Нейроэкономика 2.0

следующий шаг

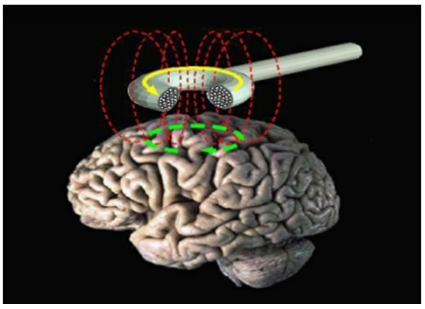
Василий Андреевич Ключарев, Высшая школа Экономики

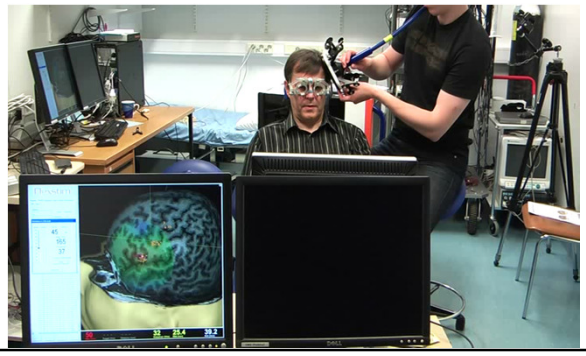
Восхитительная Гипотеза:

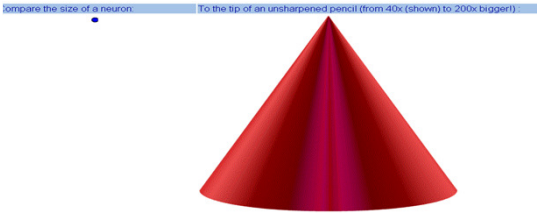
“ Мысли человека – ничего более, как поведение нейронов… и атомов, молекул которые их образовывают… “

Francis Crick (1916 –2004)

Phineas P. Gage
(July 9?, 1823 – May 21, 1860)

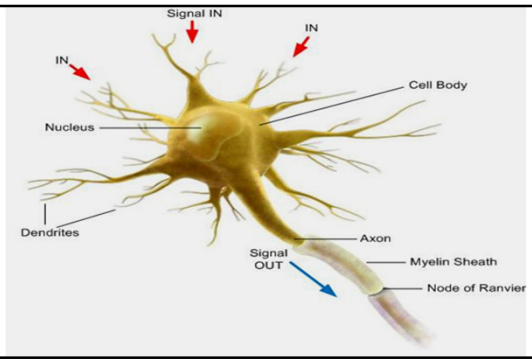




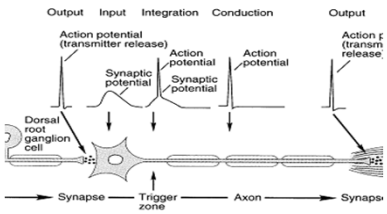


The typical size of neurons is between 10 - 50 micrometers (1 µm, 0.000001 meters)

http://www.ualberta.ca/~neuro/OnlineIntro/NeuronExample.htm



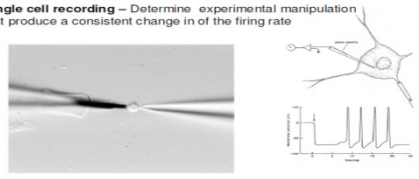
Firing rate – average number of action potentials



The neuron can be modelled as a computational element which sums its inputs within its time-constant and, whenever this sum, minus inhibitory effects, exceeds a threshold, produces an action potential which propagates to all of its outputs.

