RNAemotions

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Abstract

1 Emotions and RNA

In the following fascinating findings related to RNA and possibly expression of emotions at molecular level are discussed.

1.1 Does RNA code for pain?

I learned about an extremely interesting finding [J2] (see http://tinyurl.com/ycqxyeqk) in neuroscience. The popular article " *Scientists Sucked a Memory Out of a Snail and Stuck It in Another Snail*" (see http://tinyurl.com/y92w39gs) tells that the conditionings of snails produced by painful sensations can be transferred to other snails or even snail neurons in Petri dish by adding just the RNA of the conditioned snails to the dish!

Let us summarize the findings.

1. RNA from snails is transferred to snails or to even populations of snail neurons in Petri dish!

2. The effect involves epigenetic changes in DNA by methylation induced by RNA somehow. The reaction is to the serotonin informing for the stimulus. Avoidance behavior emerges as a response.

3. How does RNA induce the epigenetic change? RNA should couple to a a specific part of DNA and induce the effect. A pairing of DNA with RNA in question occurring also in transcription suggests itself strongly.

4. What in the RNA of the conditioned snail is different? RNA should somehow code for the conditioning induced by a painful sensory experience. RNA of sensory receptors should change somehow and communicate this change to DNA in brain by some mechanism. DNA-RNA pairing does not seem plausible. Could the pairing occur by some other means?

Before continuing it is good to summarize the TGD based models for music harmony providing also a model of genetic code (see http://tinyurl.com/yad4tqwl), for sensory perception (see http://tinyurl.com/yczv2o5b), for emotions (see http://tinyurl.com/ydhxen4g), and for impriting of emotions in water (see http://tinyurl.com/ycdywctw).

1. TGD based model for emotions and communication of emotions suggests that the communication takes place in terms of what I call music of light (also sound might be involved). Music expresses and creates emotions. Emotional state, mood, is coded by harmony or disharmony for music of light.

   12-note is fundamental for music and is represented as a closed self-non-intersecting path (Hamilton cycle) at icosahedron having 12 vertices. Icosahedron has 20 faces (triangles) and for given Hamilton cycle one can assign a 3-chord to each triangle. This gives 20-chord

harmony (or disharmony). There is quite large number of 20-chord harmonies and those allowing Z_6, Z_4 and Z_2 as symmetries is quite large. Besides this there 6 cycles with no symmetries and these could be identified as dis-harmonies.

2. 20 is also the number of amino-acids so that it is not totally surprising that the model for bioharmony as a union of 3 different 20-chord harmonies plus 4-chord harmony assignable to tetrarhedron turns out to give a model of genetic code as 64 chord bioharmony. There are 64 basic 3-chords in one-one correspondence with DNA and RNA codons. tRNA corresponds to a union of 2 20-chord harmonies. Given amino-acid corresponds to the orbit of 3-chord under symmetries of the harmony so that number of 3-chords at the orbit is the number of DNAs coding for the amino-acid. These numbers come out correctly.

3. There are two other representations of genetic code. The ordinary chemical representation and the representation in terms of dark proton sequences at magnetic flux tubes. The model for dark proton triplet predicts that its states divided to 64 analogs of DNA codons, 64 analogs of RNA codons, 40 analogs of tRNA codons, and 20 analogs of amino-acids. Genetic code comes out correctly also now by a natural pairing of dark proton triplets. One must couple these 3 representations of genetic code with themselves and with each other.

4. There is indeed resonant coupling by 3-chords realized in terms of free frequencies of dark photons. The frequencies are rather low ($E = h_{eff} \times f$, $h_{eff}/h = n$) but energies are same as for biophotons with energies in visible and UV range.

   Also dark variants of DNA, etc couple with each other via dark photon resonance. Dark DNA, etc couple with ordinary DNA, etc.. by energy resonance to form double strands. This means that dark photon transforms to ordinary photon in the coupling. Amino-acid couples to single frequency, which is the sum of codon frequencies coding for it.

   There is quite large number of 3-chord 3-harmonies defining DNA and RNA moods, and 3-chord 2-harmonies tRNA moods, and amino-acid 1-chord harmonies. There also 6 disharmonies with 20 chords each possible assignable to negative moods such as those generated by pain.

