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Can AI emulate slow & fast thinking?

Abstract

Artificial Intelligence (AI) attempts to emulate natural intelligence of Homo sapiens. Sometimes, the wise men have biases. This review pointed out the gaps, and the shortfalls to develop new AI. Currently, given the technology of the 5th G. m.m.w. communication broadband channel, real-time smart sensory inputs with rapid electronic processing become possible to overcome some gaps reasonably. The questions remain are whether AI can capture the chemical signals, such as hormones effects? We provide the motivation for AI developers care to overcome these shortfalls? (1) Financial Reasons: Space travel can have intelligent as well as emotion-sensitive robots to colonize the Space sites. (2) Earthbound Humanity Reasons: Aging WWII Baby Boomers about 100M and most of them about half without offspring to take care them, they will live long contribute their experience and wisdom but will need Humanoids take care of them with the understanding of their loneliness emotional needs.

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Introduction early generation of Artificial Intelligence (AI)

Alan Turing (King's College, 1912-1954) is a mathematics genius and has broken German Enigma code during the WWII, and changed a difficult question "Can Machine Think?" to measurable one: "Can one know whether at the other end a computer machine or human?", the so-called Turing Test. Marvin Lee Minsky (MIT, 1927–2016) developed under ONR sponsorship a simple Rule-Based system: "if-then". Furthermore, he pointed out the fact that Frank Rosenblatt (Cornel U.,1928-1971) pioneered the connectionist approach for explaining how biological systems sense, process, organize and use information with "perception" device which is kept in Smithsonian, but unfortunately one-layer device cannot do "Ex-OR" logic.

John McCarthy (1927-2011, Stanford Univ.) coined formally the name AI as he invented programming Lisp: "List Program" with "if–then–else" syntax for two parallel tracks of codes (the program will do one task (codes inside the if-block) if the condition is true and another task (different codes inside the else-block) if the condition is false). Such a dual track parallel structure under if-block and else-block appear to be more intelligent, it became the choice for AI in applications in the late 1950s beside IBM FORTRAN language. Note that (1) whenever there is a choice to make, there appears to have either some slow intelligent thinking or purely random in drawing a lottery ticket; (2). List Processor (Lisp) where the Assembly machine language Macro is similar to and after the FORTRAN; (3) with the dual-track black-red do-loops might schematically in Tai Chi Yin-Yang fashion (as if two sides of brains looping around for logical and emotional biases; but not yet implemented) Figure 1.

Figure 1 AI began with (a) Alan Turing formalized 1st Gen AI with (b) John McCarthy, together with Steve Russell, implemented together (c) An "**if–then–else**", dual tracks syntax like Tai Chi Ying-Yang, first done on IBM Punch Cards as the first Gen AI.

AI is meant to emulate human natural intelligence (NI) but early MIT Minsky's days seem to get only rule based system and one track of mind correctly. It is interesting to note from neurobiology that the left half hemisphere is generally responsible for language and speech (which are more than logical or analytical), whereas the right one generally handles emotions and facial recognition (which are not just creative or artistic). While other animal have two brains, notably the dinosaurs have two brains, one at the top and the other at the bottom to control its long tails in rapid actions.

When did we start International Neural Network Society (INNS) to began the 2nd Gen AI from static associative recall to dynamic learning

Working at Naval Research Lab we wish to catch illicit trafficking which can come with a Semi-Submersive to anywhere along the long US coast line. We were wondering whether or not some EO-RF-SN sensor suite with omputationnal processing can do the persistent surveillance job Figure 2.

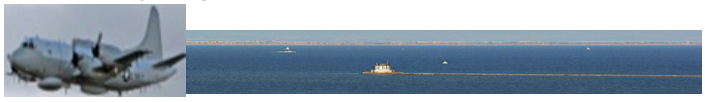

Figure 2 Surveillance against semi-submissive, that smuggle drugs with terrorists through the Los Angle Harbor.

