UNIVERSIDAD DE CHILE Santiago 24-27 de Enero 2016 SEMINARIO INTERNACIONAL Education, Society & Human Rights: The contribution of Neuroscien



Ce

TOWARD A NEUROSCIENCE OF ETHICAL NORMATIVITY? tinkering with brain organisation

Jean-Pierre Changeux





SCIENCE vs MORALITY?



David Hume «scientific activity establishes what is or what is not? the statements of a system of morality define what ought to or what ought not to be done?» prescribe rules -or norms- of conduct

does this exclude a science of morality?

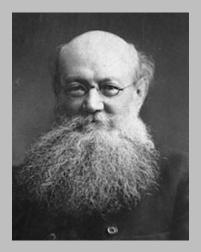


René Descartes «la morale, présupposant une entière connaissance des autres sciences, est le dernier degré de la sagesse».

> highest level of wisdom? ...of scientific knowledge? (Auguste Comte)



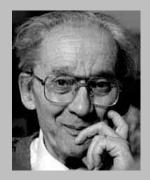
Normative ethics investigates how one ought to act morally?.



Piotr Kropotkin « Why shall I be moral ? » Ethics 1921 « nature is the first master having tougth ethics to humans, the moral principle... social instinct,

innate in humans as in social animals, the source of all ethics notions & subsequent evolution» in three successive steps: 1 sociability as mutual aid

2 sympathy & good will ... rules of justice & equality



3 generosity: the highest of moral evolution... » Paul Ricoeur Soi-même comme un autre 1990 ethical intention is «a cognitive operation»: look for the adequate action which conciliates the interest of the individual with that of the social group.

a «good life with and for others in just institutions»

TOWARD A NEUROSCIENCE OF ETHICAL INTENTION & ETHICAL NORMATIVITY ?

Changeux & Ricoeur La nature et la règle 1988 O Jacob What makes us think? 2002 Princeton UP

every actual aim must be submitted to the "sieve of the norm"

Paul Ricoeur Oneself as Another, 170).

the contribution of neuroscience to ethical normativity.

1. a multilevel evolutionary context

2. neural bases of «good life»

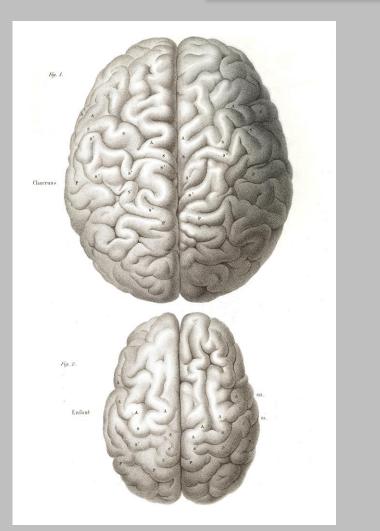
3. social relationships:

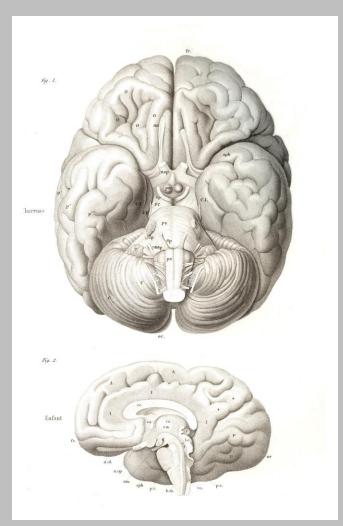
sociability as mutual aid sympathy & good will ... rules of justice & equality generosity: the highest of moral evolution...