So: Is the communication chemical by DNA-RNA pairing or by some other means? TGD based model suggests "some other means".

1. Pain in sensory receptor is certainly involved. In TGD based model differs from neuroscience view in that for sensory experiences sensory receptors are seats of the sensory qualia and brain only forms cognitive representations about them and also entangles with sensory receptors to share the pain. Somehow pain must affect RNA in sensory receptors? How?

2. In this framework the stimulus in nocireceptors would induce a disharmony expressed in terms of the disharmony associated with the expression of RNA in terms of 3-chords. The dark variant of RNA in pain receptors would entangle with the dark DNA in certain neurons in brain of the snail. Nerve pulse patterns from the nociceptors would generate also magnetic flux tube connections parallel to the sensory pathway in question and make possible the communication by dark biophoton triplets to brain possible. The dark variant of DNA in brain would have resonant coupling with ordinary DNA and induce the epigenetic change by methylation as a response to the negative mood with the mediary of biophotons. After this the organism would have avoidance behaviour towards the stimulus inducing the pain.

3. The presence of mere RNA and associated dark RNA dis-harmonious mood would do the same for any neuron by the resonance mechanism. This would allow to transfer emotions even to snail neurons in Petri dish, not only those in living snails.

The proposed mechanism provides insights to many other poorly understood problems.

1. This mechanism also allows to understand how the transfer of emotions conditioning induces epigenetic chance also in the germ cell DNA: this is not easy to understand in the standard framework requiring chemical communication through the germ cell membrane.

2. The models for learning (memories restricted to conditionings) based on formation of synaptic contacts on one hand and involving RNA are seen as exclusive in standard neuroscience. In TGD framework the formation of synaptic contacts might rely at the fundamental level on the same epigenetic mechanism. Neuromodulators might induce the emotional states in RNA in turn doing the epigenetic editing.

   In human brain the genomes differ in various neurons and epigenetic editing by the proposed mechanism might cause this. An interesting question is whether humans could edit their genomes intentionally. All conditionings are not useful and maybe it becomes someday possible to affect these conditionings at the level of dark DNA.

3. Squid and octopus are known to be able to edit their mRNA (see `http://tinyurl.com/m7m6c28`). Instead of DNA the mRNA produced in the transcription so that the translation produce different protein. The effect of emotional states of the dark variant of RNA associated with mRNA could be the mechanism involved.

4. The strong emotional state of single individual induces very effectively the same emotional state in people around: consider only concert as an example. Could the "music of dark light" mediate the emotions from the dark RNA of individual - say artist - to people around. If so all art would be basically music of light!

To sum up: this finding provides rather concrete support for the vision that emotions are coded by the music of light at molecular level.

1.2 Did RNA replicate in codon-wise manner during RNA era?

There was an interesting popular article in Spacedaily with title "*Scientists crack how primordial life on Earth might have replicated itself*" (see `http://tinyurl.com/y92ng5vd`). The research paper [I3] is titled "*Ribozyme-catalysed RNA synthesis using triplet building blocks*" and published in eLife (see `http://tinyurl.com/ya5qyjfn`).

It is possible to replicate unfolded RNA strands in Lab by using enzymes known as ribozymes, which are RNA counterparts of enzymes, which are amino-adic sequences. In the presence of folding the replication is however impossible. Since ribozymes are in general folded, they cannot thus catalyze their own replication in this manner. The researchers however discovered that the replication using RNA triplets - genetic codons - as basic unit can be carried out in laboratory even for the folded RNA strands and with rather low error rate. Also the ribozyme involved can thus replicate in codon-wise manner. For units longer than 3 nucleotides the replication becomes prone to errors.

These findings are highly interesting in TGD framework. In TGD the chemical realization of genetic code is not fundamental. Rather, dark matter level would provide the fundamental realizations of analogs of DNA, RNA, tRNA, and amino-acids as dark proton sequences giving rise to dark nuclei at magnetic flux tubes [L4] (see `http://tinyurl.com/yalny39x`). Also ordinary nuclei correspond in TGD Universe to sequences of protons and neutrons forming string like entities assignable to magnetic flux tubes.