Single cell recording

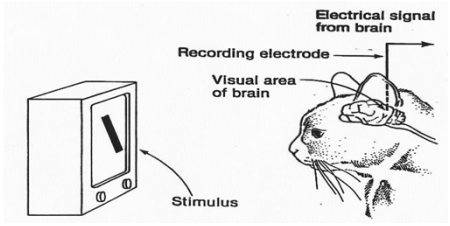
Single cell recording – Determine experimental manipulation that produce a consistent change in of the firing rate



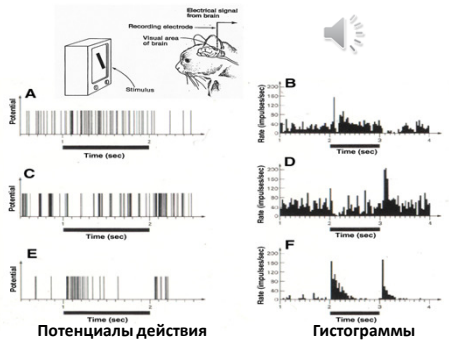
The fiber diameter is 6 µm

Firing rate – average number of action potentials

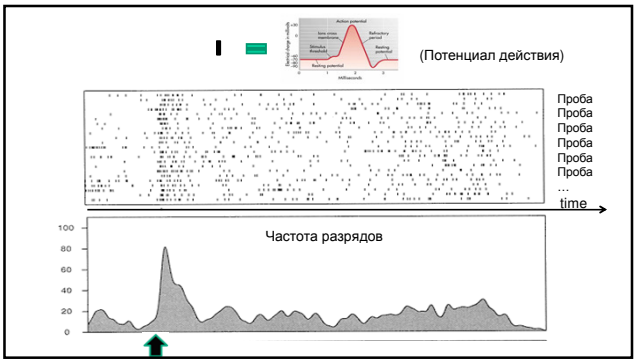
http://www.vandenhul.com/artpap/lsc-neuro.htm

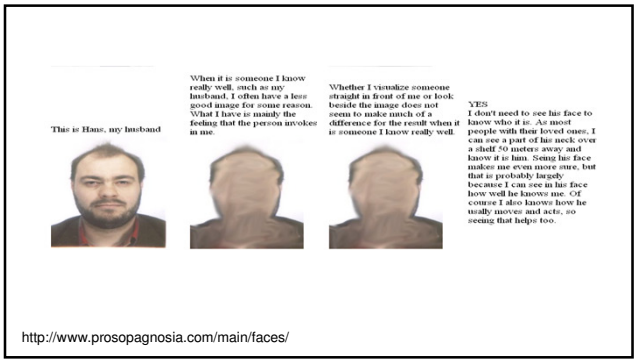


www.caip.rutgers.edu/~feher/SandP/prep1_5.html

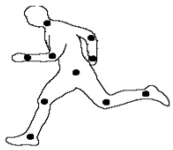


Потенциалы действия **Гистограммы**



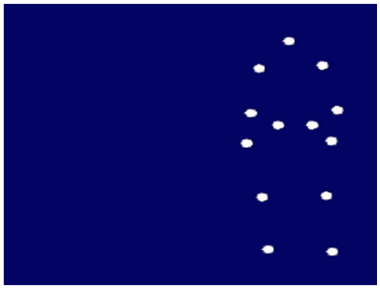


http://www.prosopagnosia.com/main/faces/

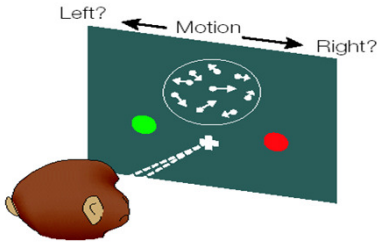


Gunnar Johansson

http://www.uni-tuebingen.de/uni/knv/arl/project_learning_research_page.html



a Perceptual discrimination task



William T. Newsome

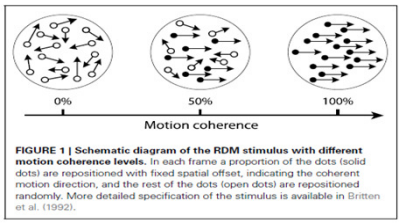


FIGURE 1 | Schematic diagram of the RDM stimulus with different motion coherence levels. In each frame a proportion of the dots (solid dots) are repositioned with fixed spatial offset, indicating the coherent motion direction, and the rest of the dots (open dots) are repositioned randomly. More detailed specification of the stimulus is available in Britten et al. (1992).

