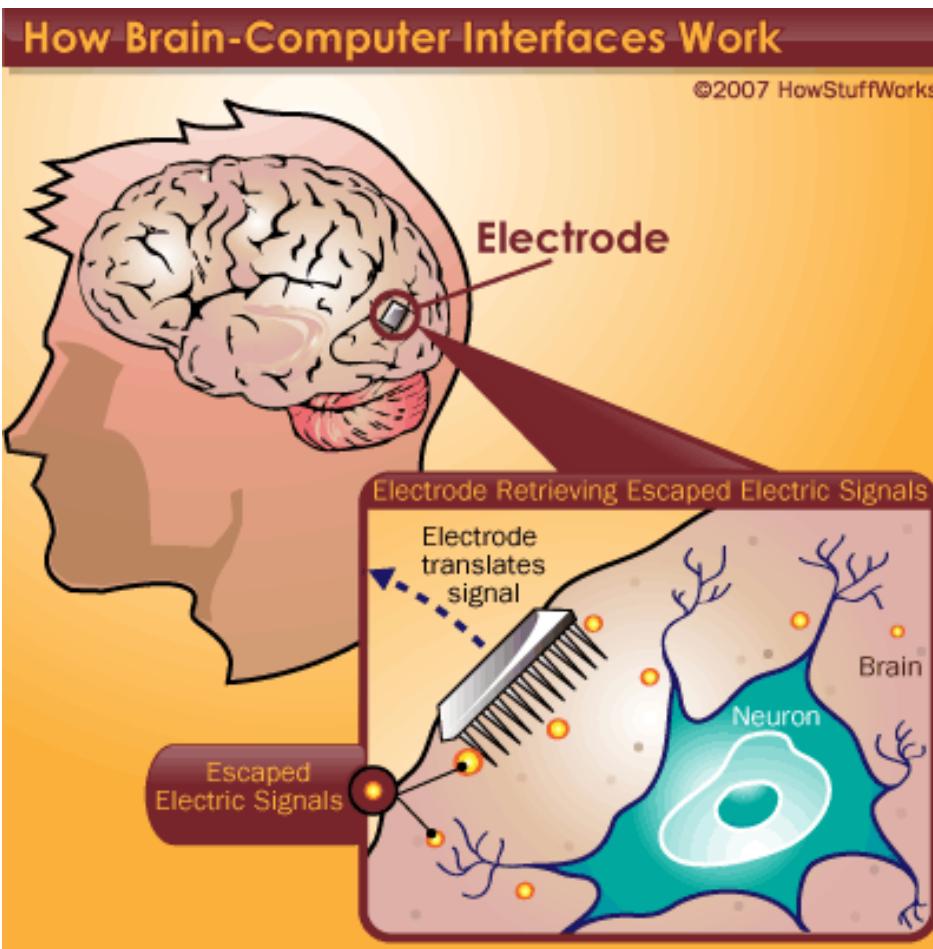


Outputs: Motor functions



How does the mind interface with the world?

The inputs and outputs can be reproduced by science



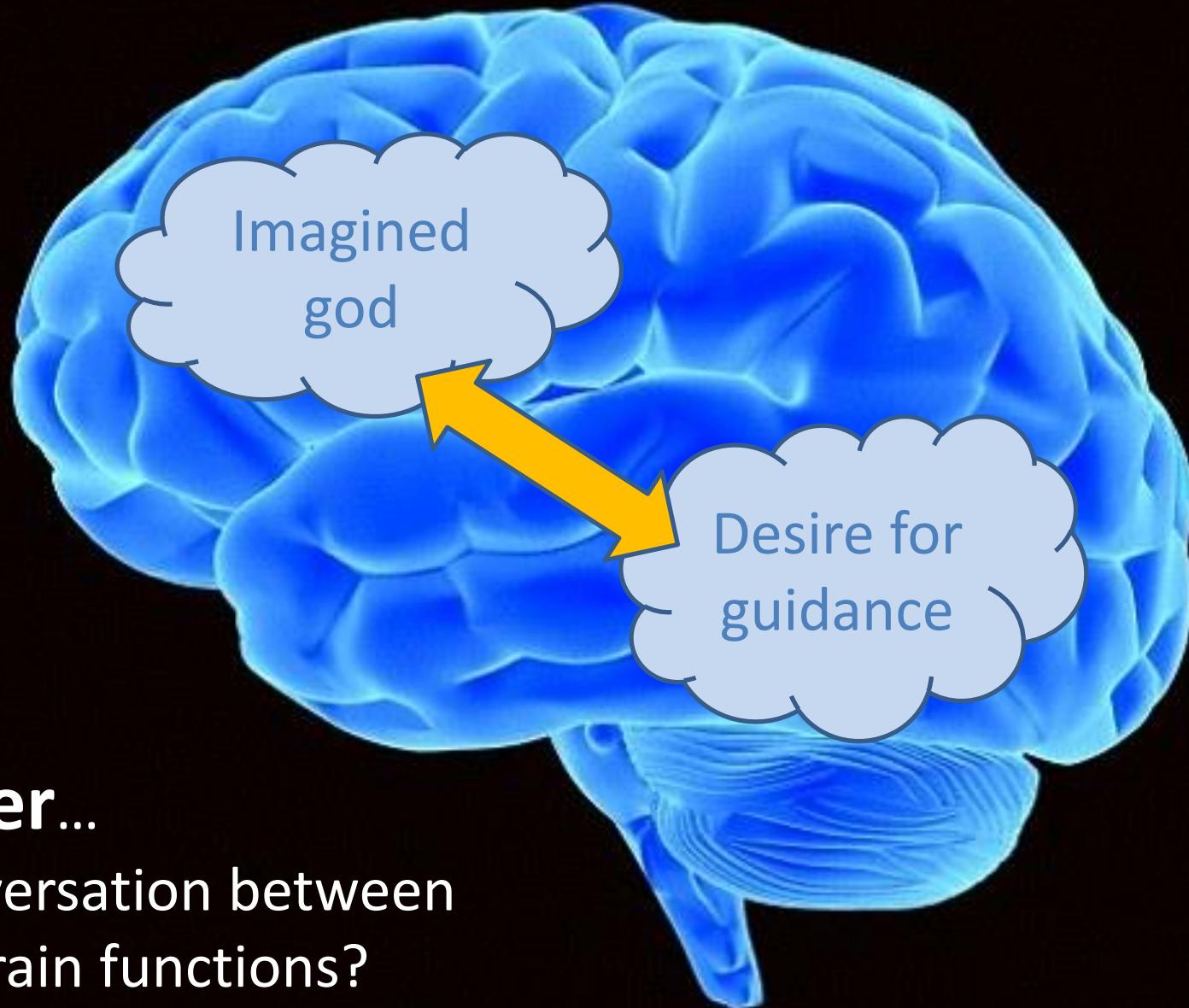
Could there be mental processes not yet understood?

At high levels of complexity: Of course

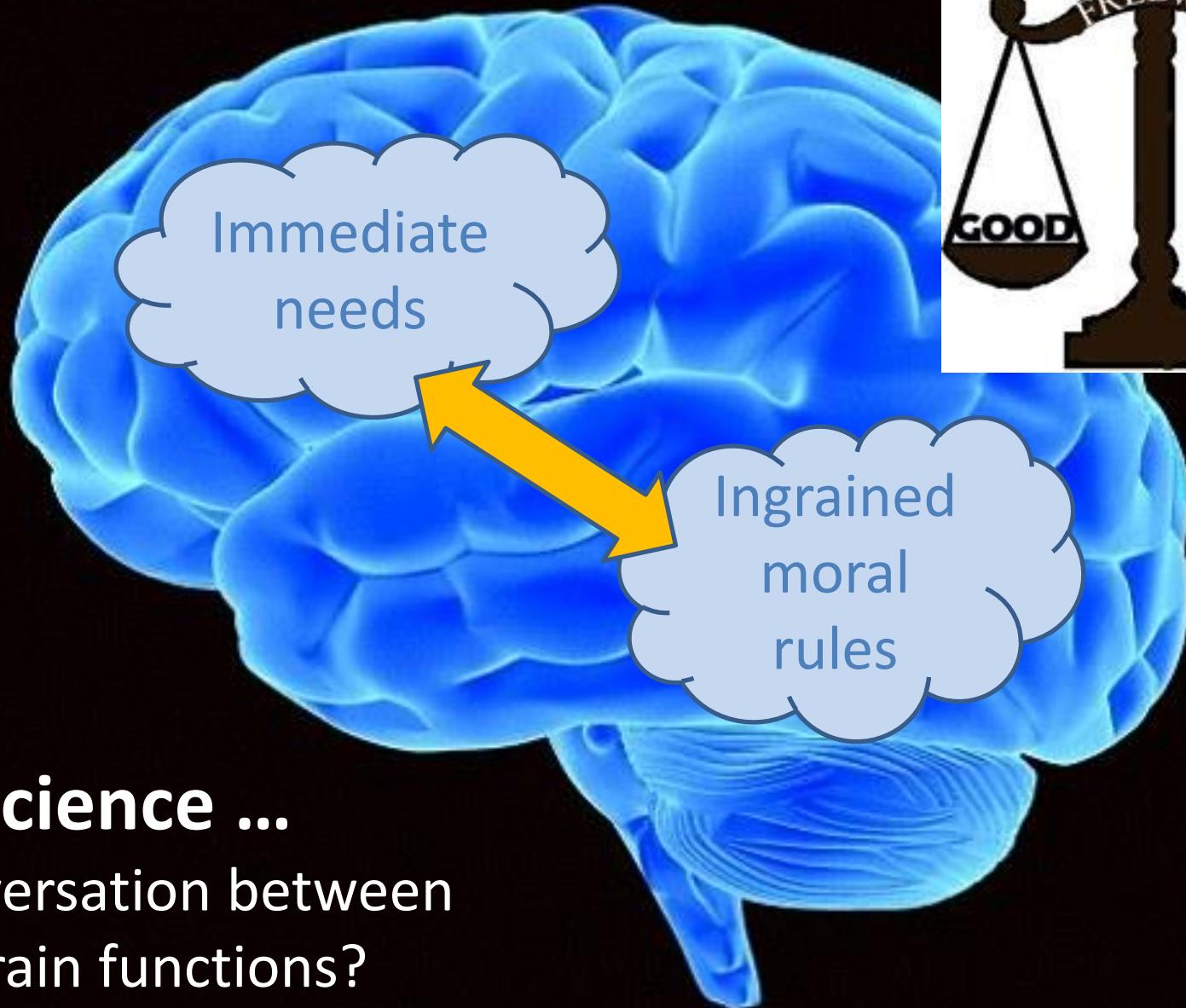
At the basic level: No, physics at the fundamental level is all sown up...