> 4. just institutions ethical rules & ethical innovation

A MULTILEVEL EVOLUTIONARY CONTEXT

THE HUMAN BRAIN

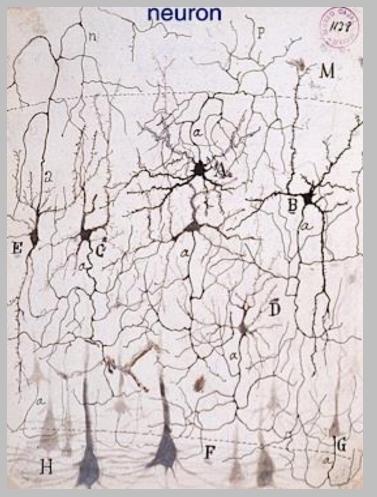




Leuret & Gratiolet 1839-1857 approx 86 billion neurons (S Herculano-Houzel) & approx 1 000 000 billion synaptic contacts in the brain: an extraordinary complexity

THE BUILDING BLOCKS OF THE BRAIN

0.1mm



μm

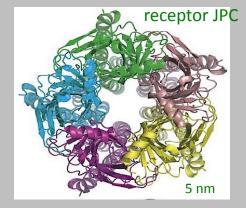
neurotransmitter

as chemical signal

rate limiting steps in information processing physical constraints

synapse





hange<mark>ux &Talv 200</mark>9



chemical to electrical conversion Katz 1966

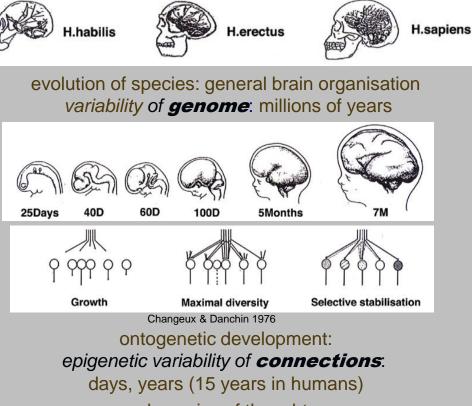


allosteric mechanism of signal transduction JPC

...the molecular & cellular «components of thought» P Gardenfors 2003

MULTIPLE LEVELS OF VARIABILITY NESTED WITHIN & BETWEEN HUMAN BRAINS

generalised darwinism

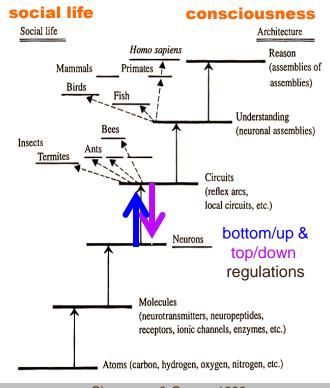


dynamics of thought: variability of spontaneous activity & synaptic efficacies: 1 à 100 ms

social & cultural evolutions: variability of synaptic efficacies & **extracerebral memories**

100 ms to thousands of years

hierarchy & parallelism



Changeux & Connes1989

human brain: open, exploratory, self-organising & conscious system engaged in social communication & cultural transmission

TINKERING MODELS OF THE BRAIN

(Changeux The Physiology of truth 2002)

the aim:

.to represent a behavior or «mental» process, on the basis of minimal yet realistic, neural architectures and activity patterns, if possible, in mathematical terms & .to build a formal organism able to pass the task & .to establish causal relationships between a specific behavior or even mental *subjective* processes and objective neural measurements. .can be challenged experimentally, from the molecular to the cognitive level, on a well-defined experimental task

but:

best theoretical model will never give... a complete & exhaustive description of reality ... ie «the brain **is** a Turing machine»...= nonsense

NEURAL BASES OF ETHICAL INTENTION «GOOD LIFE»



unity of the human brain

genome level

BRAIN – GENOME COMPLEXITY



non linear evolution of brain vs genome complexity



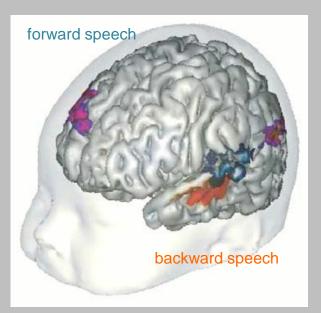
GENOME SIZE			NUMBER OF GENES	NUMBER OF NEURONES
YEASTS	13.5 Mb		6.144	
WORMS	97	Mb	18.266	302
FLY	165	Mb	13.338	250 x 10 ³
MOUSE	2.5 Gb		20-25.000	40 x 10 ⁶
HUMANS	2.	9 Gb	20-25.000	50-100 x 10 ⁹