In cases of an immersed Semi-Submersive, the traditional sensors working in the deep blue sea became ineffective operated at the yellow water harbors, due to the surface waves broad-band noises that can overwhelm the general purpose passive sonar (SN) detection, and the ocean salt ionic water reflection with unusually too smaller foot-prints to prevent the Radar penetration (RF), we began INNS 3 decades ago circa 1988 after our EO-RF-SN surveillance computational processing experiment failed in the shallow or so-called "yellow" water harbor. Nonetheless, our eyes can inference from slightly different rippling surface waves below the immersed semi-submissive, for we already knew of where to look for. Of course, with the hindsight, those days we did not follow the Gold unbiased standard dictated by the National Institute of Health (NIH), namely double blind (DB), negative control (NC), and sufficient statistics (SS).

In spite of the deficiency, we began studying the 2nd Gen AI by emulating biological Human Visual System (HVS) Deep Learning (DL) as follows: Question #1 how can our ancestors see a single photon emitted from a wolf 'eye, denoted as Δp_1 and still satisfied the Quantum Mechanical uncertainty principle at warm human body temperature $37^{o}C$? Answer: The eye has bundled 100 rods with large

spatial uncertainty Δx_{100} connected at a single detection collection unit called Ganglion. As a matter of fact, the detection logic is known as "negate the converse (no more dark inhibition current)" means we have seen the "wolf eye" by negating the not seeing condition logic.

$$\Delta x_{100} \Delta p_1 \approx \hbar \qquad (1)$$

In each human eye has 6M (pointing-shape) cones for daylight and 150M (cylinder-shape) rods for night light. They are all pointing backward to see the reflection of light without overly being burn by solar UV light (except cats have both forward and backward with rods especially suited for night light hunting). The cone has Rhodopsin molecule which can absorb the red color, made human being are special to be able to see red ripen fruits and able to lead all other animal for more nutrition, e.g. dogs, cows, and horses cannot see reds. Multiple layers Deep Learning by means of "on-center off-surround" firing rates resource management can reveal Mona Liza Figure 3.

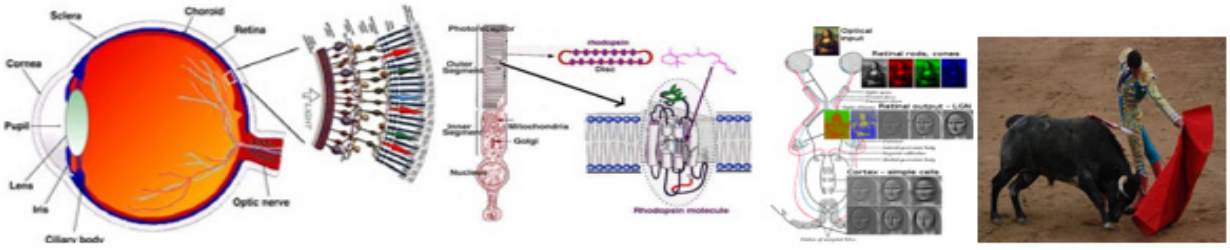

Figure 3 Both cones and rods for night light are all pointing backward to see the reflection of light without overly being burn by solar UV light (except cats have both forward and backward with rods especially suited for night light hunting). (b) The cone has Rhodopsin molecule which has seven winding loops, and the dropping of the 7th arm for a large space distance associated with lower energy gap to absorb the red color, made human being are special to be able to see red ripen fruits and able to lead all other animal for more nutrition, e.g. dogs, cows, and horses cannot see reds. (c) Multiple layers Deep Learning by means of "on-center off-surround" firing rates resource management can reveal from cone pixels to the edges, from the edges to the contours, etc. curvatures, objects detection to reveal Mona Liza. (d) In fact, despite bull fighter using red cape, the bystanders can see the red color, the bull can only see the wavy motion.

