The brain consists of 100 billion neurons (more than all the stars in the Milky Way), each connected to as many as 10,000 other neurons. Combining these neurons produces more possible states of mind than the estimated number of elementary particles in the universe.

A human brain consists of 100 billion neurons (more than all the stars in the Milky Way), each connected to as many as 10,000 other neurons, combining to produce more possible states of mind than the estimated number of elementary particles in the universe.

A new technique called functional magnetic resonance imaging (fMRI) provides high-resolution, noninvasive reports of neural activity detected by a blood oxygen level dependent signal (BOLD fMRI). This technique allows us to map human brain function, revealing the areas involved in various cognitive processes.

Motor and sensory body surfaces are topographically mapped onto the cerebral cortex with 'association areas' nearby. These mappings are variable across people and 'plastic' within people (some reorganization after injury).
Sensations & perceptions begin with the detection of a stimulus by sensory receptors. Specialized neurons or epithelial cells, such as colors, smells, sounds, and tastes - are constructions formed in the brain and do not exist outside it. Consider cochlear implants.

In vertebrates, sensory signals are action potentials that reach the brain via sensory neurons. The brain interprets them, giving the perception of stimuli. Perceptions - such as colors, smells, sounds, and tastes - are constructions formed in the brain and do not exist outside it. Consider cochlear implants.

The perception depends on where action potentials go, not what triggers them. Consider cochlear implants. The information is then sent on to the many parts of the brain that contribute to forming our perceptions.

Our memories and expectations can strongly influence our perceptions, such as colors, smells, sounds, and tastes - are constructions formed in the brain and do not exist outside it. Consider cochlear implants.

We perceive what we expect to hear or see...

...we perceive what we expect to hear or see...

(Perception involves selective attention - the cocktail party effect - & active interpretation → illusions; when we listen to sentences, we constantly guess what’s coming next & are surprised by unanticipated endings.)

The hippocampus, amygdala, some inner portions of the cortex’s lobes and sections of the thalamus and hypothalamus, form a ring around the brainstem called a ring around the brainstem called...interacts with neocortex & generates emotions.

Limbic regions (emotions) are central in determining the importance of the sensory input to the organism.


Pleasant or aversive events are:

Using positron emission tomography, we show that bilateral amygdala activity during memory encoding is correlated with enhanced episodic recognition memory...

The amygdala seems to modulate the strength of memory for events according to emotional importance...


Abstract:

...brain activation was measured (fMRI) in normal male subjects while they either responded in a normal manner to erotic film excerpts (A) or voluntarily attempted to inhibit the sexual arousal induced by erotic stimuli.

...the sexual arousal experienced in response to the erotic film excerpts, was associated with activation in limbic and paralimbic structures, such as the right superior [A], right anterior temporal pole [B], and hypothalamus [C].

...the attempted inhibition of the sexual arousal was associated with activation of the right superior [A] and right anterior [A], right anterior [B], and right anterior [C].

...reinforce the view that emotional self-regulation is normally implemented by various instructions...

...humans have the capacity to influence the electrochemical dynamics of their brains, by voluntarily changing the nature of the mind processes unfolding in the psychological space.
**Placebo and opioid analgesia - Imaging a shared neuronal network.**


We compared the analgesic effects of a placebo treatment (PPL) and a rapidly acting opioid (POP) ... in a standard pain-stimulus paradigm. Covariation between rACC and the brainstem

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**News of the Week Greg Miller**

The Emotional Brain Weighs Its Options

Theories of economic decision-making traditionally assume that humans are fundamentally rational creatures. However, humans are reproducibly irrational in characteristic ways.

Faced with a decision between two packages of ground beef, one labeled “80% lean,” the other “20% fat,” which would you choose? The meat is exactly the same, but most people would pick...

The language used to describe options often influences what people choose, a phenomenon behavioral economists call the framing effect.

De Martino *et al.* (p. 684) identify the integration of emotional biases arising from an emotional biases arising from an amygdala-based decision-making system as the underlying cause of the framing effect.

**Frames, Biases, and Rational Decision-Making in the Human Brain**


Subjects had to choose between a “sure” option framed as (“Gain,” keep £20 of £50) or (“Loss,” lose £30 of £50), and an identical “gamble” presented as a pie chart...

... when subjects decided to choose the sure option in the Gain frame (57.1% of KEEP 20 trails) and the gamble option in the Loss frame (61.6% of LOSE 30 trails)

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**Let’s look at the basic nuts & bolts picture of a sensory system - vision**

1. Rays of light (blue) reflected off of an image (3D) are focused through the lens onto the back of the eye, forming an upside-down image (2D) on the retina.

2. … we can think of the image as a (2D) pixellate map of activated and nonactivated photocells on the retina.

3. … reconstructs the pixellate map.

4. The brain... connects to a particular location in the visual cortex of the brain. *(via lateral geniculate nucleus of thalamus)*

5. then interprets (or misinterprets) the (2D) map as an (3D) image *(made up of “sensible” objects).*
Amacrine & Horizontal cells: lateral inhibition enhances edges & contrast

In the human retina, rods absent from the fovea. You cannot see a dim star at night by looking at it directly; you can see it at an angle by focusing the starlight onto the periphery & rods. You achieve your sharpest daylight vision by looking straight at the object of interest because cones are most dense at the fovea, (about 150,000 per mm²).

We allocate visual attention by sequentially pointing the fovea (saccades).