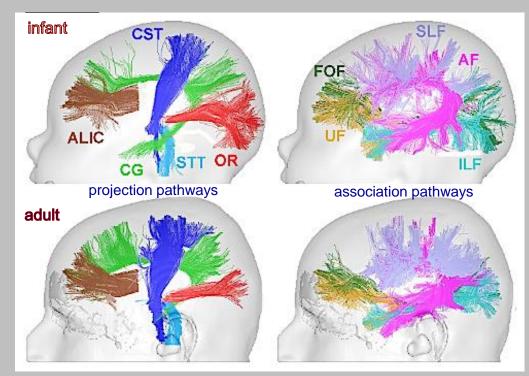
similar small number of structural genes in mice & men 1.2% sequence diff. between chimps & men! paradox? regulation of gene expression

interacting genes = «nested coherent gene groups» model (TsigeIny & JPC) no single genes for language, music, math...autism!

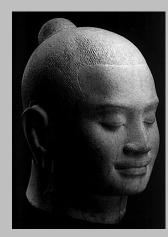
INNATE UNIVERSAL DISPOSITIONS OF THE HUMAN NEWBORN

Dehaene-Lambertz et al 2006; Dubois et al 2011, 2014





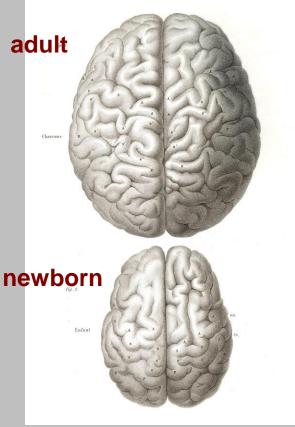
"core knowledge": for grasping & breast sucking, for distinction between living/inanimate objects, recognition of human faces, for language acquisition for conscious access, empathy and sympathy... BUT genetic variability among individuals



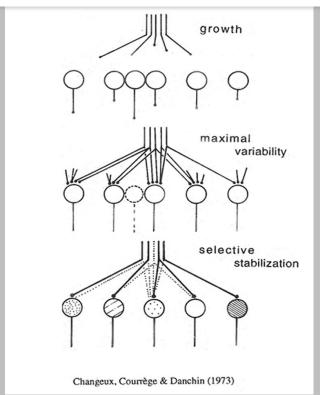
epigenetic diversity?

neuronal networks level

POSTNATAL EPIGENESIS & CULTURAL EVOLUTION



selective stabilisation of synapses



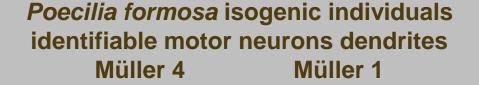
newborn to adult: brain weight x 5 ca 10 million synapses/second Lagercrantz et al 2010 nested processes of active synapse selection evidence for synapse elimination/pruning

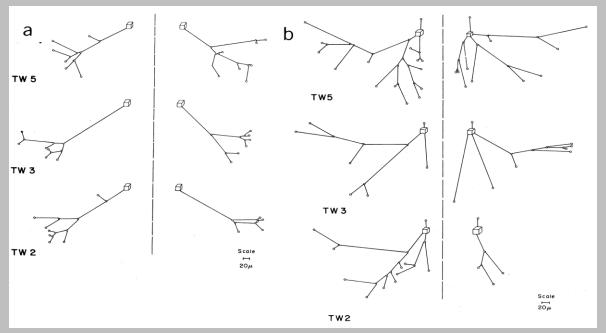
prolonged postnatal development in humans (15 years) associated with acquisition of basic knowledge, genesis & internalization of culture (Vygotsky 1978)



Changeux, Courrège & Danchin 1973

«different learning inputs may produce different connective organisations & neuronal functioning abilities, but the same behavioral abilities»





Levinthal, Macagno & Levinthal 1976

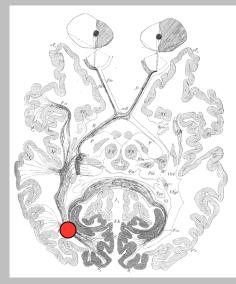
considerable epigenetic variability of the connectivity between individual brains yet with behavioral invariances