We defined the 2nd Gen AI to emulate "human" to mean "Homo sapiens" (Latin: wise man) that were evolving in Africa, inherited about 2%DNA from "Neanderthals" evolved in Europe and Asia about half millions years ago. We went back into brain to see the Hippocampus for learning & judgment at Inferotemporal Cortex of 205 neurons, e.g. Associative memory matrix for Good Guy vs. Bad Guy (This is based on Deep Learning from image to feature Domains to Unique Facial ID by Prof. Doris Tsai, Caltech, Sci. Am. Feb 2019 pp.22-29, proved from fMRI (blood) + in-situ and investigated the "on-the-center, off-the-surround" at the short time ~1/17 sec firing rates. We can understand the so-called "layer-by-layer iterative DL" due to a resource replenishment firing rate strategy. For example, the 1st layer-in all pixels, some are bights and relative to the others which are not. Once few bight pixels fired, on-the-center, the neighborhood pixels will not fire, off-the-surround. Then, the bight-dark contrast will be enhanced like an edge segments, and the iteratively the edges move on to the next layer. All those edge segments will be decide to be connected or broken away? This happened at Layer#2: edges-in, connected object-out; Layer#3: connected object-in, object concave or convex curvature-out: Layer#4: curvature-in, associative memory object ID-out. These were efficiently done in matrix-matrix computation in nowadays known as multiple layers Artificial Neural Nets (ANN) nowadays called DL to achieve pattern recognition similar to the back of our heads called cortex 17.

Looking back, all human sensors are in pairs. This might be because we need the instantaneous decision: "Agree, Signal; Don't, Noise" for survival reasons. We realized the importance to have neurologists, biologists, engineers, mathematicians, physicists as an interdisciplinary team to investigate human natural intelligence, Consequently, we are motivated to incorporate a professional society to leverage one another with 17 interdisciplinary scientists formed the so-called International Neural Network Society (INNS) incorporated at Wash DC with Secretary and Treasurer office located at NRL with the help of Mr. Frank Polkinghorn and Intern Joseph Landa.

150 Millions rods with every100 rods are bundled together with their own "(no incident light called the dark) currents" to (inhibit) their integrator neuron called Ganglion, while the Ganglion is standing by with own energy ready to fire to the cortex 17. Recently, we went back to Hippocampus for learning & judgment at Inferotemporal Cortex of 205 neurons, e.g. Associative memory matrix for Good Guy vs. Bad Guy (This is based on Deep Learning from image to feature Domains to Unique Facial ID by Prof. Doris Tsai , Caltech, Sci. Am. Feb 2019 pp.22-29, proved from fMRI (blood) + in-situ Figure 4A&4B.

Figure 4A Prof. Doris Tsai, Caltech, using fMRI identified Inferotemporal Cortex of 205 neurons for associative memory.

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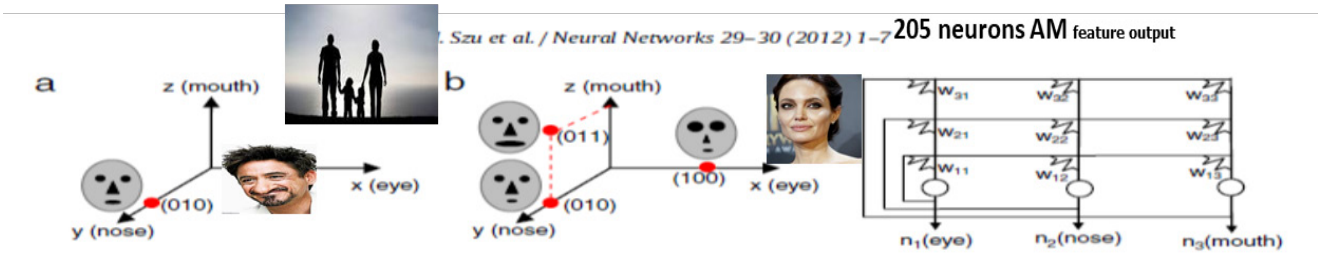


When the child saw that the Big Nose Uncle opened Big Mouth Laughed~z, Who was he?

WRITE: Hippocampus feature AM (firing rates 1=100Hz, 0<50Hz)

$$[AM]_{big\ eye\ aunt} = \overrightarrow{output} \otimes \overrightarrow{input} = \begin{bmatrix}1\\0\\0\end{bmatrix} \begin{bmatrix}1 & 0 & 0\\0 & 0 & 0\\0 & 0 & 0\end{bmatrix}$$

$$[AM]_{big\ nose\ unde} = \overrightarrow{output} \otimes \overrightarrow{input} = \begin{bmatrix}0\\1\\0\end{bmatrix} \begin{bmatrix}0 & 1 & 0\\0 & 0 & 0\\0 & 1 & 0\\0 & 0 & 0\end{bmatrix}$$

$$[AM]_{big\ nose\ unde} + [AM]_{big\ eye\ aunt} = \begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 0\end{bmatrix}.$$

READ:

$$\text{Recall Vector} = [AM][\text{error transmitted}] \cong \sigma\left(\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 0\end{bmatrix}\begin{bmatrix}0\\1\\1\end{bmatrix}\right) = \begin{bmatrix}0\\1\\0\end{bmatrix}_{uncle\ smiles}.$$

Figure 4B Static Associative Memory, schematically related to thousands pixel neurons to final feature neurons for associative recall.