At least in the here and now.

What about telepathy, prayer etc?



Prayer...
a conversation between
two brain functions?

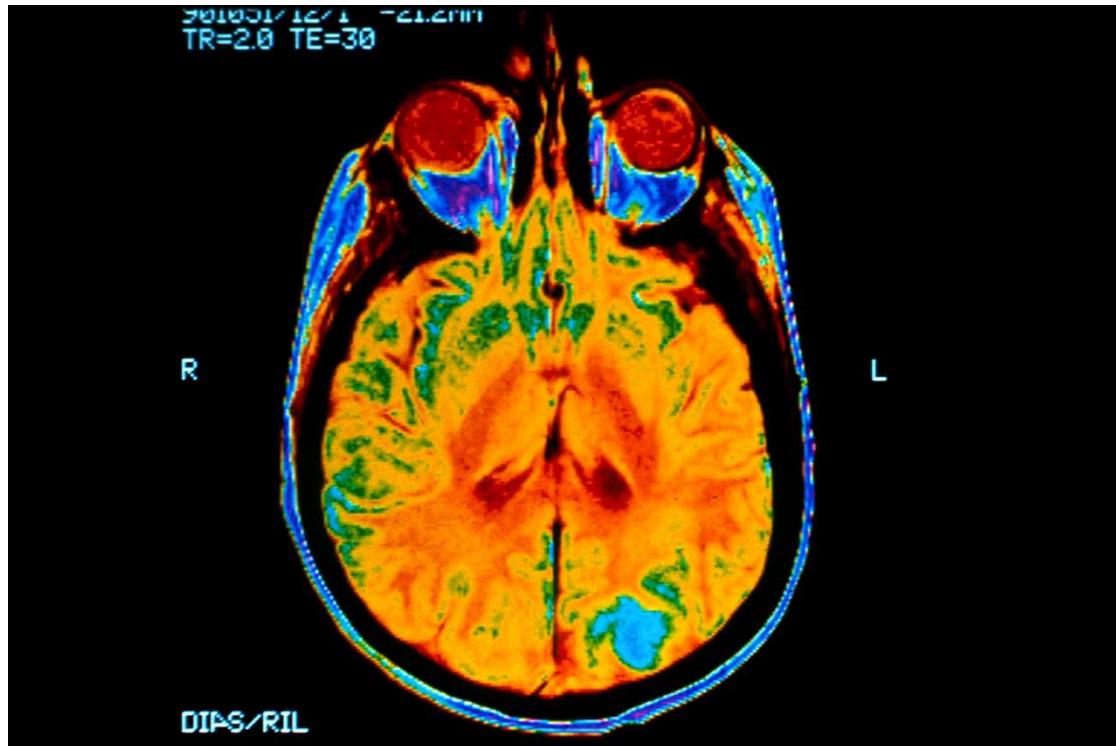


Conscience ...
a conversation between
two brain functions?

Therefore, our wellbeing is
determined by the here and now.
The laws of science.
Not by any supernatural influence

Sentience is rooted in science

What are mental processes?
They are all internal brain functions!



They are layers of complexity – emergent properties
– of physical matter

Theories of ethics

Why study sentience? Or: Theories of ethics

Some slides from:
Measuring Morality
I Bryce 2009-2015

Where do morals come from?

(e) Modern science (evolution and neuroscience) says:

Material realm

Genes
Packages of DNA
passed from parents

One generation

Next generation

How
characteristics
(physical and
social) are
propagated
through time

Memes
Packages of behaviour
passed from parents
and community

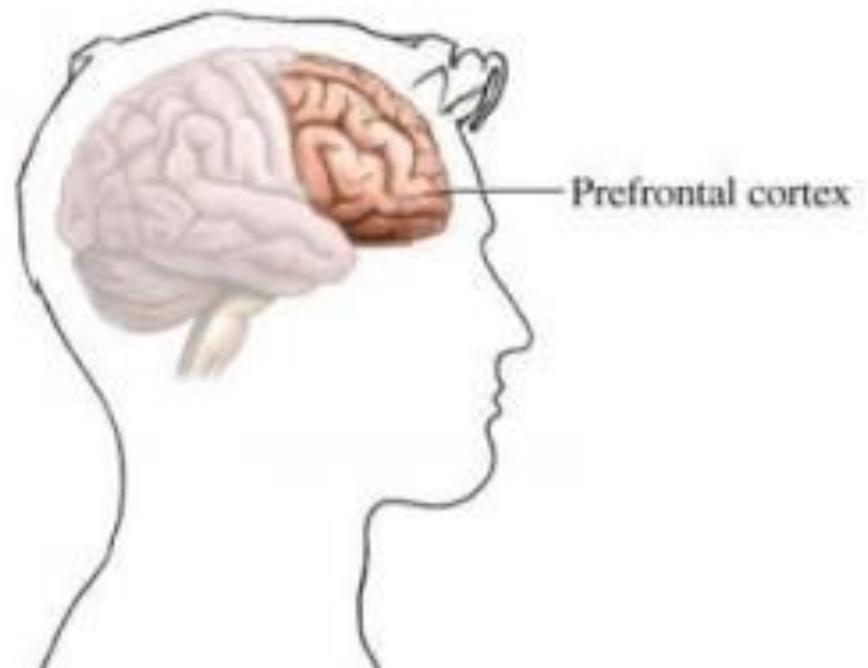
This behaviour can
be described as
“built-in”, instinct, or
intuition

A new source of morality

Humans now* have a very active prefrontal cortex

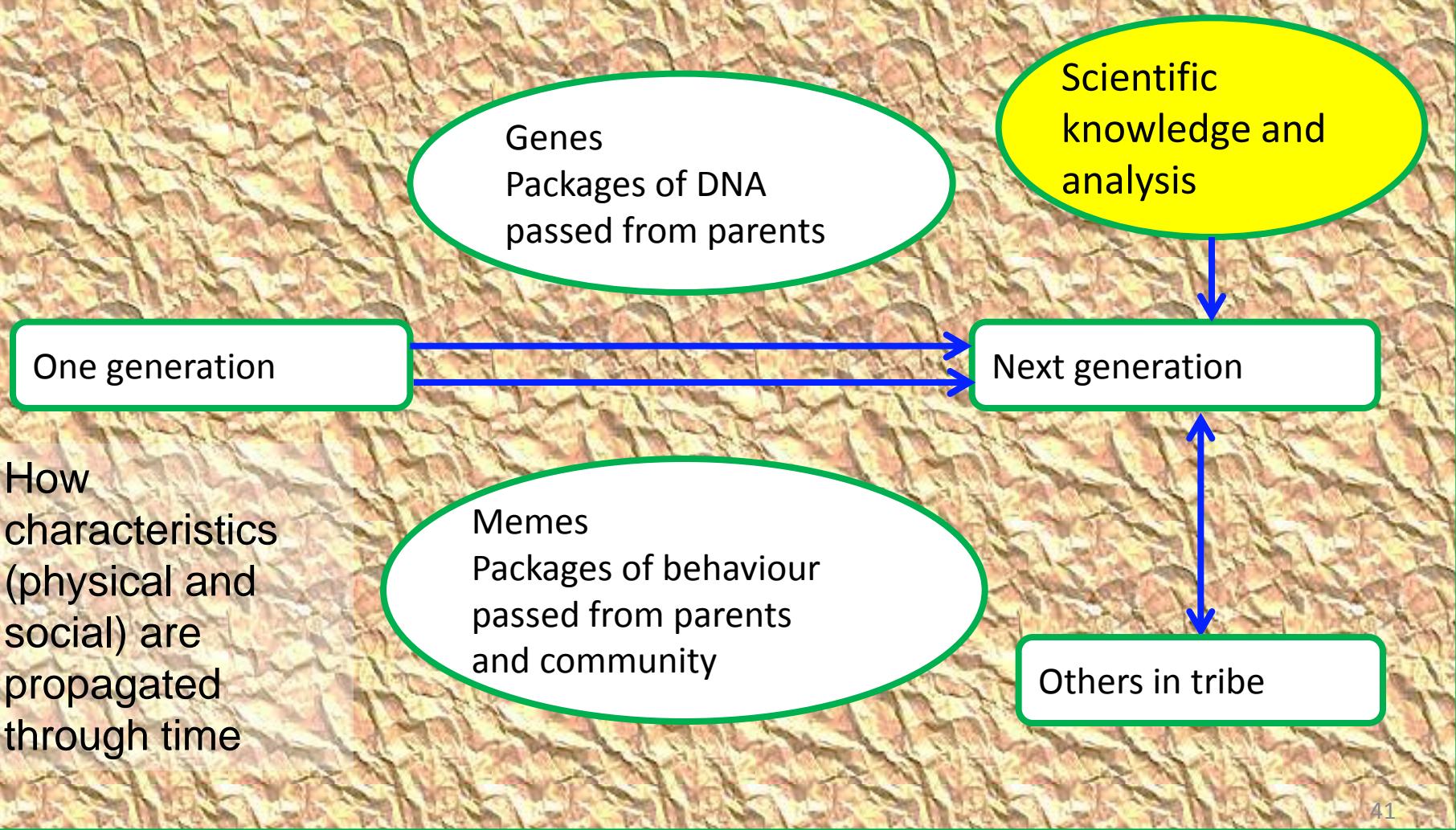
* Homo Sapiens 200,000 years

- Allows detailed reasoning
- Has provided scientific knowledge
- Allows enhanced moral decisions



Where do morals come from?

(e) Modern science: Now add a new source of behaviour



Where do morals come from? We have three sources:

A: Hardwired by genetics – instinct - eg spider spin web

B: Taught by parents – eg human morals (or lack thereof)
– eg O'Beid family – sons like the father

C: Reason

- Brain functions
- Neocortex
- We are free to make up our own morals
- But we must live with the consequences!
- That's what we are doing here tonight!