The basic unit representing DNA, RNA and tRNA codon and amino-acid would consist of 3 entangled dark protons. The essential aspect is that by entanglement the dark codons do not decompose to products of letters. This is like words of some languages, which do not allow decomposition to letters. This representation is holistic. As we learn to read and write, we learn the more analytic western view about words as letter sequences. Could the same hold true in evolution so that RNA triplets would have come first as entities pairing with dark RNA codons from from dark proton triplets as a whole? Later DNA codons would have emerged and paired with dark DNA codons. Now the coupling would have have been letter by letter in DNA replication and transcription to mRNA.

It is intriguing that tRNA consists of RNA triplets combined from amino-acids and analogs of mRNA triplets! The translation of mRNA to amino-acids having no 3-letter decomposition alone forces the holistic view but one can ask whether something deeper is involved. This might be the case. I have been wondering whether during RNA era RNA replicated using a prebiotic form of translational machinery, which replicated mRNA rather than translated RNA to protein formed from amino-acids (AAs) with AA serving as a catalyst.

1. During RNA era amino-acids associated with pre-tRNA molecules would served as catalysts for replication of RNA codons. The linguistic mode would have been "holistic" during RNA era in accordance with the findings of the above experiments. RNA codon would have been the basic unit.

2. This would have led to a smaller number of RNAs since RNA and RNA like molecules in tRNA are not in 1-1 correspondence. A more realistic option could have been replication of subset of RNA molecules appearing in tRNA in this manner.

3. Then a great evolutionary leap leading from RNA era to DNA era would have occurred. AA catalyzed replication of RNA would have transformed to a translation of RNA to proteins and the roles of RNA and AA in tRNA would have changed. [Perhaps the increase of h_{eff} in some relevant structure as quantum criticality was reached led to the revolution]

4. At this step also (subset of) DNA and its transcription to (a subset of) mRNA corresponding to tRNA had to emerge to produce mRNA in transcription. In the recent biology DNA replicates and is transcribed nucleotide by nucleotide rather than using codon as a unit so that helicases and DNA and RNA polymerases catalyzing replication and transcription should have emerged at this step. The ability of DNA to unwind with the help of helicase enzyme helping DNA to unwind is essential for the transcription and translation of DNA. Therefore helicase must have emerged together with the "analytic linguistic mode" as an analog of written language (DNA) decomposing codons to triplets of letters. This would been a crucial step in evolution comparable to the emergence of written language based on letters. Also the counterpart of RNA polymerase and separate RNA nucleotides for transcription should have emerged if not already present.

   An alternative option would involve "tDNA" as the analog of tRNA and the emergence of helicase and polymerases later as the transition from holistic to analytic mode took place.

   The minimal picture would be emergence of a subset of DNA codons corresponding to RNAs associated with pre-tRNA and the emergence of the analogs of helicase and DNA and RNA polymerases as the roles of amino-acid and RNA codon in tRNA were changed.

5. How DNA could have emerged from RNA? The chemical change would have been essentially the replacement of ribose with de-oxiribose to get DNA from RNA and U$\rightarrow$ T. Single O-H in ribose was replaced with H. O forms hydrogen bonds with water and this had to change the hydrogen bonding characteristics of RNA.

   If the change of $h_{eff} = n \times h_0$ was involved, could it have led to stabilization of DNA? Did cell membrane emerge and allow to achieve this? I have proposed [L4] (see `http://tinyurl.com/yalny39x`) that the emergence of cell membrane meant the emergence of new representation of dark genetic code based on dark nuclei with larger value of h_{eff}.

   Remark: One has $h = 6 \times h_0$ in the most plausible scenario [L2, L5] (see `http://tinyurl.com/goruuzm` and `http://tinyurl.com/y9jxyjns`).

The communication between dark and ordinary variants of biomolecules involves resonance mechanism and would also involve genetic code represented as 3-chords, music of light, and it is interesting to see whether this model provides additional insights.