Dynamic ANN

Albert Einstein said well "Science has nothing to do with the truth, but consistency;"

& "Keep it simple; not any simpler" then anything consistent should be represented consistently in logic as well Figure 5:

Figure 5 Physicists Mathematician Albert Einstein (1879, 1955) thermal diffusion, Alexandra Lyaponov (1857, 1918), Academician John Hopfield (1933), Adrei Kolmogorov (1903-1987), contributed to ANN.

Newton force equation of learning weight matrix $[W_{i,j}]$

$$\frac{\Delta[W_{i,j}]}{\Delta t} = -\frac{\Delta H}{\Delta[W_{i,j}]} \qquad (2)$$

John Hopfield (1988)

Iteratively input $\bar{X}_{pairs}$ & output $\hat{y}_{pairs}$, after sigmoid σ threshold output, we iteratively went back at the other/input layer again $\bar{X}'_{pairs}$

$$\hat{y}_{pairs}(t) = [W_{i,j}(t)]\bar{X}_{pairs}(t) \qquad (3)$$

$$\text{New } \bar{X}_{pairs}(t') = \sigma\left(\hat{y}_{pairs}(t')\right) \qquad (4)$$

Adrei Kolmogorov (1903-1987) layer approximation of any functions and

Alexandra Lyaponov (1857, 1918) convergence proof.

$$\frac{dH}{dt} = \frac{\partial H}{\partial[W]}\frac{d[W]}{dt} = \frac{\partial H}{\partial[W]}\left(-\frac{\partial H}{\partial[W]}\right) = -\left(\frac{\partial H}{\partial[W]}\right)^2 \le 0 \quad \text{Q.E.D. (5)}$$

How Homo-sapiens hemodynamic build neuronal sigmoid threshold logic?

1. After ice age, warm-body temp is necessary keeping oxygenated hemoglobin elastic enough to squeeze through capillary)

$$T_0 = 273 + 37^0 C = 310; \quad k_B T_0 \cong \left(\frac{1}{37}\right) eV \qquad (6)$$

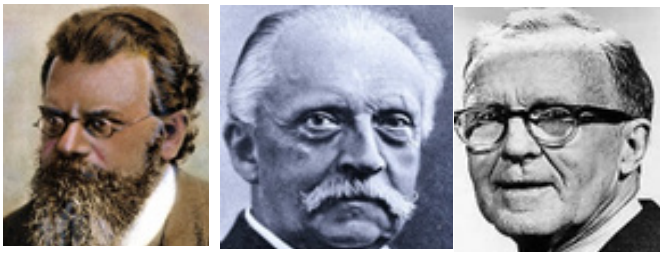
2. Secondly, where does the neuronal threshold logic come from Boltzmann Entropy?

$$S_{entropy} = k_B \log W_{phase\ space\ probability} \quad (7)$$

$$W = \exp\left(\frac{S}{k_B}\right) = \exp\left(\frac{ST_0}{k_B T_0}\right) \quad (8)$$

$$E(in) + S(out)T_0 = 0$$

Figure 6a-6c



(a), **(b),** **(c)**

Figure 6 (a) Ludwig Boltzmann asserted scalar phase space volume measures the probability, of which the degree of uniformity is called the entropy, (b) Hermann Helmholtz introduced the free to do work energy; and (c) Donald Hebb observed "Neurons fire together, wire together" 1949 input energy produces more uniformity entropy S at a constnat temperature.

$$\exp\left(\frac{(S(in)+S(out))T_0}{k_B T_0}\right) = \exp\left(-\frac{E(\text{in}) - S(\text{in})T_0}{k_B T_0}\right) = \exp\left(-\frac{H(in)}{k_B T_0}\right) \quad (9)$$

$$H(in) \equiv E(in) - S(in)T_0$$

$$y(x) = \frac{\exp\left(-\frac{H(out)}{k_B T}\right)}{\exp\left(-\frac{H(out)}{k_B T}\right) + \exp\left(-\frac{H(in)}{k_B T}\right)} \equiv \frac{1}{1+\exp(-x)} = \sigma(x) = 1, @100Hz,$$