POSTNATAL SELECTION OF CULTURAL CIRCUITS

the example of writing & reading

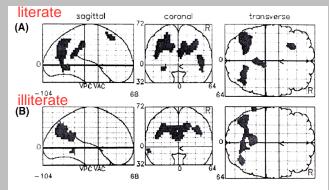


Jules & Augusta Dejerine

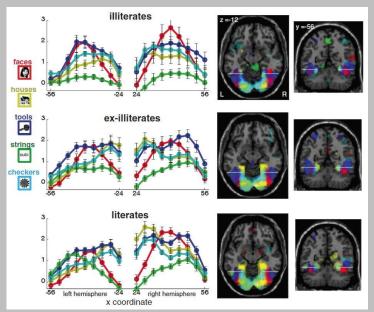


Dejerine 1901

lesion giving alexia without agraphie



Castro-Caldas, Peterson, Reis, Stone-Erlander & Martin Ingvar 1998



Dehaene, Pegado, Braga, Ventura, Nunes Filho, Jobert, Dehaene-Lambertz, Kolinsky, Morais & Cohen 2010

reading & writing = epigenetic appropriation of developing neural circuits



cognition access to consciousness

internal & external worlds

LEVELS & EVOLUTION OF «CONSCIOUS ACCESS»

J.Barresi & C.Moore 1996; Zelazo's 1996; Lagercrantz & Changeux 2009

LEVEL 1: minimal consciousness :

newborn & simple organisms *intentional representation of objects*, anticipations approach & avoidance behavior, delayed-response tasks but *unreflective* species without social life: i.e.mice & rats

LEVEL 2: recursive consciousness:

8-15 months infant imitative organisms with shared intentional relations to object holding two representations in working memory shared attention but without mutual understanding i.e.vervet monkeys,

LEVEL 3: self-consciousness:

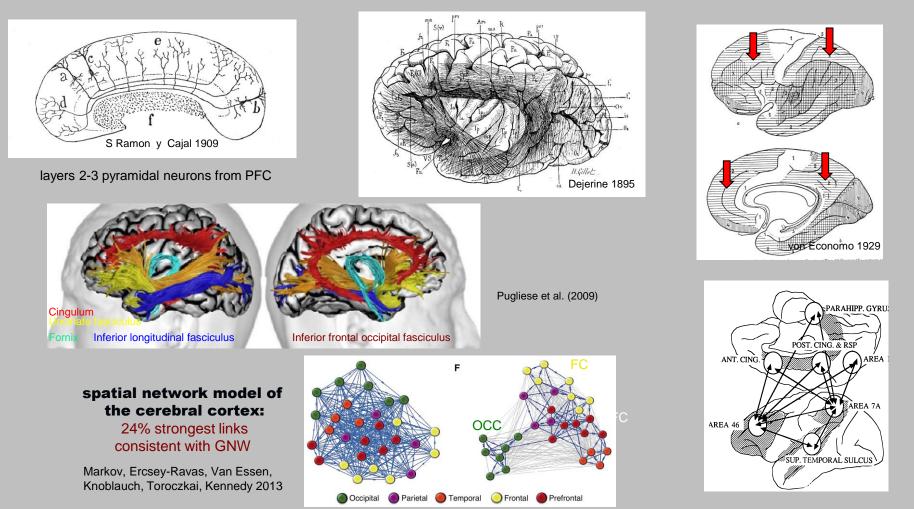
2 year old child & chimps imagination & the self-other distinction concept of intentional agent, self recognition on mirror tests

LEVEL 4: *reflective consciousness* & theory of mind: 3-5 year child full conscious experience