Welfare

What is included in “welfare”? #1

Obviously the basic physical factors:

- Food
- Water
- Shelter
- Environment
- Health

And *security of person* = basic **freedoms** from:

- Violence
- Oppression
- Freedom of speech

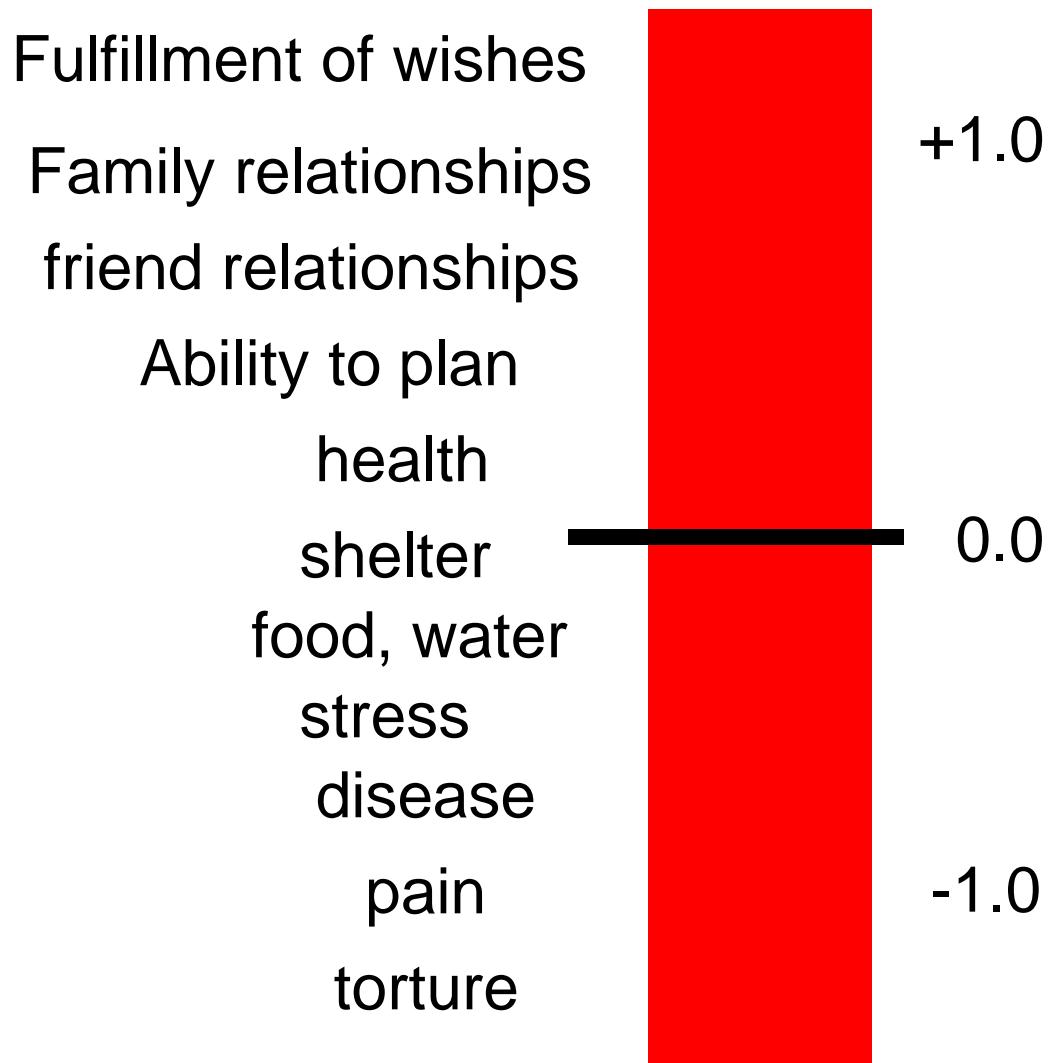
What is included in “welfare”? #2

Our lives also rely on many **social structures**, such as:

- learning from the responses of others to our actions,
- establishing friendships where helpful actions are likely to be repaid,
- making plans for the future,
- enjoying success,
- and regretting failure.

These capabilities add to our pleasure and pain, and hence to the value we place on life.

Welfare – can be put on a scale:



What are human rights?

- Arise through human NEEDS
- Physical needs include food, water, clothing, shelter, safety
- Psychological needs include freedom from oppression, forming relationships, setting goals
- If we respect other peoples feelings, we will recognise these rights

Examples of “Sentience” and “Welfare” from our dogs

Observing human welfare is difficult, because

- (a) we are intimately part of it, and
- (b) the life cycle is too long!

Fortunately, I am part of a dog business, where the things happen much faster. I have observed many cradle-to-grave life cycles involving many ups and downs.



Pup is born - Rapid rise in sentience as the senses become active, and bond formed with the mother



Mating - certainly a peak in Welfare

Examples from the canine life cycle



Dog is blind, but can still play (I taught them tug of war).
Welfare reduced, but still positive



Injury - a dip in Welfare and hence Quality of Life
Eventually becomes negative - the dog is put to sleep

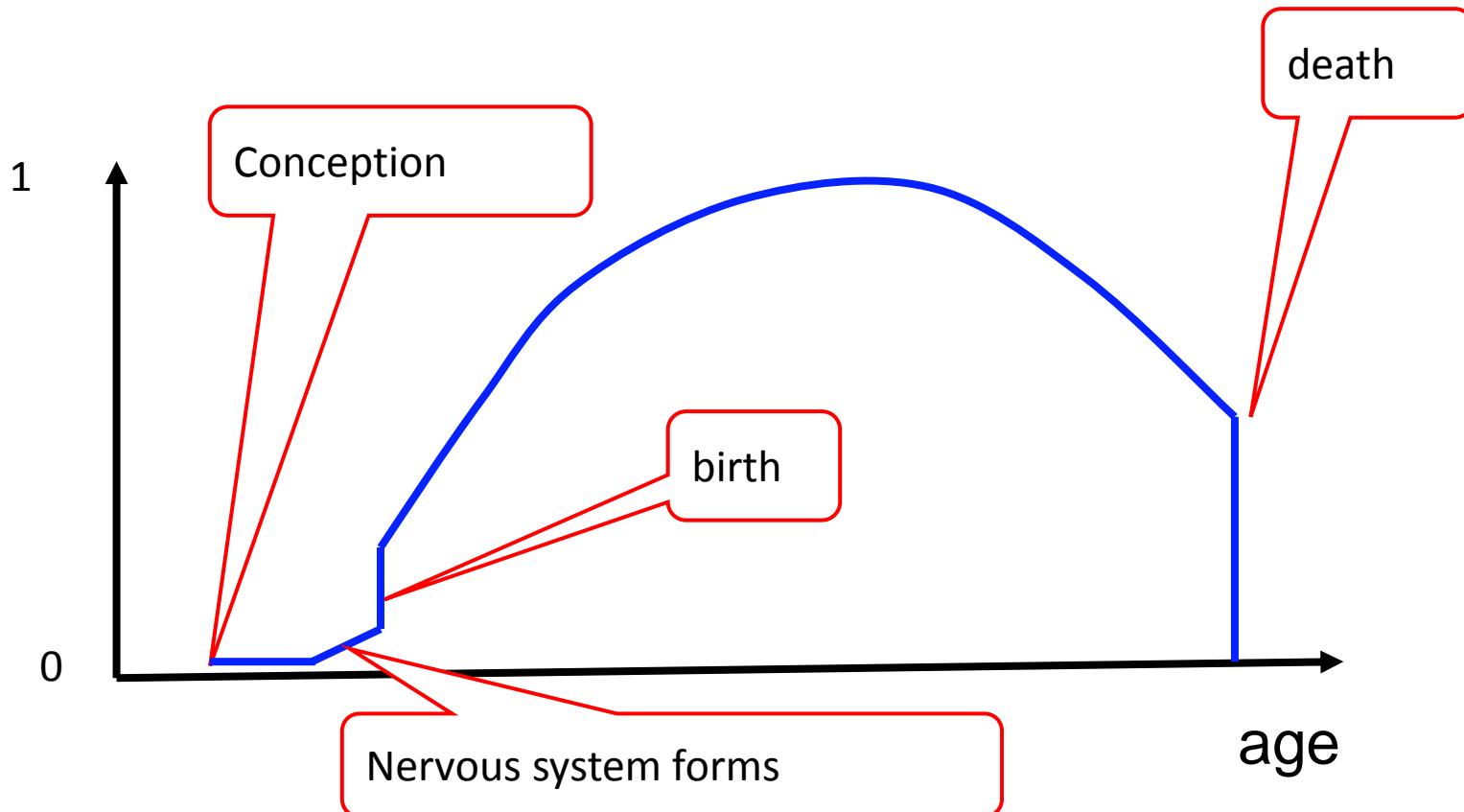
Observing social animals through their entire lifecycles, is much easier than observing humans over lifetimes. It gives a greater understanding of the bigger picture of human life.

Sentience in detail

Sentience - the capacity for Pleasure & Pain (brain function)

– variation throughout a normal life

Sentience



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Sentience in humans - degradations

Many things can degrade the sentience of a person

- Sleep
- Alcohol & drug use
- Anesthetic
- Brain injury
- Induced coma
- Mental illness
- Dementia

Awareness or sentience can be estimated qualitatively by knowing the person,

And quantitatively by technical means (later).