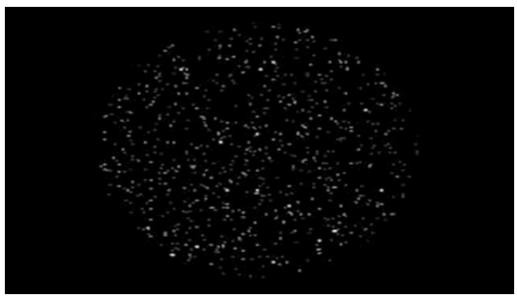
Jiaxiang Zhang 2013

Difficult perceptual decision

100%

http://monkeybiz.stanford.edu/

Easy perceptual decision



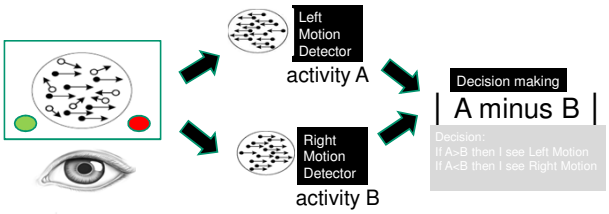
50%

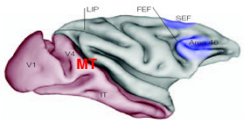
http://monkeybiz.stanford.edu/

Very difficult perceptual decision

0%

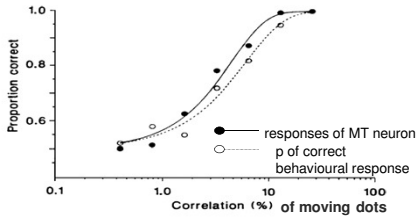
http://monkeybiz.stanford.edu/

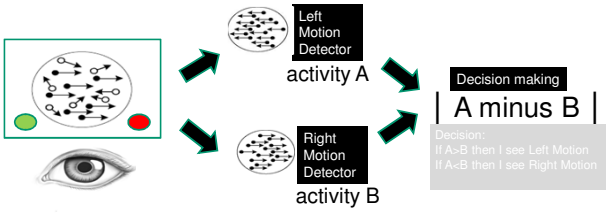


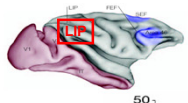


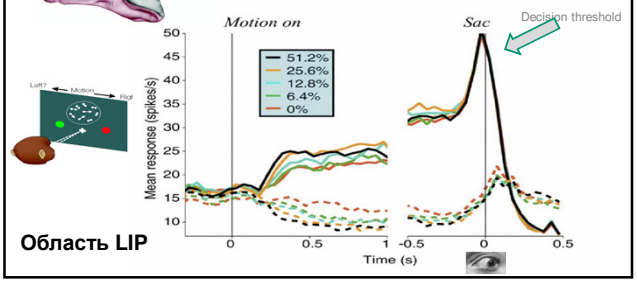
Детекторы движения– областьMT

The likelihood that the monkey would make a rightward saccade was a lawful function of the firing rate of the rightward motion–preferring neurons in area MT.