«GLOBAL NEURONAL WORKSPACE» HYPOTHESIS

long range brain connectivity & conscious access

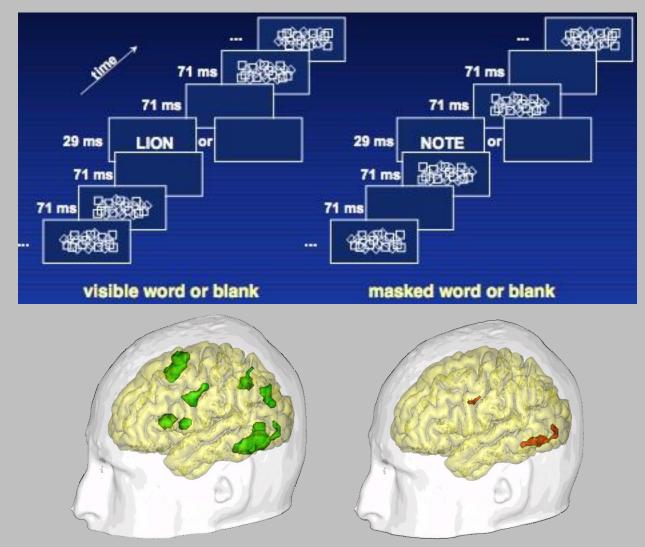
(Dehaene, Kerszberg & Changeux 1998. Dehaene & Changeux Neuron 2011)



hypothesis: long range axon neurons broadcast signals to multiple brain areas yielding subjective experience = conscious access

BRAIN IMAGING (FMRI) OF CONSCIOUS ACCESS

Dehaene et al 2001



differents brain circuits for conscious vs non-conscious processing distinguish inner vs outer worlds

«GOOD LIFE»

reward circuits & pleasure (dopamine)

happiness

Past remembrance (d) Opiate binding Cingulate regions (a) (g) Prefrontal cortex Depression Monitoring Present (h) (b) (e) THAL Midline MD Amy Future prospection Medial Prefrontal cortex LHb Cinquiotomies (f) (c) (i) Hipp Нуро ₩J STN SN/VTA Ventral tegmental Kringelbach & Berridge 2009 area Raphe

Haber & Knutson 2010

enhancement by drugs, electrical stimulation, videos...?

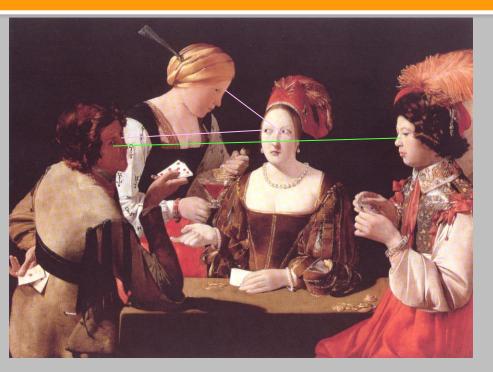
PPT

different neuronal circuits for hedonism (pleasure, *plaisir*) & eudemonism (happiness, *bonheu*r)

a neuroscience of good life?

WITH & FOR OTHERS» (Ricoeur) **SOCIAL RELATIONSHIPS** «sociability, sympathy & good will, generosity: highest of moral evolution» (Kropotkine)

ONESELF AS ANOTHER & THE NOTION OF «MIND READING»



Le tricheur à l'as de carreau George de La Tour

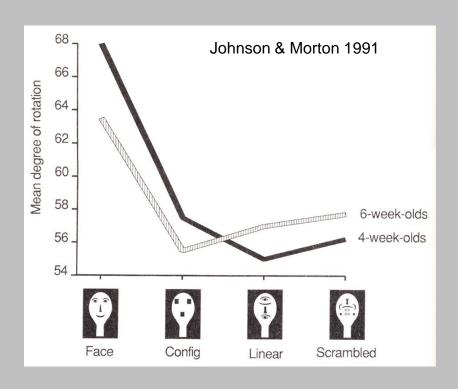
attribution of mental states to another (Premack & Woodruff 1978)

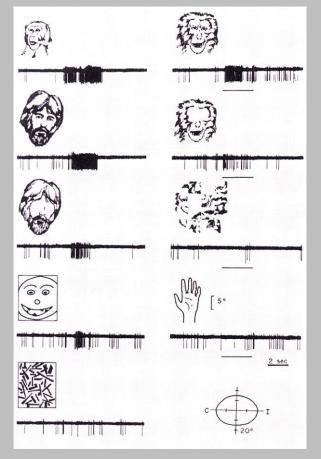
mind reading:

an innate disposition to put oneself to the place of the other, yet, without necessarily sharing the emotions

WHO IS THE OTHER?