Sentience - degradations

Sentience

Partial recovery

1

Brain injury

Vegetative state

0

age

Estimation of sentience by neuroscience:

(a) overall

Knowledge of brain function relates sentience (crudely) to several physical factors:

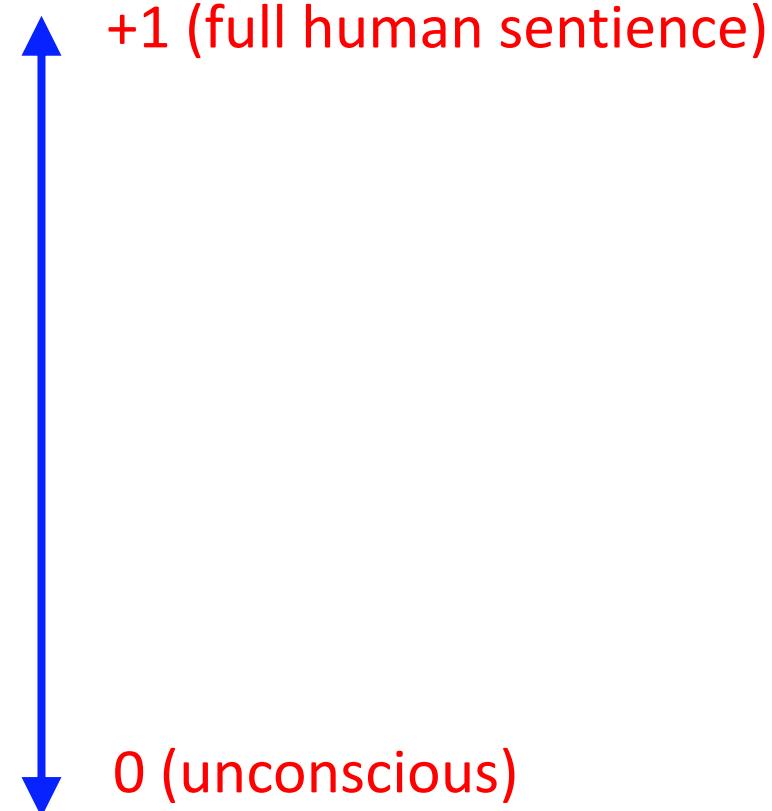
- Measured brain activity (EEG)
- Chronological development of nervous system
- Brain size (absolute or relative to body size)
- Number of neurons and their organization
- Number of axons (connections between neurons)
- Presence of brain stem, limbic brain and cortex, which all play a part in awareness
- Evolutionary development
- Consciousness (further investigation required)

(b) Sentience in extant animals

The techniques of slide 1 enables us to estimate a scale, such as:

- Humans
- Chimps & bonobos
- Other apes
- Monkeys
- Dolphins
- Whales
- Dogs
- Cats mice
- Worms
- Bacteria

There is still much to learn!



(c) Sentience in impaired humans

Emergency responders routinely measure consciousness of victims (accident, stroke etc).

Methods include: eyelids, pupil response to light.
Response to questioning.

Safely Sedated | States of consciousness vary when patients get anesthesia



General anesthesia

Patient is unconscious.
Gases or vapors are inhaled through a breathing mask or tube and other drugs are given through a vein.

Deep sedation

Patients sleep through surgery with little memory of it upon waking. Breathing can slow and supplemental oxygen is often given.



Moderate sedation

Patients feel drowsy and may sleep through procedure. Patients awaken when spoken to or touched. Memory of the procedure is minimal.



Minimal sedation

Patients feel relaxed and may be awake. They can answer questions and follow a physician's instructions.



Regional anesthesia

Injection near a cluster of nerves will numb the area that requires surgery. Patients stay awake, or are given a sedative.



Local anesthesia

Anesthetic drug is usually injected into the tissue to numb the specific location requiring minor surgery.

(c) Sentience in impaired humans #2

Anesthetists do so during and after surgery, so they can adjust the dose of anesthetic. They use:

- EEG
- Pin prick
- auditory-evoked potentials
- Arousal
- Questioning during
- Memory (by questioning afterwards)

All this forms a coherent picture of sentience in humans.



Example of a scientific paper: *Consciousness monitoring: A standard of the future?*

(d) Sentience through the evolutionary chain

We can roughly estimate the sentience of our ancestors through:

- behaviour revealed by archeology
- Brain size and features from fossils.

This enables us to estimate a scale:

- Mammals 1.0
- Primates
- Monkeys
- *Homo habilis*
- *Homo erectus*
- *Australopithecus*
- Recently extinct homo sapiens (neanderthal, Flores "hobbit")
- Current humans 1.0

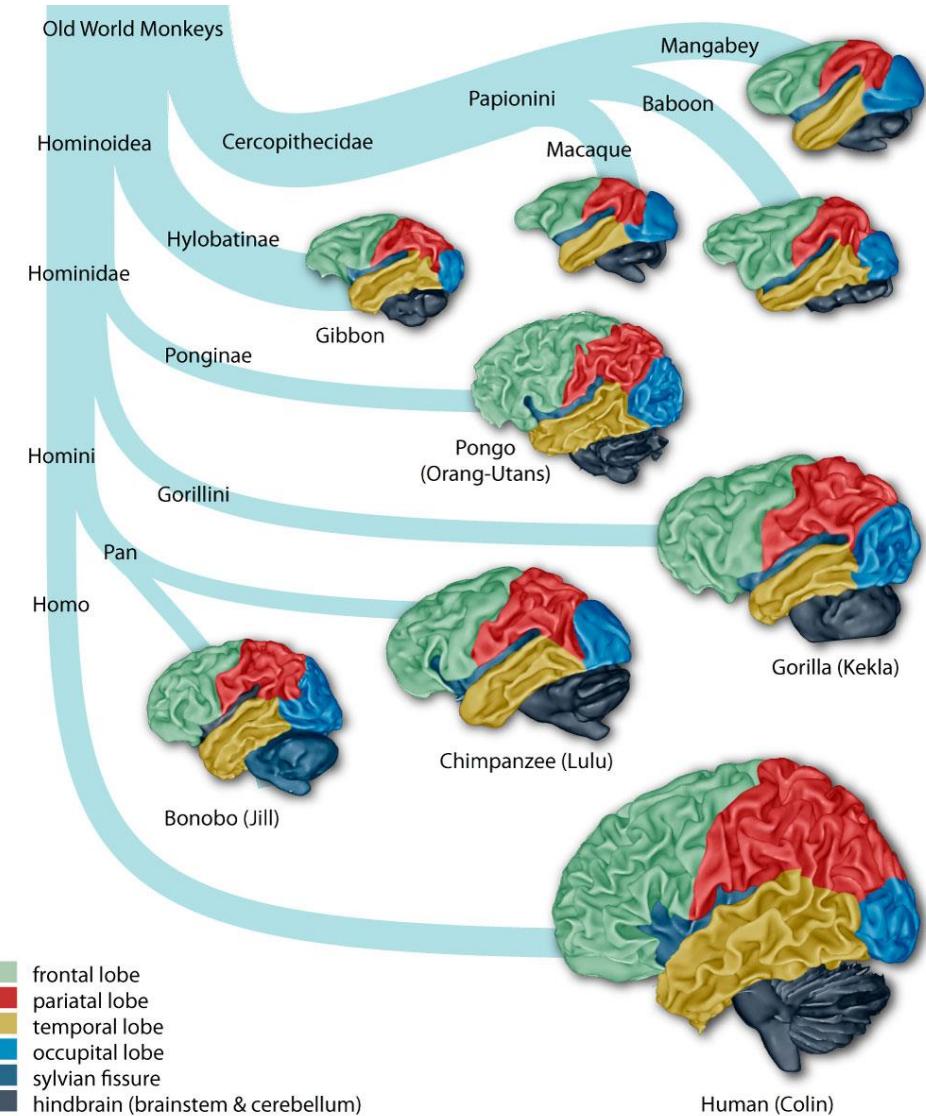
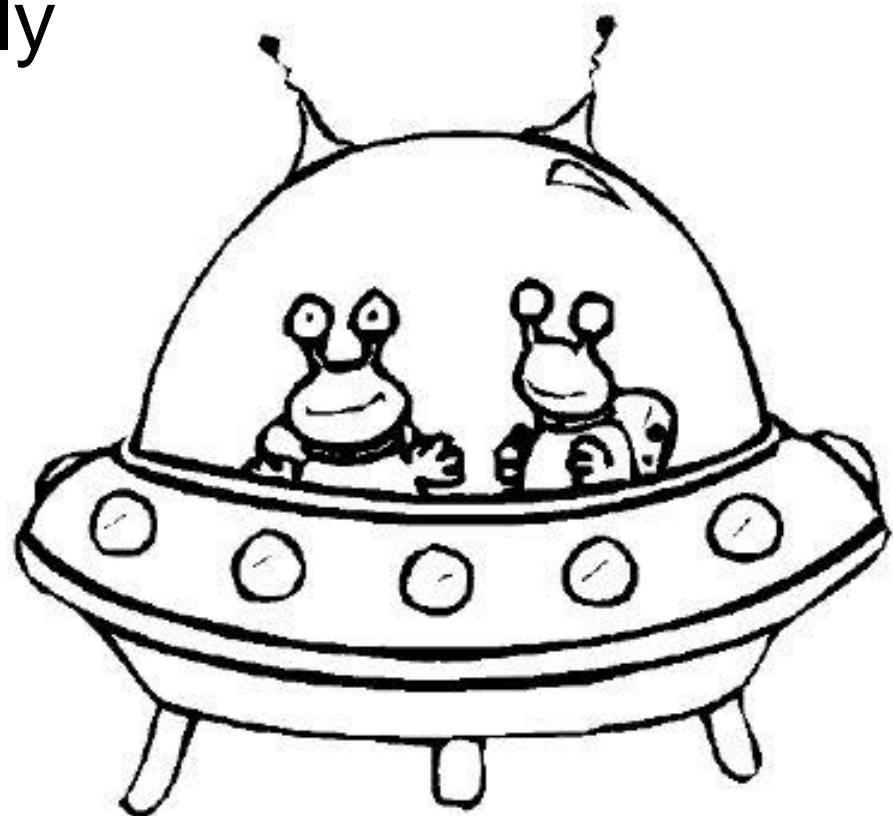


Fig. HE: Visualization of evolution of brains in primates based on the inner surface. The lobes, the sylvian fissure and the hindbrain (brainstem and cerebellum) are colorized for better orientation.

(e) Sentience in aliens

- Given that human sentience has steadily advanced through evolution...
- It is likely that aliens will be much more evolved
- And possibly more sentient!



The Fetus and Abortion

A very emotive topic.
Many religious people
feel the need to impose
their personal views on
others.

Humanists prefer a more
reasoned approach.