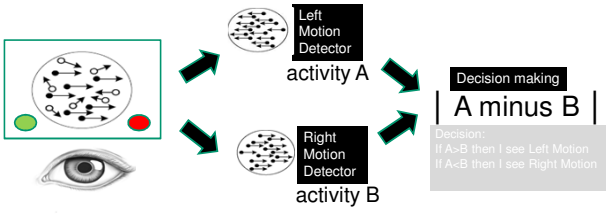


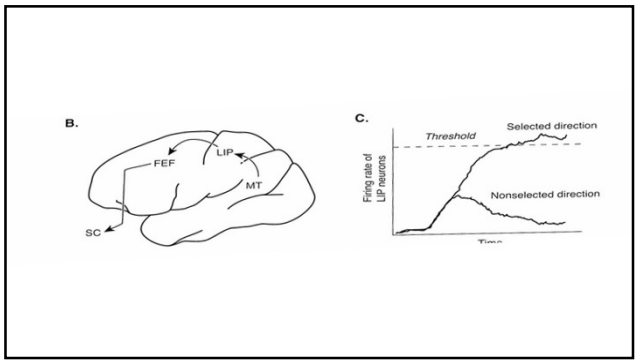


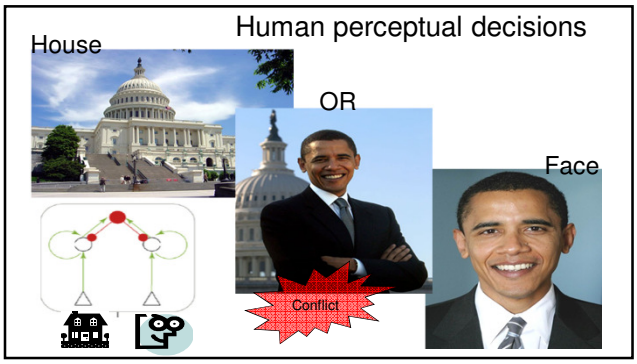


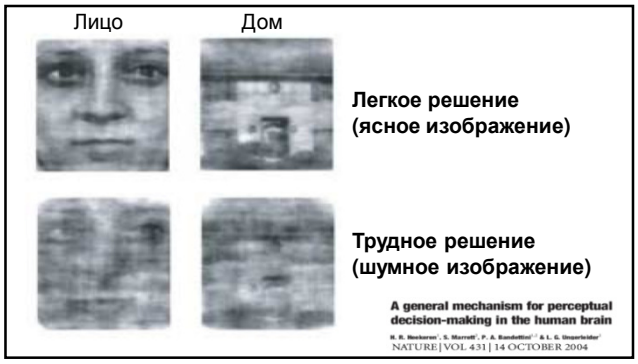


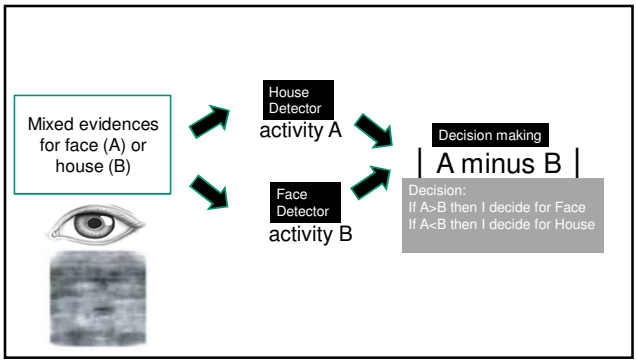
Область LIP



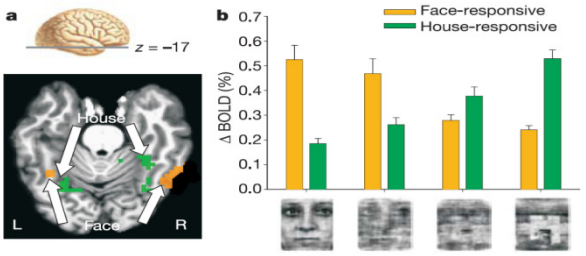

B.
FEF
LIP
MT
SC
C.
Threshold
Selected direction
Nonselected direction
Firing rate of LIP neurons
Time


Human perceptual decisions
House
OR
Face
Conflict

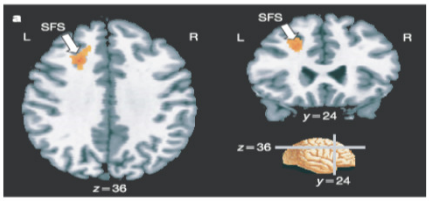

Лицо
Дом
Легкое решение
(ясное изображение)
Трудное решение
(шумное изображение)
A general mechanism for perceptual decision-making in the human brain
NATURE | VOL 431 | 14 OCTOBER 2004


Mixed evidences for face (A) or house (B)
House Detector
activity A
Face Detector
activity B
Decision making
| A minus B |
Decision:
If A>B then I decide for Face
If A<B then I decide for House

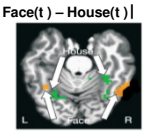
BBC ONE



Search for diffusion model integrator:



|Face(t) – House(t)|



Perceptual decision-making in posterior **DLPFC**. The DLPFC shows both a higher response to clear images of faces and houses relative to noise images, and a correlation with **|Face(t) – House(t)|**, suggesting that this brain region integrates sensory evidence from sensory processing areas to make a perceptual decision

Диффузионная модель

(a) Left DLPFC = | Face(t) – House(t) |

(b) DLPFC predicts behavioral performance.