1. The proposal is that 3-chords assignable to nucleotides as music of light with allowed 64 chords defining what I have called bio-harmony is essential for the resonance [L6, L7, L5](see `http://tinyurl.com/ydhxen4g`, `http://tinyurl.com/yd5t82gq`, and `http://tinyurl.com/y9jxyjns`). The 3 frequencies must be identical in the resonance: this is like turning 3 knobs in radio. This 3-fold resonance would correspond to the analytic mode. The second mode could be holistic in the sense that it would involve only the sum only the sum of the 3 frequencies modulo octave equivalence assigning a melody to a sequence of 3-chords.

2. The proposal is that amino-acids having no triplet decomposition are holistic and couple to the sum of 3 frequencies assignable to tRNA and mRNA in this manner. Also the RNAs in tRNA could couple to mRNA in this manner. One could perhaps say that tRNA, mRNA

and amino-acids codons sing whereas DNA provides the accompaniment proceeding as 3-chords. The couplings of DNA nucleotides to RNA nucleotides would rely on the frequencies assignable to nucleotides.

3. If the sum of any 3 frequencies associated with mRNA codons is not the same except when the codons code for the same amino-acids, the representation of 3-chords with the sum of the notes is faithful. The frequencies to DNA and RNA nucleotides cannot be however independent of codons since the codons differing only by a permutation of letters would correspond to the same frequency and therefore code for the same amino-acid. Hence the information about the entire codon would be needed also in transcription and translation and could be provided either by dark DNA strand associated with DNA strand or by the interactions between the nucleotides of the DNA codon.

4. The DNA codon itself would know that it is associated with dark codon and the frequencies assignable to nucleotides could be determined by the dark DNA codon. It would be enough that the frequency of the letter depends on its position in the codon so that there would be 3 frequencies for every letter: 12 frequencies altogether.

   What puts bells ringing is that this the number of notes in 12-note scale for which the model of bio-harmony [L1, L6] (see `http://tinyurl.com/yad4tqwl` and `http://tinyurl.com/ydhxen4g`) based on the fusion of icosahedral (12 vertices and 20 triangular faces) and tetrahedral geometries by gluing icosahedron and tetrahedron along one face, provides a model as Hamiltonian cycle and produces genetic code as a by-product. Different Hamiltonian cycles define different harmonies identified as correlates for molecular moods.

   Does each DNA nucleotide respond to 3 different frequencies coding for its position in the codon and do the 4 nucleotides give rise to the 12 notes of 12-note scale? There are many choices for the triplets but a good guess is that the intervals between the notes of triplet are same and that fourth note added to the triplet would be the first one to realize octave equivalence. This gives uniquely $CEG\sharp$, $C\sharp FA$,$DF\sharp B\flat$, and $DG\sharp B$ as the triplets assignable to the nucleotides. The emergence of 12-note scale in this manner would be a new element in the model of bio-harmony.

   There are 4!=24 options for the correspondence between $\{A,T,C,G\}$ as the first letter and $\{C,C\sharp,D,D\sharp\}$. One can reduce this number by a simple argument.

   (a) Letters and their conjugates form pyrimidine-purine pairs T,A and C,G. The square of conjugation is identity transformation. The replacement of note with note defining at distance of half-octave satisfies this condition (half-octave - tritonus - was a cursed interval in ancient music and the sound of ambulance realizes it). Conjugation could correspond to a transformation of 3-chords defined as

   $$CEG\sharp \leftrightarrow DF\sharp B\flat \quad , \quad C\sharp FA \leftrightarrow D\sharp GB \quad .$$

   (b) One could have

   $$\{T,C\} \leftrightarrow \{CEG\sharp, C\sharp FA\} \quad , \quad \{A,G\} \leftrightarrow \{DF\sharp B\flat, D\sharp GB\} \quad ,$$
   $$\text{or}$$
   $$\{T,C\} \leftrightarrow \{DF\sharp B\flat, D\sharp GB\} \quad , \quad \{A,G\} \leftrightarrow \{CEG\sharp, C\sharp FA\} \quad .$$

   .

   (c) One can permute T and C and A and G in these correspondences. This leaves 8 alternative options. Fixing the order of the image of (T,C) to say $(C,C\sharp)$ fixes the order of the image of (A,G) to $(D,D\sharp)$ by the half-octave conjugation. This leaves 4 choices. Given the bio-harmony and having chosen one of these 4 options one could therefore check what given DNA sequence sounds as a sequence of 3-chords [L1].