« the relationship to a face is right away ethical» Emmanuel Lévinas

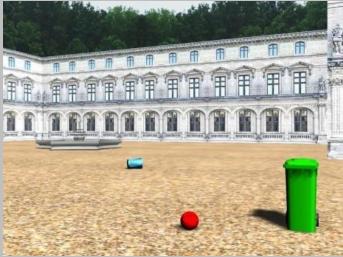




Gross et al 1981

innate disposition to recognize «the other»

EGO- vs **ALLO-CENTRIC REPRESENTATIONS**



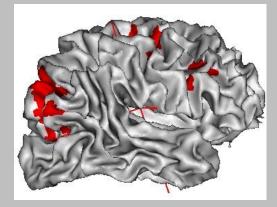
which is closest to you ?
which is closest to the red ball

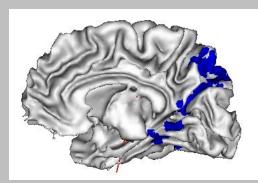
egocentric

hippocampus

allocentric

para-hippocampic bilateral median temporal brain imaging fMRI identification of objects in an architectural space



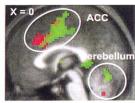


Commiteri, Galati, Pizzamiglio, Berthoz, Lebihan, Paradis 2004

"oneself" vs the "other" under the control of prefrontal cortex?

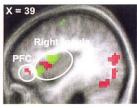
EMPATHY FOR SUFFERING

Α

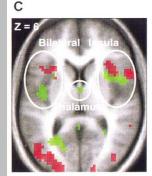


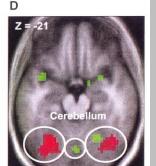
ACC anterior cingular cortex PCC prefrontal cortex

В









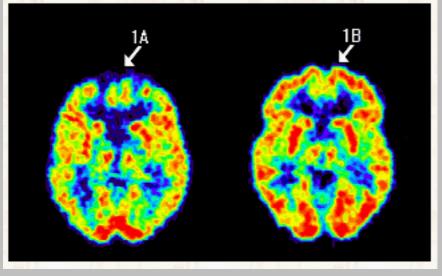
Singer, Seymour, O'Doherty, Kaube, Dolan & Frith 2004

apply electrical stimulus to self or to other partner red: pain/ self green: pain/ the other neural circuits of empathy?

SOCIOPATHY & VIOLENCE INHIBITOR

lesion left orbitofrontal cortex sociopathic personnality

normal



Adrian Rayne 1997

sociopathy: antisocial personality, aggressivity, eg serial killer, lack of remorse, though capacity of attribution preserved = violence inhibition altered

neural circuits of sympathy?

neural circuits of self-other recognition & evaluation

DEHUMANIZED PERCEPTION



Harris & Fiske 2006 Fried 1997

empathy does not necessarily mean sympathy

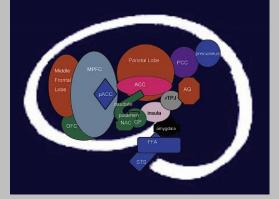


Terror in France 1793 Armenian genocide, nazi Holocaust, Red Khmers, Rwanda, Bosnia, Daech...

dehumanization: a person is viewed as a nonhuman without internal life, mental states, thoughts & feelings and without an identity as a person.

no longer compassion or other moral responses.

reduced medial prefrontal cortex activation also amygdala & insula involved in dehumanized perception



CAN WE BE EPIGENETICALLY PROACTIVE?