Net sum $X_i = \sum_j \left[W_{i,j}\right] y_j$ (10a, b)

$$x = \frac{H(in)}{k_B T} - \frac{H(out)}{k_B T}$$

$$y(x) = 2\sigma(x) - 1 \quad (11)$$

Major accomplishment of 2nd Gen AI:

(1) Emulating homo sapiens

As noted by Daniel Kahneman thermal noises Eq(6) drive behind threshold Logic, as we have mathematically derived the sigmoid Logic derived from the product between the thermal temperature and Boltzmann Entropy, which is a measure of the degree of uniformity beach sands have higher entropy than mountain top rock)". As a result, an occasional "hot flush" (thermal fluctuation) may make "different/ wrong" choice.

(2) Implementation of smart sensory In/Output

Figure 7

Figure 7 Could we emulate emotion using wireless 5G millimeter wave Net (2018--2020)(Jeff Brown, angle fund after Channel sold $60B) "Our feeling may be represented by real time virtual reality hologram" New 5G wireless transceiver enables 3D real time hologram display of zoo lion. It appears to be life.

(3) There are economic motivations for developing AI-Robots to assist astronauts to travel to the other planets to bring back crucial resources. More reasons to design "humanoids" who can perceive the loneliness emotion of 100 millions of home alone sensors (HAS) of World War II baby boomers for they can take care of HAS better with the superficial empathy. We can summarize mankind activities from Art philosophy Science to Technology (APST). That cannot be escaped both logically and emotionally represented in Figure 8(a, b, c, d, e, f).

(4) Big Data Analysis (BDA) Now that we have deduced the AI logic, AI can program the home-care early warning screening e.g. too much UV light exposure skin cancers, and other more subtle disorders. For example, an app in "Deep Learning" "Breast Cancer in Singapore: Trends in Incidence 1968-1992," A SEOW, S W DUFFY, M A McGEE, J LEE & H P LEE, Int'l J. Epidemiology, Vol. 25, No. 1, pp.40-45 (1996 Britain) Figure 9.

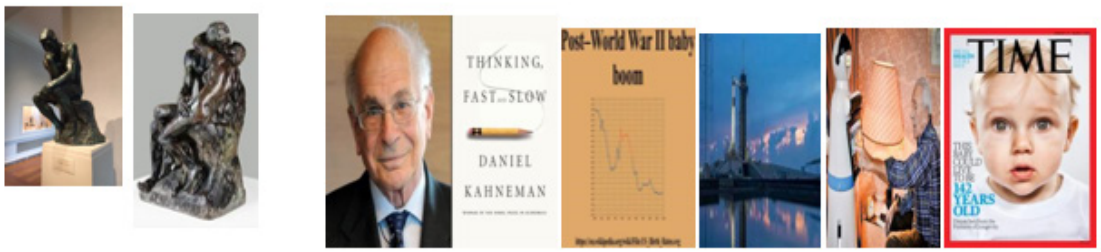


Figure 8(a) emotionally "Le Baiser (the Kiss)"(original Marble at French Musee Rudin, Bronze at Mexico The founder of modern sculptures by Auguste Rodin(French 1840-1917) (b) Also support Logically "Le Penseur (The Poet Thinker at the Gates of Hell in "Alighieri Dante", deep contemplation, philosopher, exhibit photo taken at Smithsonian-Nat. Gal. Art, 2021); (c) "Thinking; Fast and Slow," by Daniel Kahneman, Nobel Laureate 2002(interpreted as emotionally fast and logically slow by Author); (d) Post World War II Baby Boom Statistics 78M in the US alone;(e) Logically Space-X launch to the outer space; (e) Emotionally Humanoids take care of millions Hone Alone Seniors.(f) Time Magazine (Feb 23, 2015) predict that this baby could live to 142 years old.