"They were in quite a
dilemma," says Lisa Sowle
Cahill, who teaches Catholic
theology at Boston College.
"There was no good way out
of it. **The official church
position would mandate that
the correct solution would
be to let both the mother
and the child die.** I think in
the practical situation that
would be a very hard choice
to make."

Zoe's Law

A pregnant woman was injured in a car accident, and lost her 32-week fetus.

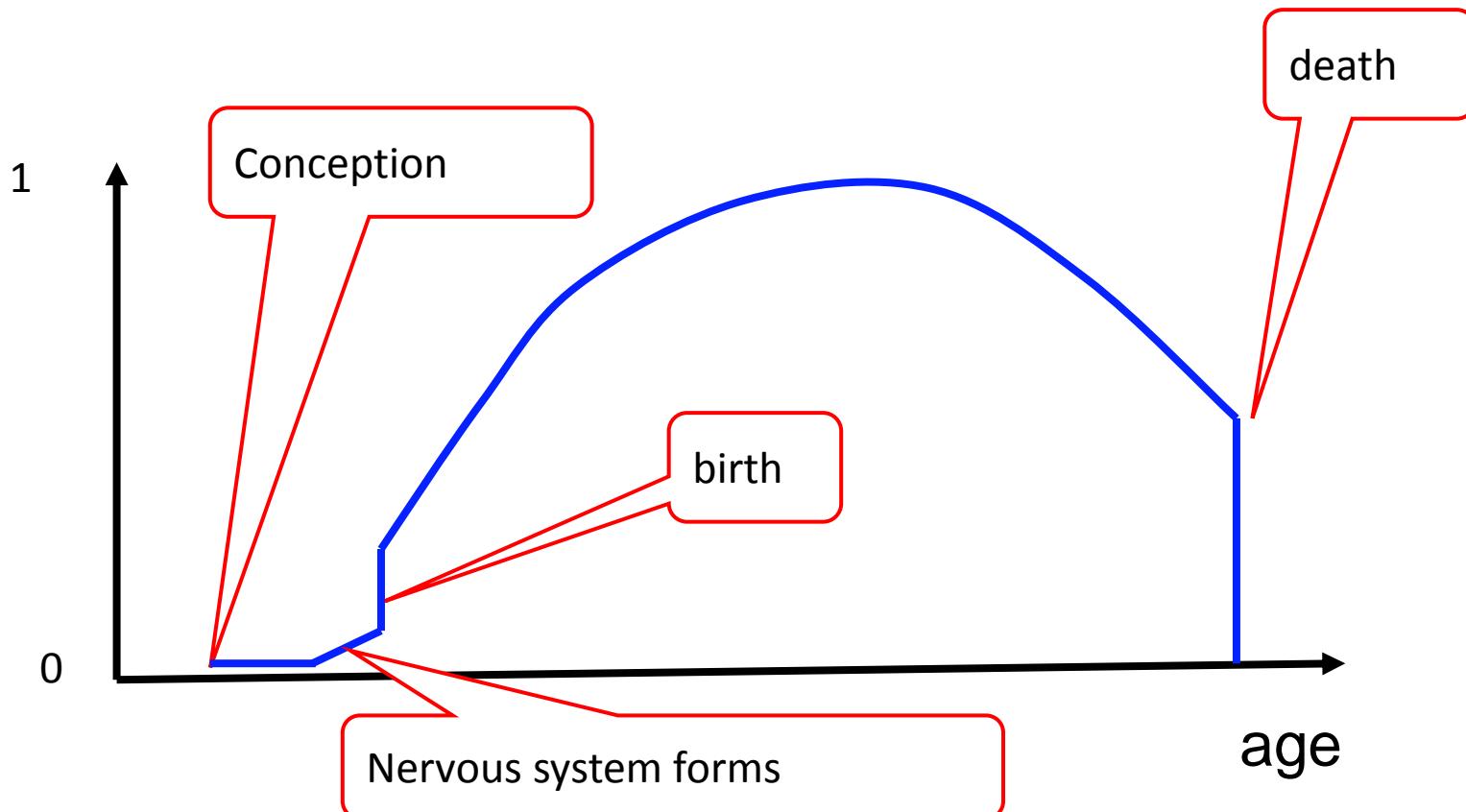
The woman had already named her unborn child Zoe, had bought clothes, decorated room etc. She had focussed on the potential not the actual.

She embarked on a campaign to change the law so that a fetus of 20 weeks would be legally a *person*, and (in future cases) the driver would be charged with manslaughter.

Sentience - the capacity for Pleasure & Pain (brain function)