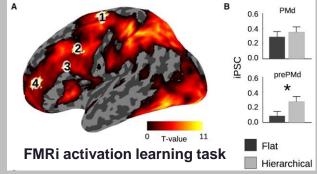
Evers & Changeux 2015

combinatorial explosion of possible representations in the brain selection & storage in memory of an «efficient rule» that limits, constrains and organize underlying representations

Changeux the Physiology of Truth 2004

"epigenetic rules" as acquired patterns of connections hypothetically stored in frontal cortex long-term memory regulate decision-making in a top-down manner.

frontal cortex & the discovery of abstract action rules Koechlin et al 2003; Badre, Kayse & D'Esposito 2010

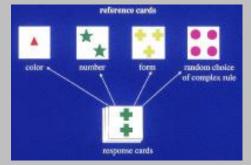


being "epigenetically proactive" = let us reciprocally adapt our social structures, in both the short and the long term, to benefit, influence and constructively Interact with our ever-developing brain architecture

MODEL OF «MENTAL DARWINISM»

Dehaene & Changeux 1991

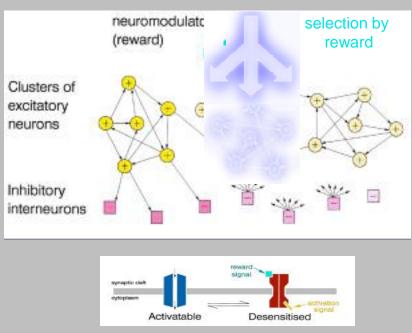
Wisconsin card sorting task

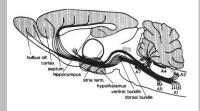


rules for colour, number, shape..

importance of spontaneous activity

= variable pre-representations coded by coherent *clusters* of excitatory neurons





dopaminergic reward neurons selection by reward of representations matching the outer world

allosteric receptors as signal integrators

role of reward (& anticipation of) in the selection of rules



THE AGORA

(J-P Vernant)

multiplicity of schools of thought public debate & open critics Interacting brains within intentional framework

selection of the solution which works the best the most adequate to the real world beyond social conventions & religious myths thus the most universal

in constant revision & in constant progress...

the search for objective **truth** together with inter-subjective **good**

ethics committees... a mondial ethics committee?

IN JUST INSTITUTIONS ethical rules & ethical innovation

THE GOLDEN RULE : EAST-WEST



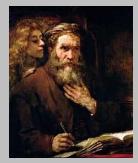
Confucius 551–479 BC «do not do to others what you do not wish done to you»



Mô-Tzu 470 BC – ca. 391 BC «he who loves others will be loved in his turn; he who causes others to profit will profit in his turn»

אבש איניי על איידי לא אואיני אישטאלא איידי איין אראיי אומיאיאביה לעי איידי איידי איידי איידי איידי איידי איידי אייניי אמראיאיאביה לעי איידי איידי איידי איידי איידי באיידי אייני יעד בוויני ישבעשער איידי איידי איידי איידי אייני אוז אייני יעד בוויני ישבעשער ובאיידי איידי איידי אייני אוז יידי בעינו איידי איידי איידי איידי איידי איידי איינון אוזי ויידי געער איידי גער איידי איידי איידי איידי איינון אוזי ויידי גער איידי גער איידי איידי איידי איידי איידי איינון אוזי ויידי גער איידי גער איידי איידי איידי איידי איידי איידי איידי איידי איידי ויידי גער איידי גער איידי גער איידי גער איידי Leviticus 19 8 ca. 400 (538–332) BC «love your neighbor as you love yourself» Hillel 110 BC-10 BC Babylonian Talmud «what is hateful to you, do not do to your neighbor»





Matthew 7:12 80-95 AD «do unto others as you would have them do unto you»

norm of reciprocity in the social group based upon the understanding of one-self in relation to others & «enlarging sympathy» (Darwin The Descent of Man 1871)

BIONT THE CANDAR NEYDU CITOYEN

PRÉAMBULE

bles et sacrés de lhomino; alla que cette décla. ent présente à tous les membres du corps al, Increappelle sans cesse teurs drotts at leurs devotes ; les actes du pouvoir lezislatif et œux du pouvoir est le contrantication politique, en coient plus respectés afin que les relarrotions des etogens, fondées décorronts sur des princi-on aimples et incontectables, iournant toujours au maintien de la constitution et du bonheur de tous.

de la constituition et cui contrictir de tous. EN conséquence, lassemblée nationale reconnoit et déclare, en presence et tous les auspiers de l'Étre suprême les droits suivans de l'homme et du citayen.