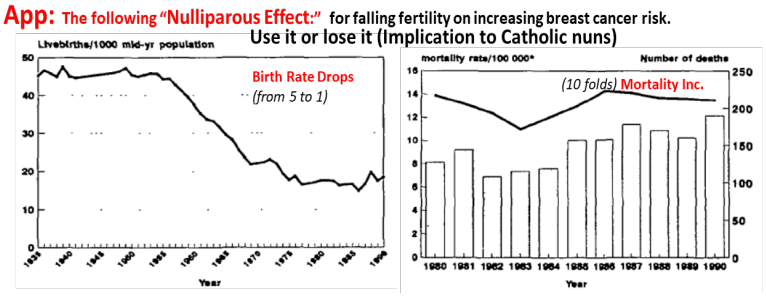


Figure 9 Nulliparous-women effect: https://www.verywellfamily.com/nulliparous-women-3522717.

Conclusion

Can the Future AI be a disruptive technology replacing human being?

Yes. It most likely will take over all routine chores of human society. Nonetheless, there are two accounts that Humanoids cannot replace human, namely (1) Poetic Artistic Beauty & (2) Scientific Creativity.

This dual track phenomena has been formally noted by 2002 Nobel Laureates Daniel Kahneman & Amos Tversky in their financial "Prospective Theory (in terms of Richard Bellman Multi-stage Dynamic Programming)" for the psychology of judgment and decision-making (e.g. Kahneman said "people may drive across town to save $5 on a $15 calculator (5/(5+15)=1/4=25% as needed) but not drive across town to save $5 on a $125 coat (5/(125+5)=1/60=1.6% furthermore there are multiple choices in size, color & texture; He further said AI will win for it suffers no "noise" as human does).

Shortfall of Humanoids: The direct implementation of the hormone chemical signal may not be possible, since they are numerous macromolecules, circa 50, mediated with diffusion and blood vessel for communication and arrivals are selected by receptors but in our brain limbic system to different parts of body would be difficult e.g. a pair of Amygdales that secrete hormones chemical signals response for feeling, (not the ion-electronic signal that AI has emulated with).

Even though the AI can program itself but nonetheless cannot be innovative, e.g. namely AI cannot identify "gaps and fill in the value," nor AI can anticipate the future gap, called shortfall, and fill-in with new value, the so-called creativity.

Of course, creativity is:"a journey of a thousand mile began with the first step,"--said the Confucius; but added a qualification "so long as pointing the right direction" by Prof. Mark Kac--President of Am. Math. Society, who is famous for Ornstein-Uhlenbeck stochastic processes, e.g. Brownian motions taught at The Rockefeller Univ. The right direction is not definable without the conditional probability. For example, we may equip humanoids with smart sensors to capture all inputs from human facial expressions with voices & hands gestures as well as body languages. Then the humanoids may decide from millimeter wave 5G communications in simultaneous processing from the Cloud Storage to find the closest set among Fuzzy Membership Function (FMF).

Lossless Divide & Conquer Chemical Signal Circuitry? The first step might be decomposing the simplest hormone into implementable parts, e.g. choose a hexagon or pentagon with a side chain, and build an "equivalent circuits". Then, the molecule size issue may be resolved based on the orthogonal property of circuitry as between the Current & the Voltage; we may mathematically similar to the lossless divide and conquer solving Travelling Salesman Problem. We suggested that we may need to consider a lossless divide and conquer techniques. For example, consider an actual circuit of Power P= Voltage V time Current I. Whether we can achieve a "loss-less divide and conquer theorem"

$$\min\left|\vec{A}-\vec{B}\right|^2=\min\left|\vec{A}-\vec{C}\right|^2+\min\left|\vec{C}-\vec{B}\right|^2;\text{iff}\left|\vec{A}-\vec{C}\right|\perp\left|\vec{C}-\vec{B}\right| \quad (14)$$

Proposed early solving the NP complete Travelling Salesman Problem---the shortest distance for a travelling salesman to cover in the world, $|\vec{A}-\vec{B}|^2$ which could be divided into the US $|\vec{A}-\vec{C}|^2$, and EU $|\vec{C}-\vec{B}|^2$, if and only if the interconnect between the US $\left|\vec{A}-\vec{C}\right|$ and the EU $\left|\vec{C}-\vec{B}\right|$ is orthogonal.