The comparison of the outputs **the diffusion model** could be a general mechanism by which the human brain computes decisions.

Потери и Приобретения

?

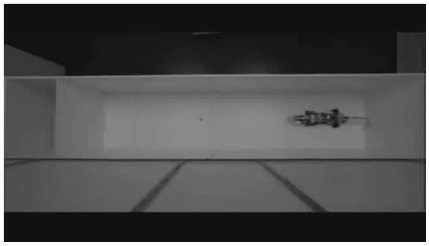
Fugu contains lethal amounts of the poison tetrodotoxin in its organs. 30-60 victims per year, an average fatality rate of 6.8%.

Ожидаемые приобретения

Ventral striatum

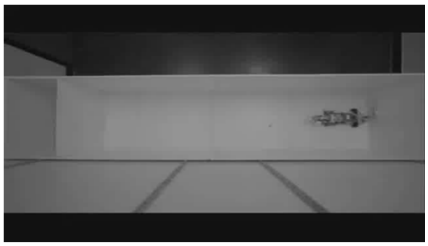
Fig. 5.1 A rat pressing a lever in order to obtain brain-stimulation reward. The reward is provided by a 0.5-s train of pulses of stimulation at typically 50–100 Hz delivered each time the rat presses the bar. (After Olds 1956.)

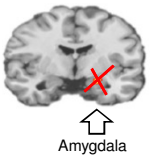
Ожидаемые потери



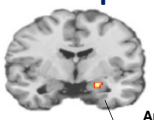
Amygdala

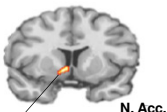
Ожидаемые потери



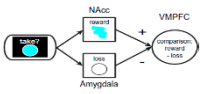


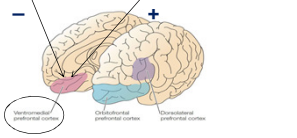
Потери & Приобретения



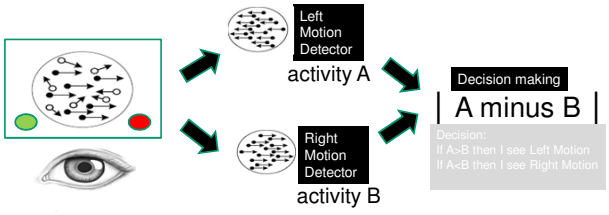


cost–benefit comparison





Basten et al 2010 PNAS



Additional perspectives

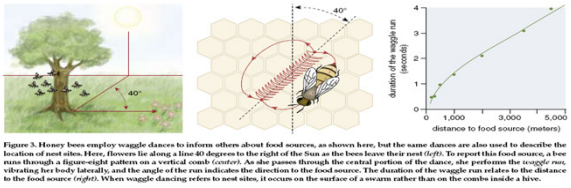


Figure 3. Honey bees employ waggle dances to inform others about food sources, as shown here, but the same dances are also used to describe the location of nest sites. Here, flowers lie along a line 40 degrees to the right of the Sun as the bees leave their nest (*left*). To report this food source, a bee runs through a figure-eight pattern on a vertical comb (*center*). As she passes through the central portion of the dance, she performs the *waggle run*, vibrating her body laterally, and the angle of the run indicates the direction to the food source. The duration of the waggle run relates to the distance to the food source (*right*). When waggle dancing refers to nest sites, it occurs on the surface of a swarm rather than on the combs inside a hive.

Additional perspectives

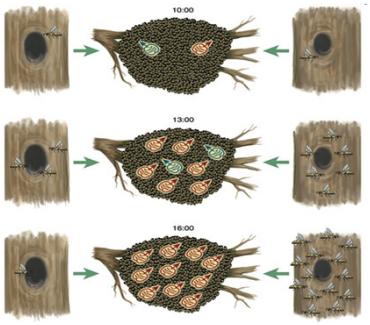
Bee Dance (Waggle Dance)

Bienentanz Gesellschaft für Kommunikation mbH in Berlin, Germany (www.bienentanz.com).