ARTICLE PREMIER LES horrows naissent et demeturent libras et égator en drois les disinctions sociales ne pouvent îlre fandres que sur Tallité commune.

I X Jui de tour association politique est la conservation des droits naturale et inpresertables de l'horone, ces droits sont la ilberté, la proprieté la surrié, et la résistance a l'oppression. III LE principe de toute souveralocié réside essentiellement dans la nation, nul corps, nul individu ne peut exercer dautorité.

qui nére simare expressément. LA liberté consiste a pouvoir fuer losires qui ne mile par à autrei dinsi forercite des droits naturels de chaque homme, n'a de boi, nes que celles qui assuren aux autres membres de la société la jouissance de ces mêmes droits; ces bornes na peuvent

la jourseure detre déterminées que par la loi Les déterminées que par la loi Louis na le drois de défendre que les actions muisibles à la société Tource qui n'est pas défendu par la loi ne peur être empêché et nul ne peur être contraint à fière ce qu'êlle nhr.

conne pas. VI. LA loi est l'expression de la volonté générale; tous les citoyens ont d'ioit de concourir personnellement, au par leurs représentans, à sa formation: elle doit être la même pour tou, son qu'ille protege, soit qu'ille puntase, Tous les etto yens étant égaix a sesyeux, sent égairment admissibles a toute's dignités places et emplois publics, selon leur ca-

vertus et de leurs talens

V11. NUT, horame ne poui être accusé, arreté ni détirmi que dans les ess détirminés par la loi, et solori les formes quelles à preservites, ceves qui sollici. tent, espédient, exécutari ou font exécuter das ordras ar-bienters, doivenc fire puivels music lous et dyon appelé ou saist en værin de la loi, doit oksir a linstant, il se rend coupable

par la refistance. L'A loi ne doit établis que des peines se rictement et évidim-ment nécessaire, et nul ne paut être puni qu'en verus dime ant être a chaque instant comparés avec le but 📩 loi établie et pranulquée antérierement au délit et légale

went appliquée. DX. TOUT homme étant présamé innoerni jusqu'à cequil dit dé déclar écupable, s'il es jugé indispensable de l'arrêter, ioute rigueur qui co sontigan nécessaire pour s'assurer de sa personne doit ême sérécement réprince par la loi. NUT, ne doit être inquiére pour sossopinions mêmes religi-quees pouvas que her manifestables ne trechle pas ferèce public établi par la loi.

XI. LA libre communication des pensées et des opinions est en des droite les plus presieux de Themme, suit citoge peut dont parler écrice, imprimer librement · sauf à ré pendre de labus de cette liberté dans les cas déterminés sar la loi

L'A garantie des droits de Fhomme et du citoyers nécessité une laice publique rette bace est donc insituée pour levue goe de toux, et non pour l'utilité particulière de ceux à qui ille est confliée. XIII

Pour est confiére. Pour l'invertien de la lorce publique, et pour les dépenses dédrivinistration, une contribution construine est indépen-sable, elle doit dre égylervent sépartie entre les ettoyens en raison de leurs facultées

Tetteorre reure inclutere LEScienzens ont le droit de consister par eux, infine ou par leurs représentairs, la nécessité de la contribution pub lique, de la consentir librement, d'en suivre lamplei et den diterminer la quoité, lassitée, le recouvrement et le durée.

LA société a le droit de demander compte a tout agent public de son adm stration .

TUUTE société dans laquelle la garantie des droits nis

LES propriétés étant un droit înviolable et sacre nul ne peut en être privé, si ce n'est lorsque la nécessité publique, légalement constatée, lexige evidémment, et sous la condi-tion d'une juste et préalable indemnité.

DECLARATION OF HUMAN RIGHTS 1789

liberté, égalité, fraternité

UNIVERSAL DECLARATION OF HUMAN RIGHTS 1948



Eleanor Roosevelt & René Cassin

toward a universal ethics?

AUX REPRESENTANS DU PEUPLE FRANCOIS



to be epigenetically proactive? Keith HARING