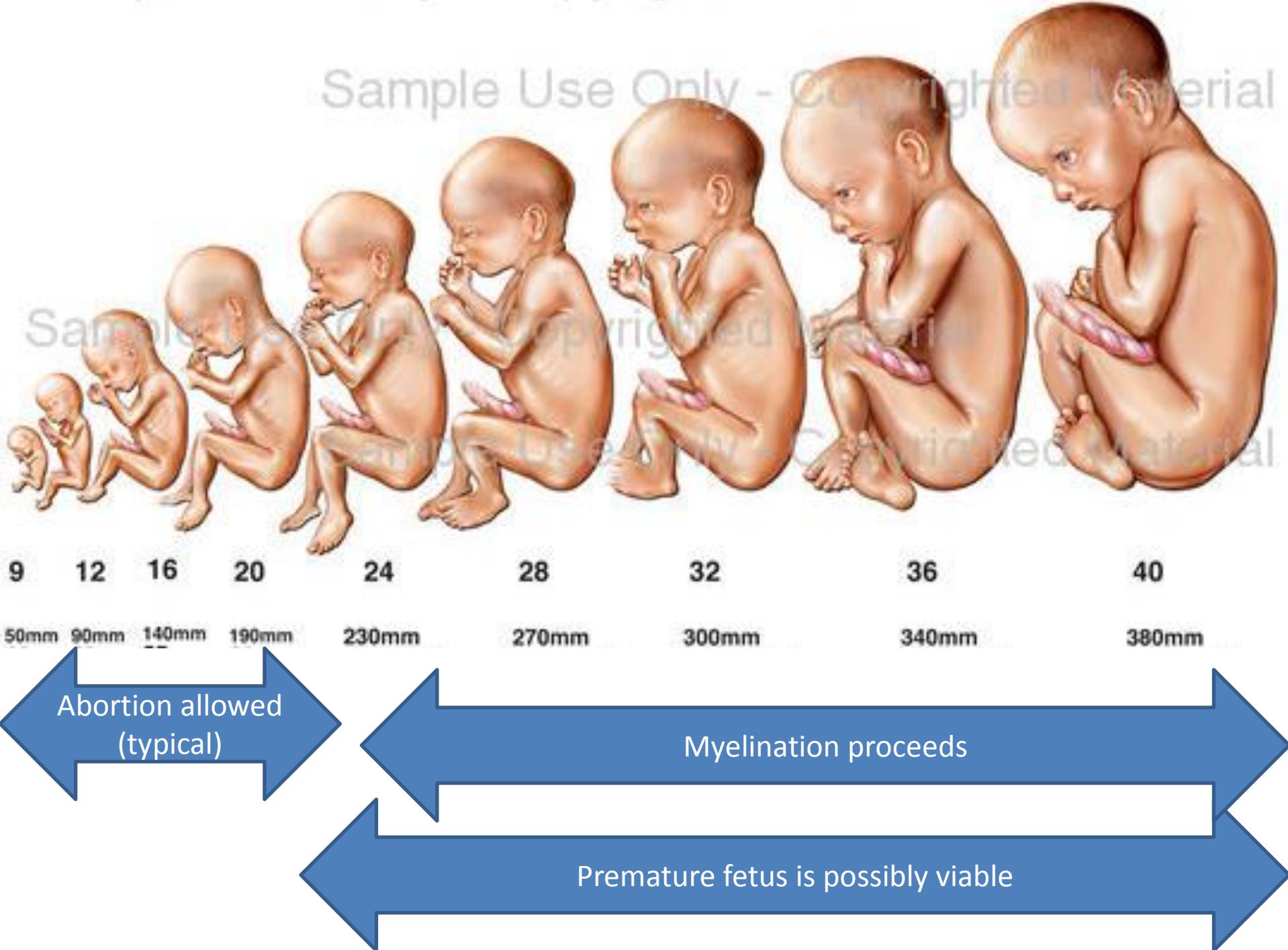
– variation throughout a normal life

Sentience

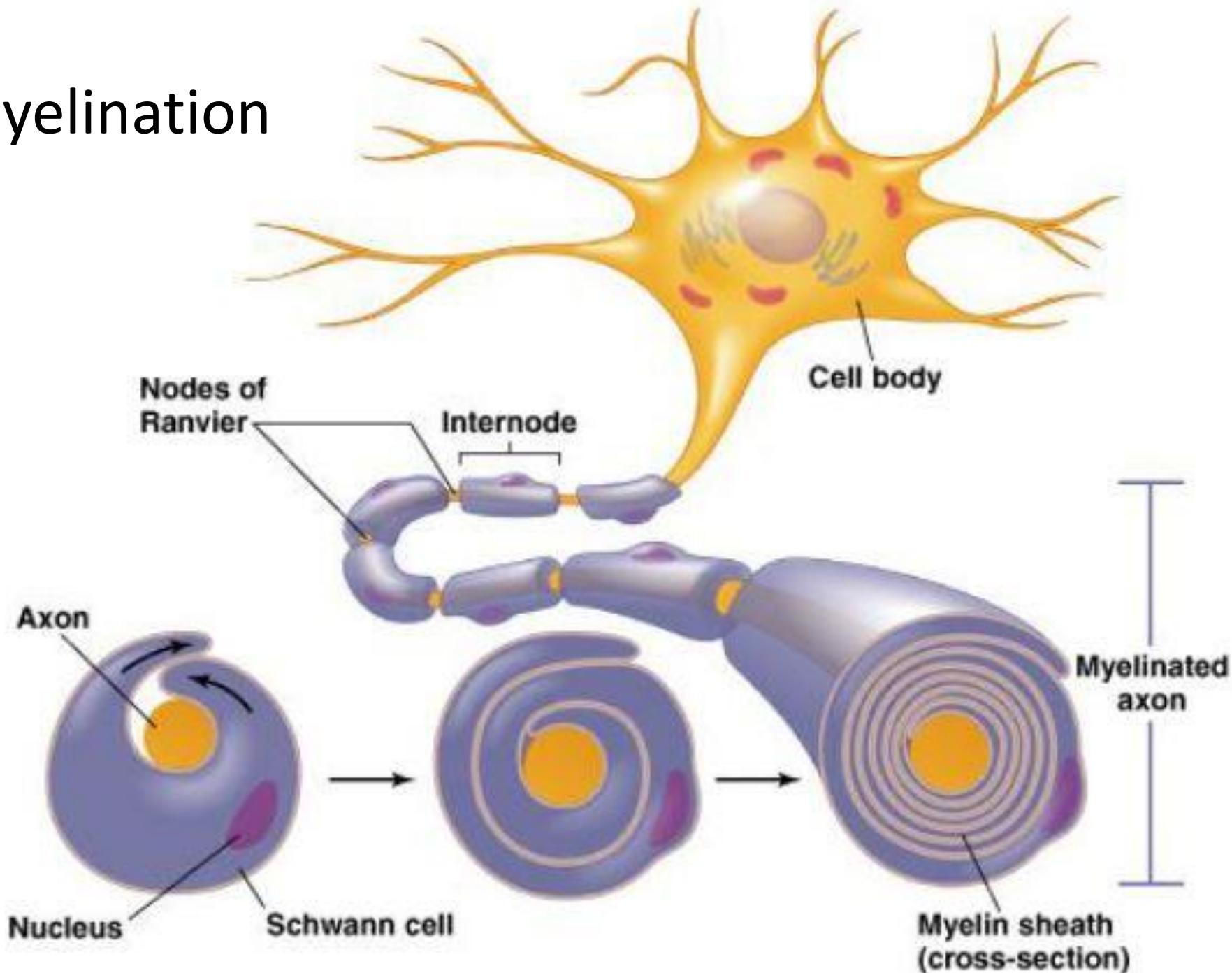


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Myelination



Some findings:

- A myelin sheath on nerves is necessary for proper impulse transmission.
- It first starts at 14 weeks but is very slow until birth.
- It accelerates after birth, in common with a sudden bombardment of sensory inputs.
- Therefore, a fetus is certainly not sentient before 23 weeks

In morality studies, what is the significance of the loss of a fetus?

From its pleasure-pain point of view, this loss is indistinguishable from it never having existed.

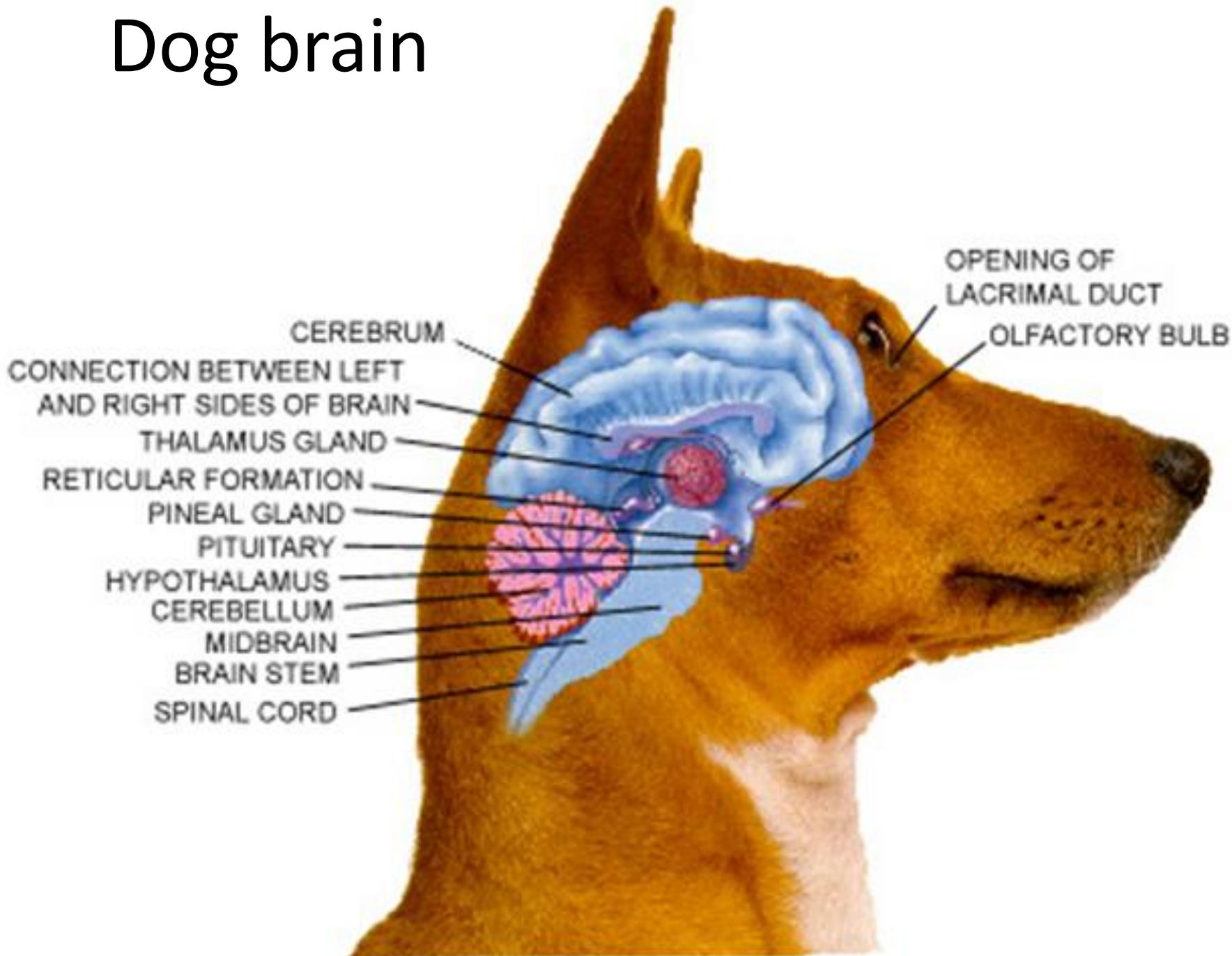
The effect on the mother, however, is more significant.

This suggests that abortion is a matter for the mother to choose, above all.

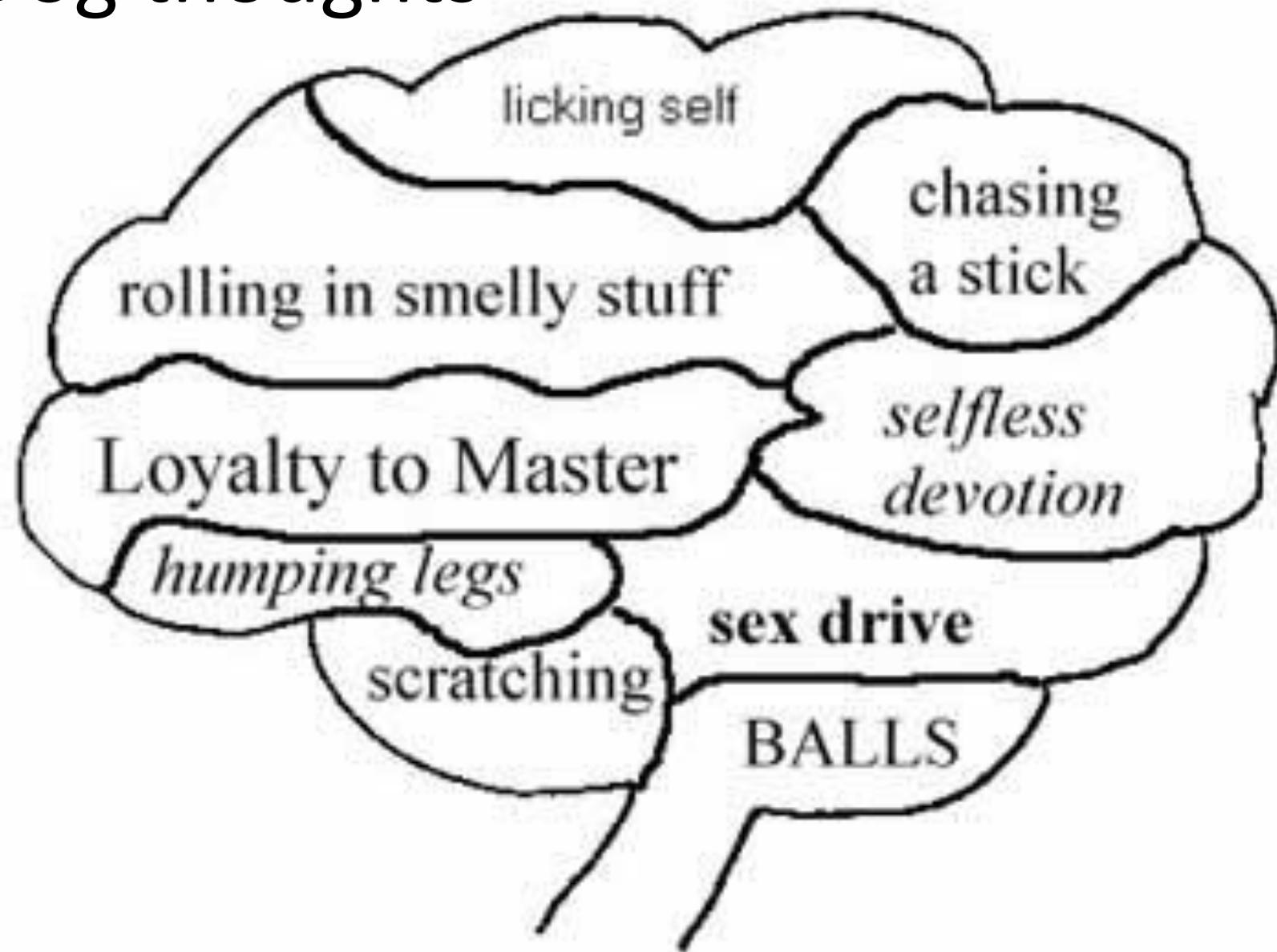
If she does not want to have the child, no one should interfere.

Sentience in Animals

Dog brain



Dog thoughts



Sentience in Animals is an essential element in animal ethics and animal justice.