When the 3D world is projected onto the 2D retina, the image is ‘underdetermined’: different hypothetical ‘real 3D worlds’ could have created the same 2D image.

From phylogeny and ontogeny, the mind has expectations about how the real world works, things like:
- every mark is in only one place at a time
- a dot on one retina corresponds to only one dot on the other,
- matter is smooth and cohesive, etc (“folk physics”)

We are constantly testing alternative hypotheses against sensory data in “the mind’s eye.”

“Whilst part of what we perceive comes through our senses from the object before us, another part (and it may be the larger part) always comes out of our own mind.”

William James
The body-surface to cortical-surface mapping crosses over, unless ...

... whereas the left hand (operated by the right hemisphere) will choose a shovel (needed to remove snow in the scene).

Gazzaniga's 'left-brain interpreter' (from Massimo Pigliucci)

if asked to explain ... the left hemisphere acted as an interpreter ... and fabricated a just-so story to fit all the available data!

Cut corpus callosum to control epilepsy

M. Gazzaniga

The Blind Decision-Maker

What is the relation between intention, choice, and introspection?

Johansson et al. (p. 116) used a card trick in a simple decision task to identify a dissociation between awareness of the initial choice and the outcome when this has been surreptitiously altered.

Participants were given a choice to make

in the attractiveness of two female faces shown on two cards, and then asked to justify their choice as they examined the card with the alternative they had allegedly chosen.

In some trials, the experimenters covertly switched the cards.

In the majority of such trials,

participants failed to recognize the switch, and proceeded to:

... of the card they were handed, although it was not the one they had selected.

... participants may produce confabulatory reports when asked to describe the reasons behind their choices.

(post hoc rationalization)

{Our consciousness may be primarily} from moment to moment, about what we did and why we did it. It is a thin, often inaccurate veneer rationalizing a mountain of unconscious processing.

Hans Moravec, 1998

Reductionist efforts are getting us to the neural correlates of brain function, but we still haven’t found 'the mind.'

http://www.sci-con.org/reviews/20031101.html

The split-brain phenomenon gave rise to a host of conflicting propositions about the neuroanatomical localization of the self.

Where is the self in the split brain?

In the left hemisphere? In the right hemisphere? In both?

With fMRI we can now distinguish what specific areas of the brain are active when people think, feel, imagine, perceive, and so on.

Researchers are starting to apply this technology to find the self in the brain.

Mirror self-recognition (MSR) and seem to be associated with...

{but explaining verbally is localized on left}

During an infant’s or child’s brain development, typically …

The right hemisphere is stronger at spatial relations, music …

{the 'holostic hemisphere'}

The left is most adept at fine visual and auditory details …

{the 'reductionist hemisphere'}

Neurology: Self-recognition and the hemisphere.

Here we show that in humans the hemisphere of the brain seems to be preferentially involved in self-face recognition.

JULIAN PAUL KEENAN et al.

Nature brief communications

Neurology: Self-recognition and the hemisphere.

From 400, 5000 (2000), 4000, 2000, 2000

Figure 1 Five patients were presented with a picture showing a morph of a face that was composed of their own face and a famous face during the time when either the right or the left hemisphere of their brain was anaesthetized.

Following anaesthesia of the left hemisphere (LH), patients selected the 'self' face as having been shown to them (5/5); after anaesthesia of the right hemisphere (RH), patients selected the famous face as the one they had viewed (4/5).
An optical illusion can help define which parts of the brain are responsible for human consciousness.

People cannot consciously perceive a number flashed on a screen for 16 ms if it is quickly followed by another stimulus in the same area. (a ‘mask’)

As the time between the two stimuli increases, the first stimulus becomes visible; that is, it is accessible to the person’s consciousness. (can report seeing it)

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**Brain Dynamics**

**Underlying the Nonlinear Threshold for Access to Consciousness**

Antoine Del Cul et al. 2007. *PloS* ...

... Conscious perception of masked stimuli corresponded to activity in a ... this late stage ...

... clearly separated from subliminal processing and mask-target interactions, can be regarded as a marker of consciousness.

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**The extreme male brain theory of autism**


‘Empathising’ is the drive to identify another person’s emotions and thoughts & to respond appropriately. ...

... allows you to predict a person’s behaviour.

I review evidence that on average, females spontaneously empathise to a greater degree than do males.

‘Systemising’ is the drive to analyse a system, to derive the underlying rules that govern the behaviour of a system.

... allows you to predict the behaviour of a system.

I review evidence that, on average, males spontaneously systemise more than do females ...

... autism can be considered as ...

... males tend to have ...

... (associated with higher levels of testosterone in uterus)

people with autism show this trait in a magnified form

2nd to 4th digit ratios, fetal testosterone and estradiol.


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**Contagious yawning:**

the role of self-awareness and mental state attribution


We hypothesized that contagious yawning is part of a more general phenomenon known as mental state attribution (i.e. the ability to inferentially model the mental states of others).

... we compared susceptibility to contagiously yawn with performance on a self-face recognition task (left-right hand response time), several theory of mind stories, (about false beliefs & social faux pas) and on a measure of schizotypal personality traits. (the SPQ test)

... yawning faces triggered more than twice as many yawns in non-autistic children than in their autistic counterparts ...

Senju, A. et al. Biology Letters (2007) ... yawning faces triggered more than twice as many yawns in non-autistic children than in their autistic counterparts ...