As said, for example the hormone's hexagon (Figure 10) as if in TSP optimization it were the US, and its side-chain as if it were the EU, in order to design the human chemical hormone signals, which are too many, about 50, and too big, in millimeters, to squeeze through any communication channels, so we choose blood vessels and thermal diffusion mechanisms, as well as the final destination selected with specific hormone receptors.

Emotion Empathy: Our Brain has the limbic system connected to Hippocampus memory center, & Amygdale hormone emotion; but humanoids do not yet.

Basically difficulty of AI-humanoids is lacking Chemical hormones signals about 50 kinds in 5 essentials. They are made of 3D hexagon, pentagon & side chains molecules: paracrine, endocrine, autocrine, direct signaling across gap junctions.

Dopamine (Creativity) lacking of might cause Parkinson disease.

Melatonin; Serotonin: Happy Hormone (imbalance led to depression) Figure 11

If we introduce the following operators into Kahneman "flip (-1)-flop $(+1)$" sayings as follows:

(1) "A reliable way to make people believe in falsehoods $(\text{denoted as}-1)$ is frequent repetition $(\text{denoted as}\times)$, because familiarity is not easily distinguished from truth $(\text{denoted as}+1)$".

(2) "This is the essence of intuitive heuristics: when faced with a

difficult question, we often answer an easier one $(\text{denoted as} +1)$ instead usually without noticing the substitution $(\text{denoted as} -1)$."

(3) "The gorilla study illustrates two important facts about our minds: we can be blind to the obvious $(\text{denotedas} +1)$, and we are also blind to our blindness $(\text{denoted as} -1)$"

Then we can formulate Wiseman's rational and emotional experience as the following theorem Finally in honor of Nobel Laureate as a Kahneman theorem: Only the Truth is invariant.

According to Dr. Kahneman, this emotion/experience e-bias may be captured its truth, "negate the converse (false)" $(-1)\mathrm{x}(-1)=+1$, When the negative product: $(-1)\times(-1)\times$ is in a chain, the result will appear to be either positive in even number of repetitions, or negative in odd number of repetitions; but such a representation chain does not flip flop in the case of the truth: $(+1)\times(+1)\times\ldots$ That is because the truth is by definition invariant. Q.E.D.

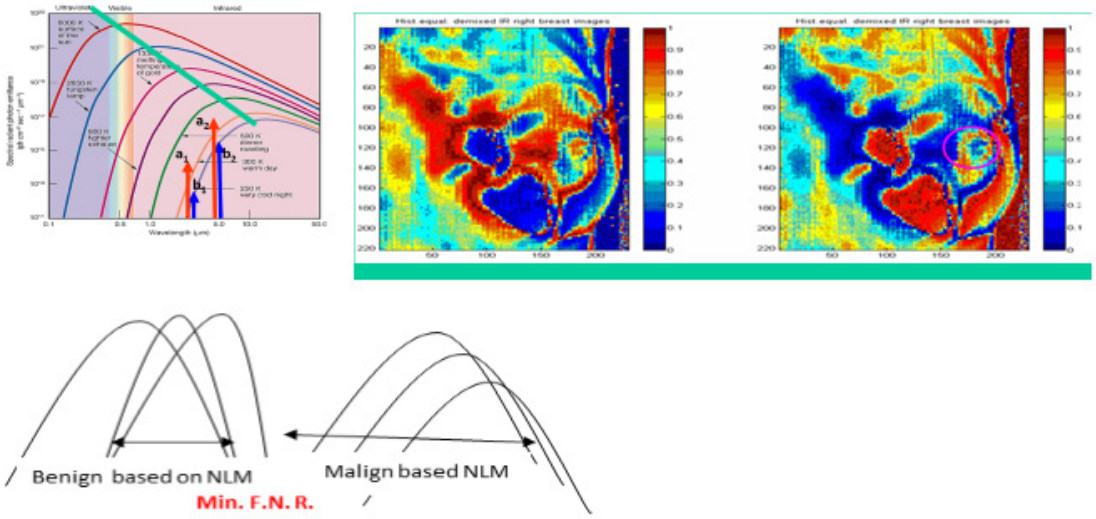


Figure 10 BDA applications: Dual IR from a base point temperature $\bar{b}_T$ determined by $\bar{b}_T(b_1,b_2)\rightarrow\bar{a}_T(a_1,a_2)$ to activated growth-rate temperature level at the same point determined by $\bar{a}_T$ indicate a warning sign to see physician. This has been done supplementing X-ray monograms to detect Ductile Carcinoma In-Situ (DCIS), esp. Nulliparous-women.