This scientific theory allows a combined system of morality for humans and animals.

We can then address the welfare of:

- Humans
- Animals in the wild
- Wild animals in captivity
- Farm animals
- Beasts of burden
- Pets etc

What are human rights?

- Arise through human NEEDS
- Physical needs include food, water, clothing, shelter, safety
- Psychological needs include freedom from oppression, forming relationships, setting goals
- If we respect other peoples feelings, we will recognise these rights

What about animal rights?

- Animals also have needs
- Physical needs include food, water, shelter, safety
- Psychological needs include freedom from oppression, forming relationships, (less than humans)
- Animals generally have less sentience (capacity for pleasure and pain)
- So animals should have rights to suit their needs

Animal sentience and pain

Slides from Measuring Morality – I Bryce

We have shown animals as having lower sentience than humans.

How do we estimate pain suffered by animals (both farmed and in the wild)? 12 ways:

1. **Behavioural capabilities** such as agility, hearing, sight, problem solving, social relations, language etc - can be observed and compared to humans.
2. **Comparing animal vs human brains** shows the relative size of the various parts. This can be linked to observed behaviour and skills.

Advanced Topic #2: Animal sentience and pain

3. Fossils of brain cases reveal the different parts of the brain in extinct primates. This illuminates the development of skills during evolution.

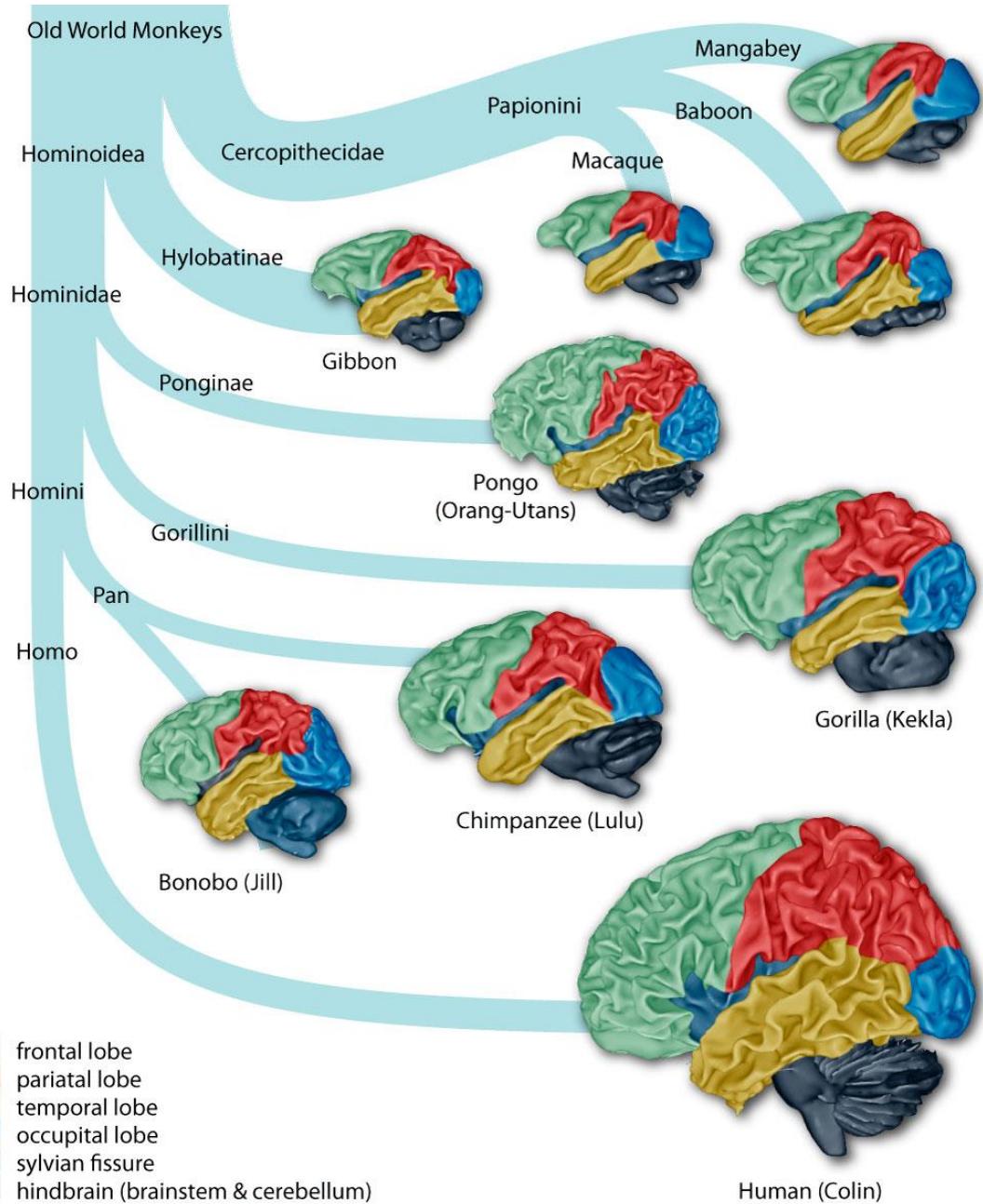
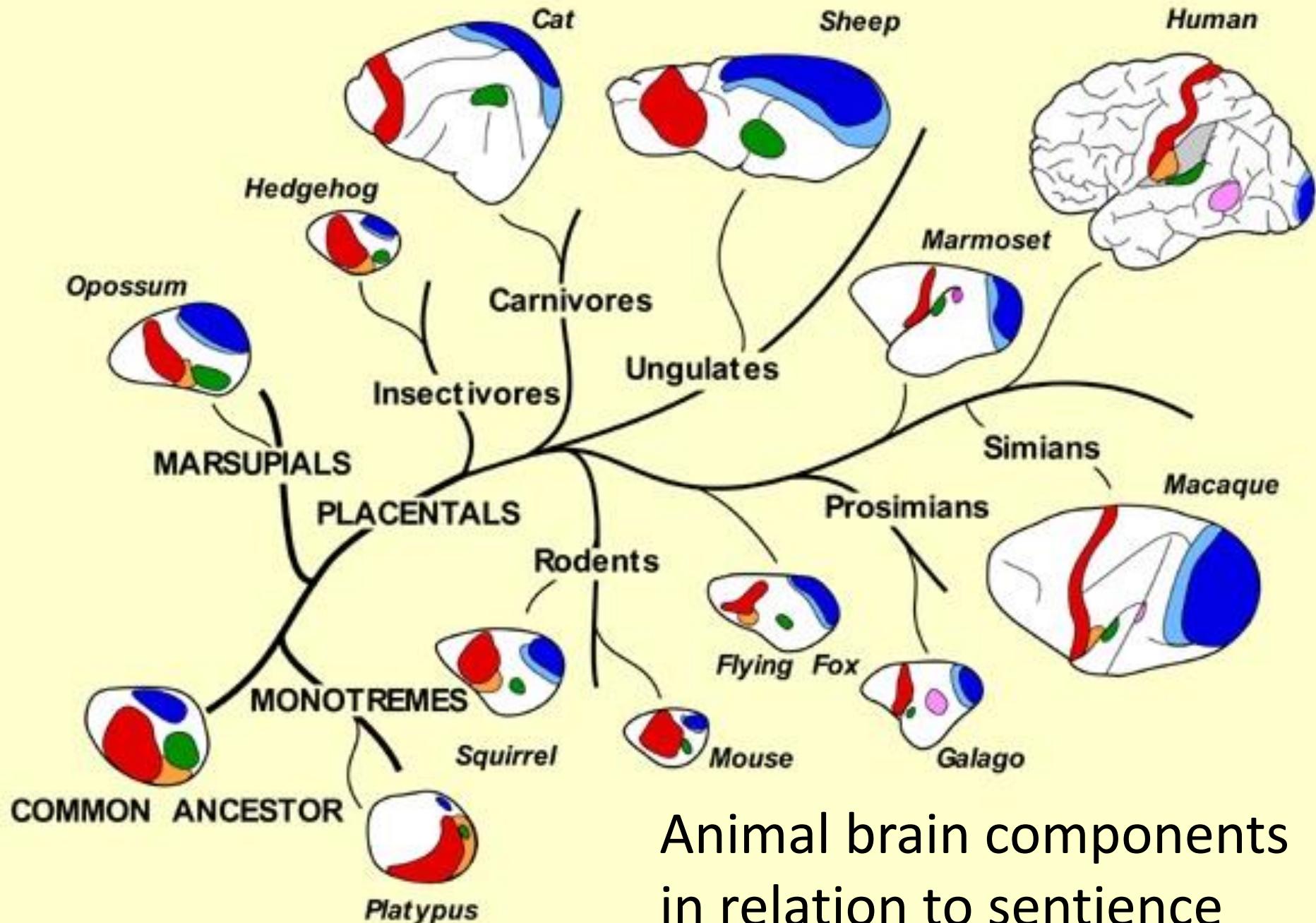


Fig. HE: Visualization of evolution of brains in primates based on the inner surface. The lobes¹, the sylvian fissure and the hindbrain (brainstem and cerebellum) are colorized for better orientation.



Animal sentience and pain

4. Neural complexity – some measures:

- Chronological development of nervous system
- Brain size (absolute or relative to body size)
- Number of neurons and their organization
- Number of axons (connections between neurons)
- Presence of brain stem, limbic brain and cortex, which all play a part in awareness
- Evolutionary development
- Consciousness (further investigation required)

Advanced Topic #2: Animal sentience and pain

- 5. Stress** (general meaning) in animals - in the short term can be measured by many physiological parameters, including blood cortisone, hormones, neurotransmitters, respiration, heart rate.
- 6. Changes in behaviour** as regards feeding, mating, and nesting – also indicate stress.
- 7. Reproductive success** is the most basic long-term measure of wellbeing of a species.