Additional perspectives

Seeley et al (2006)

Additional perspectives



Seeley et al (2006)

Additional perspectives

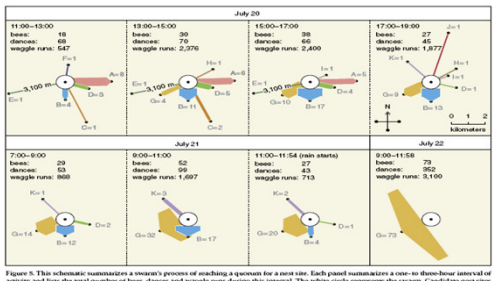
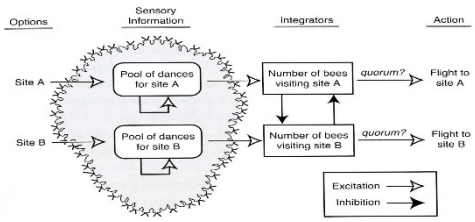
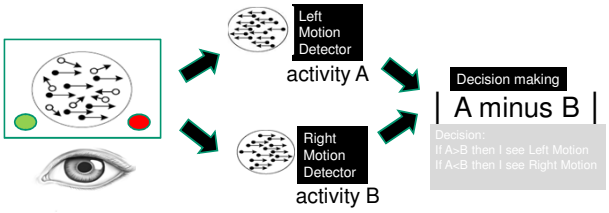


Figure 5. This schematic summarizes a swarm's process of reaching a quorum for a nest site. Each panel summarizes a one- to three-hour interval of activity and lists the total number of bees, dances and waggle runs during this interval. The white circle represents the swarm. Candidate nest sites (*black dots*) are assigned letters in the order in which the bees reported them. Each arrow indicates direction and distance to a site; the thickness of the arrow correlates with how many bees are dancing in support of that site during the interval, as shown by the number next to each site's letter designation. In this case, the swarm considered a total of 11 sites over three days, but none was advertised much more strongly than the others during the first half of the decision-making process. During the second half, however, site G gradually gained support and became the subject of all the dances.

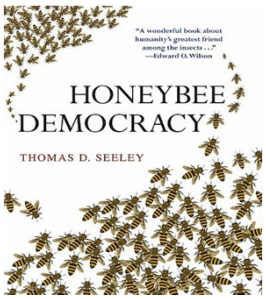
Seeley et al (2006)



Seeley et al (2006)



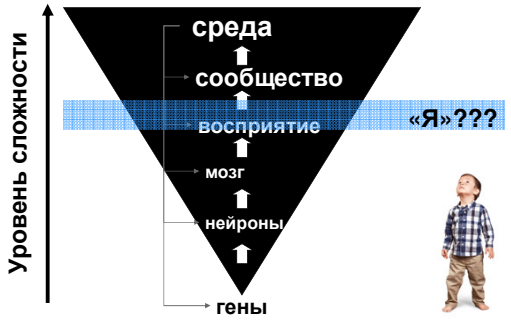
Additional perspectives

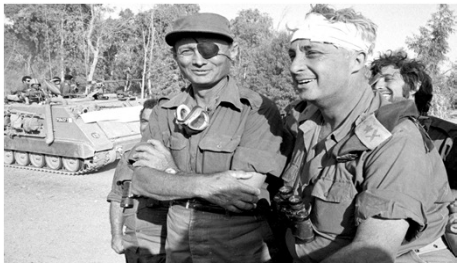


Небольшой вывод

- ✓ «Диффузионная модель» принятия решений предполагает что выбор происходит тогда, когда разница в доказательствах в пользу одной из альтернатив достигает нескорого порогового значения.
- ✓ **Мозг по-видимому работает по «диффузному» принципу**

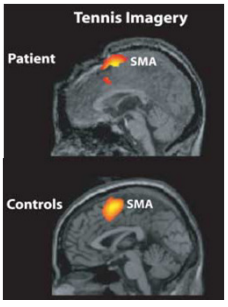
Ну и что?