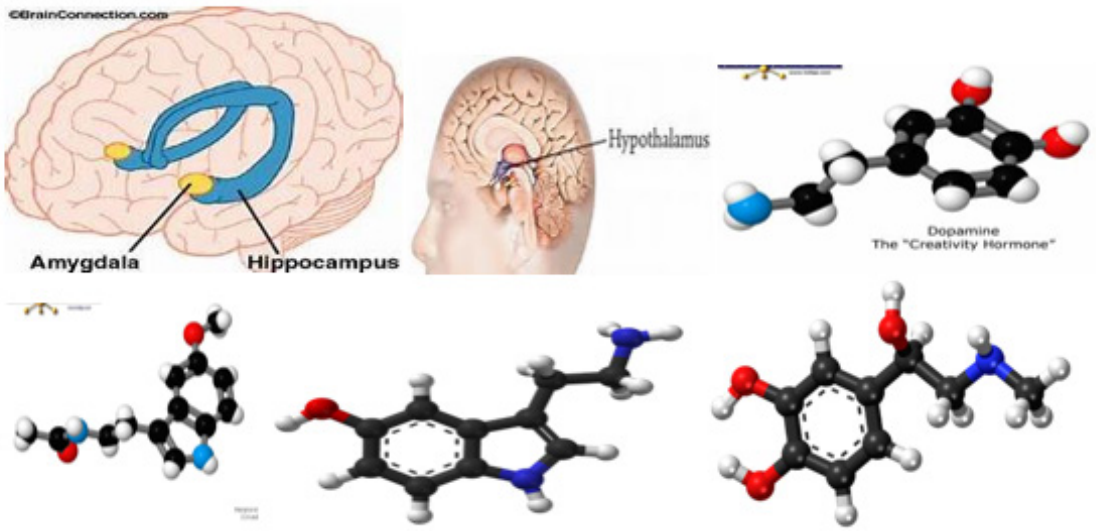


Figure 11 Chemical Signal typical Hormones are regulatory substances produced in an organism and transported in tissue, blood or sap to stimulate specific cells or tissues into action.

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Appendix

Appendix A. Alternatively, in an algebra expression Thomas Bayes (1701-1761) likelihood ratio or the Theorem of Conditional Probability that help us guess Hypothesis H based on a little data evidence E. we can apply conditional probability to capture this intuition psychology of Kahneman in terms of Hypothesis H and Evidence E, to switch around, we assume $H = A; E = B;$ then the intersection of two must be the same, irrespective their orders:

$$P(A \cap B) = P(B \cap A)$$

This identity allows us to derive conditional probability as follows:

$$LHS = P(H \cap E) = P(H|E)P(E)$$

$$RHS = P(E \cap H) = P(E|H)P(H)$$

Consequently, the equality of both sides yields consistently the switch over

$$P(H|E) = \frac{P(H \cap E)}{P(E)} = \frac{P(E \cap H))}{P(E)} = \frac{P(E \mid H)P(H)}{P(E)} \quad ;$$

$$P(H|E) = \frac{P(E \mid H)P(H)}{P(E)}$$

Appendix B: Famous Quote of Slow & Fast Thinking by Daniel Kahneman

1) Mood evidently affects the operation of System 1: when we are uncomfortable and unhappy, we lose touch with our intuition
2) Intelligence is not only the ability to reason; it is also the ability to find relevant material in memory and to deploy attention when needed.
3) Nothing in life is as important as you think it is, while you are thinking about it
4) Our comforting conviction that the world makes sense rests on a secure foundation: our almost unlimited ability to ignore our ignorance.
5) The idea that the future is unpredictable is undermined every day by the ease with which the past is explained.
6) The confidence that individuals have in their beliefs depends mostly on the quality of the story they can tell about what they see, even if they see little.
7) You are more likely to learn something by finding surprises in your own behavior than by hearing surprising facts about people in general.

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