Advanced Topic #2: Animal sentience and pain

8. Self-recognition in a mirror – shows a concept of self.



Advanced Topic #2: Animal sentience and pain

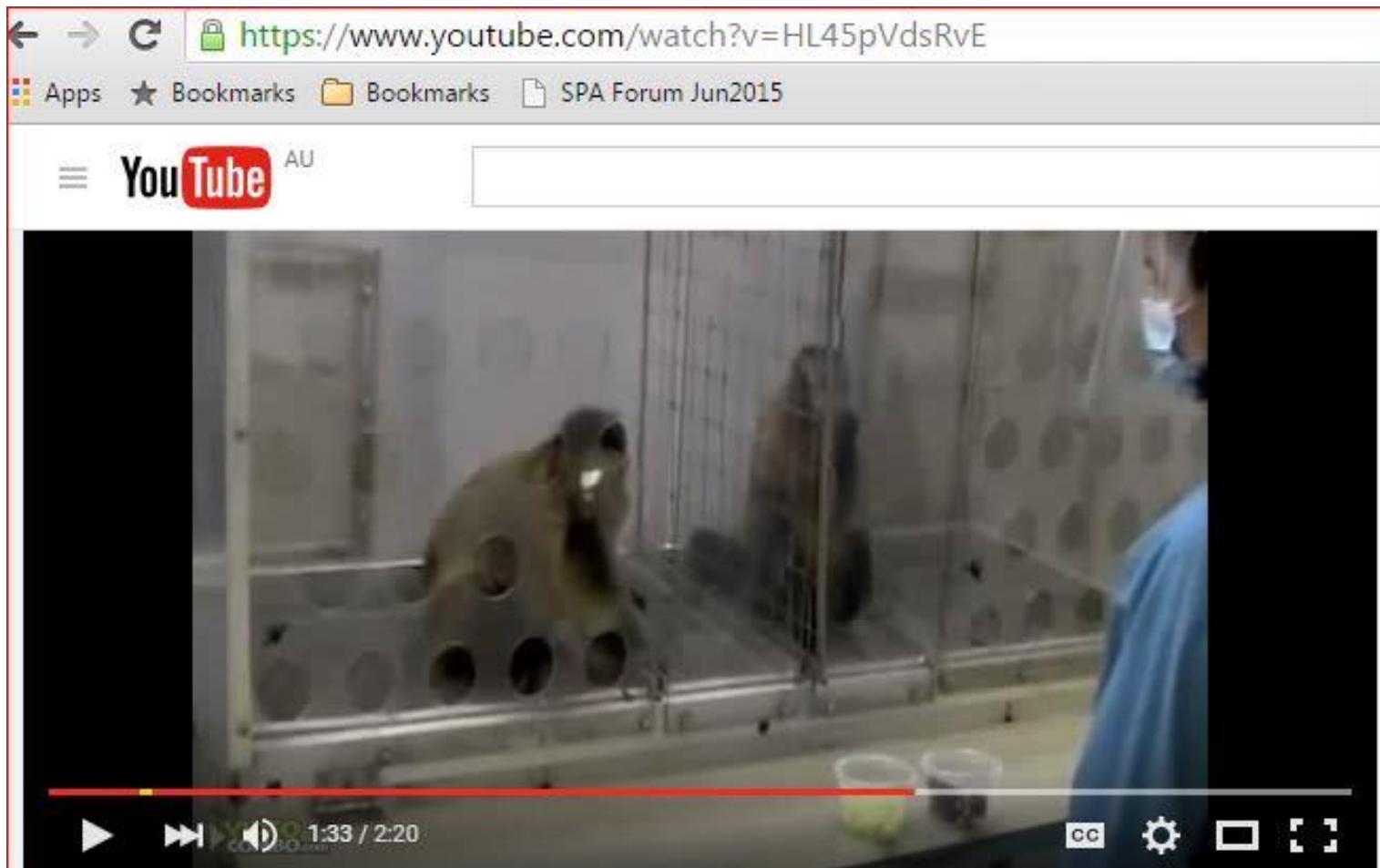
9. Fairness tests – the famous cucumber-grape demonstration with capuchins

<https://www.youtube.com/watch?v=HL45pVdsRvE>

[Cucumbers-grapes capuchin Youtube.mp4](#)

9. Fairness tests – the famous cucumber-grape demonstration with capuchins

<https://www.youtube.com/watch?v=HL45pVdsRvE>



What happens when you give one monkey cucumbers but grapes for another monkey

Advanced Topic #2:

Animal sentience and pain

10. Pleasure-seeking behaviour - Studies with rats running over electrified grids (to obtain drugs which they enjoy) suggest they are more willing to do so than humans.

11. Function of pain - We know that pain evolved as a warning to avoid further damage to the body. There is no reason for this to be more pronounced in animals than in humans.

12. Ethics committees of research laboratories, farming industries etc make daily decisions on whether to allow (or modify) experiments and treatment of animals. Clearly they have a unified concept of what animals experience.

Advanced Topic #2: Animal sentience and pain

The measures of neural complexity, and the above numbered points, form a coherent picture of human and animal brain functions.

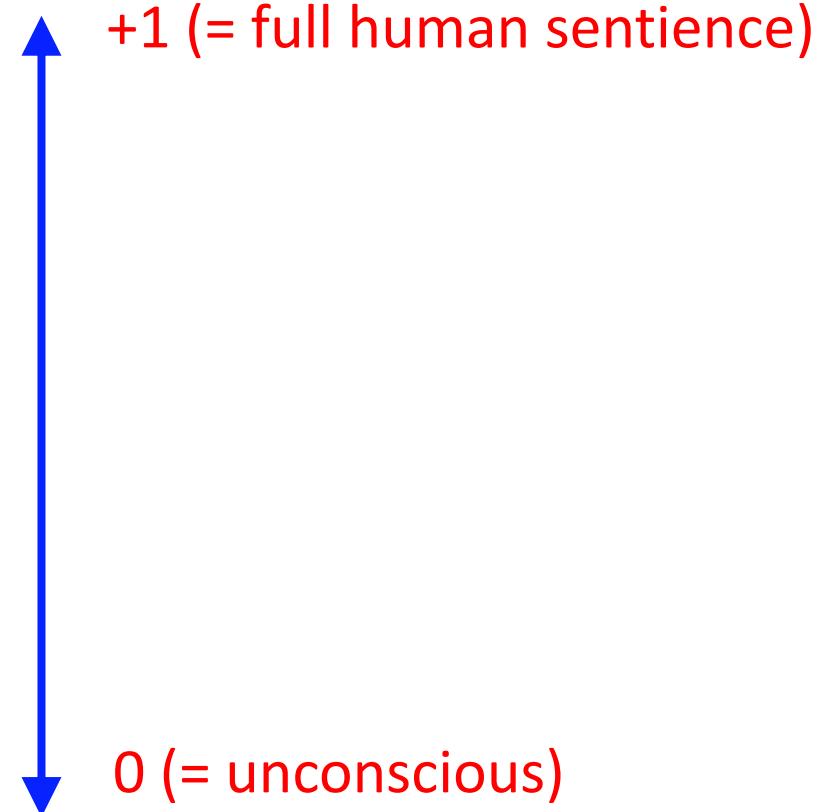
Scientists are confident that such factors correlate with sentience, and hence an ability to suffer from pain.

Sentience in extant animals

The techniques of slide 1 enables us to estimate a scale, such as:

- Humans
- Chimps & bonobos
- Other apes
- Monkeys
- Dolphins
- Whales
- Dogs
- Cats mice
- Worms
- Bacteria

There is still much to learn!



What about animal rights?

- Animals also have needs
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Measures of animal welfare

Eg an eagle – food, freedom, family relations



A Plant, such as
a tree



Example: Live cattle export to Indonesia?

We need to know:

- How sentient the animals are
- The pleasure and pain induced by different treatment
- We can then maximize their quality of life.

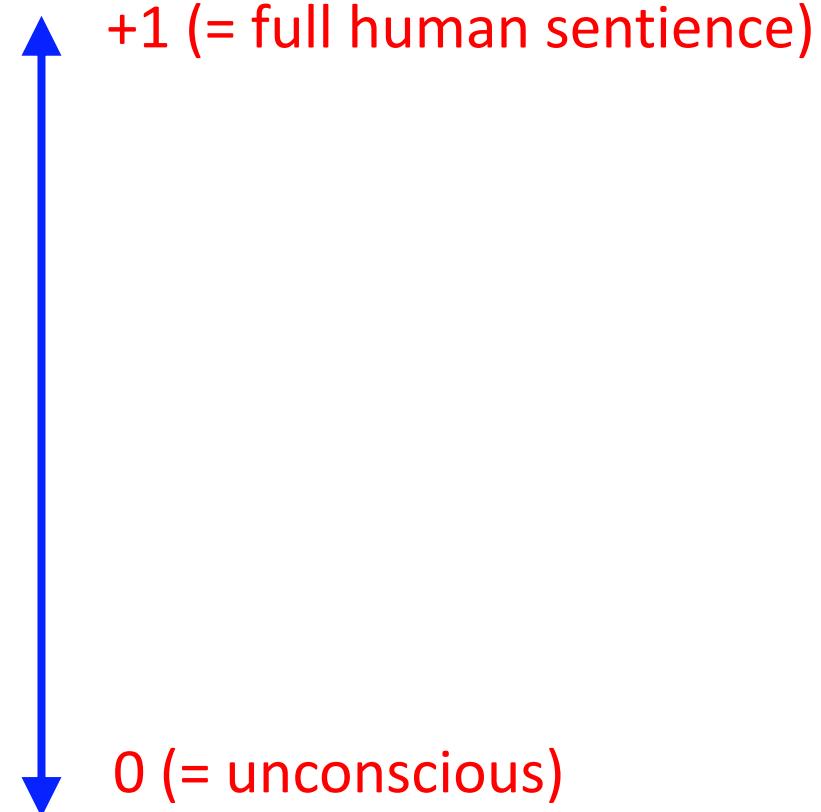
Ref: Dr Temple Grandin's research

(b) Sentience in extant animals

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There is still much to learn!



Conclusions

We saw how Sentience arose through evolution

Survival value

Illuminated by the fossil record

Can be applied to all human races, recently extinct
races, animals

We can estimate sentience through

- Behaviour
- Brain structure
- Evolutionary processes.

Study of sentience is necessary for evaluating ethics

It is a key element of the Humanist position.

These slides may be downloaded
from

<http://www.meetup.com/Secular-Party-NSW/files/>

tomorrow

Or email me

ianrbryce@gmail.com