EXPRESS

Miraculous moment 16-year-old boy wakes up and hugs his father after four month coma



Detecting Awareness in the Vegetative State

Adrian M. Owen,[1]* Martin R. Coleman,[2] Melanie Boly,[3] Matthew H. Davis,[1] Steven Laureys,[2] John D. Pickard[2]

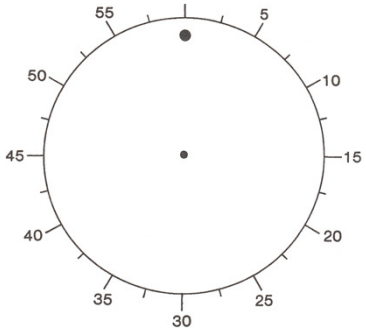
8 SEPTEMBER 2006 VOL 313 SCIENCE

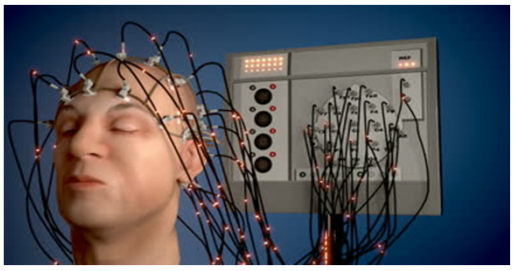
Представление о личной ответсвенности....

Benjamin Libet
(1916-2007)

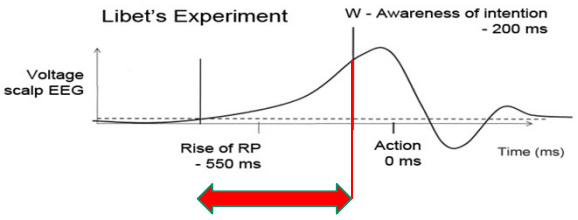
University of California

Libet, Benjamin; Gleason, Curtis A.; Wright, Elwood W.; Pearl, Dennis K. (1983).
"Time of Conscious Intention to Act in Relation to Onset of Cerebral Activity (Readiness-Potential)
- The Unconscious Initiation of a Freely Voluntary Act". *Brain* **106**: 623–642.



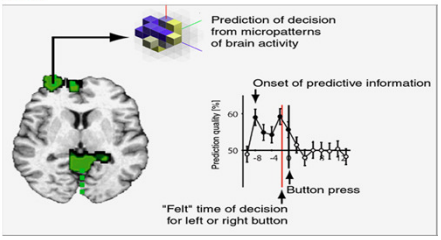


Dabarti CGI

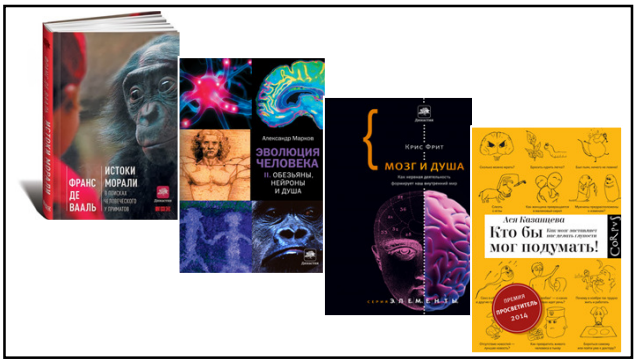


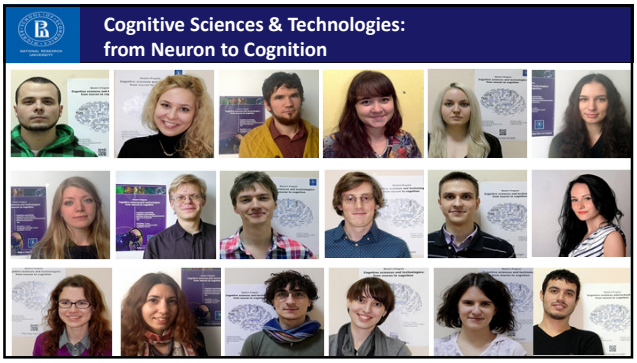
http://www.informationphilosopher.com/freedom/libet_experiments.html

nature neuroscience



"Your decisions are strongly prepared by brain activity. By the time consciousness kicks in, most of the work has already been done," said study co-author John-Dylan Haynes





www.hse.ru/en/cdm-centre

Департамент Психологии ВШЭ

Спасибо за внимание!