   That the position the frequency associated with the nucleotide depends on its position in the codon would also reflect the biochemistry of the codon and this kind of dependence would be natural. In particular, different frequencies associated with the first and third codon would reflect the parity breaking defining orientation for DNA.

1.3 How do slime molds learn?

Quanta Magazine is a treasure trove of popular articles about hot topics in basic research and biology and neuroscience are the hottest topics now. The popular article "*Slime Molds Remember but Do They Learn?*" about learning of slime molds (see `http://tinyurl.com/ydc8gh4d`) serves as a good example of pleasant surprises popping up on weekly basis. There are several research articles referred but the related to the following comments are about the work of Dussutour and others [I1, I2] (see `http://tinyurl.com/hbo88c` and `http://tinyurl.com/y83o5sfs`).

1. The popular article tells that slime molds are monocellulars - for long time believed to belong to fungi - but actually somewhat like amoebas. They have neither neurons nor brains. The neuroscientific dogma says that neurons are necessary for learning so that slime molds should not learn. They should only adapt by selecting behaviors from a genetically inherited repertoir. Same would be true about plants, which are also known to learn.

   For physicist these beliefs look strange. Both animals and plants and also slime molds share the basic aspects about what it is to be alive, why should they be unable to learn? The research of biologist Audrey Dussutour and her team described in the article indeed shows that slime molds are indeed able to learn.

2. Conditioning is the basic mechanism of learning, which by definition leads to a creation of a new kind of behavior rather than selecting some behavior from an existing repertoir as happens in adaptation. Typically the conditioning is created by associating unpleasant sensory stimulus such as electric shock to some other stimulus, which can be pleasant, say information about the presence of food. This leads to avoidance behavior and the mere presence of food can induce the avoidance behavior.

3. It was found that slime mold [I1] learns a habit of avoiding the unpleasant stimulus - habituation is said to take place. Habituation involves generation of new behavior and is not mere adaption. For instance, habituation can mean stopping noticing stimulus like smell if it is not dangerous or important for survival. In the experiments the slime molds were conditioned to avoid noxious substances (having bitter "taste") and they remembered the behavior after a year of physiologically disruptive enforced sleep as the technical terms expresses it. This learned behavior was also transferred in cell fusion to individual that had not learned the behavior [I2].

4. Central nervous system has been believed to be responsible for habituation since neurons receive and process the sensory the stimuli, build kind of cognitive representations about them, and generate motor response. Neuroscientist believe that learning means strengthening of synaptic contacts eventually giving rise to a learned motor response to a sensory stimulus by a sequence of associations

   Against this background the ability of slime molds to learn looks mysterious. How do they perceive the stimulus, how do they process it, how do they respond to it? We know actually little about cognition and learning: we know a lof about the neural correlates of cognition but not what cognition is.

Forgetting the question about what cognition is, one can just ask what could lead to the change of behaviour of the slime mold. Some time ago I learned about another fascinating finding related to learning from the article "*Scientists Sucked a Memory Out of a Snail and Stuck It in Another Snail*" (see `http://tinyurl.com/y92w39gs`). What was found that one can take RNA of a snail that has been conditioned by some painful stimulus and transfer it to another snail by scattering RNA on its brain neurons! Same can be achieved also by feeding snail with the conditioned snail. RNA must somehow represent memories. If this is true for snail it can be true also for the slime mold.

Usually learning is assigned with cognition regarded as kind of linguistic cognition. One speaks also of emotional intelligence: could learning be based on emotions? The TGD based model for emotions (see `http://tinyurl.com/ydhxen4g`) inspired by the model of music harmony [L1, L8] (see `http://tinyurl.com/yad4tqwl` and `http://tinyurl.com/y8njuctq`) leading to a model of genetic code predicting correctly vertebrate coderelies on this idea and leads to a model for what learning could be also in the case of slime molds.

1. Music expresses and creates emotions coded in its harmony (think of major and minor scales as simple examples). This could be true in much more general sense. Not only music made of sound but also of light - dark photons in TGD framework - could realize these functions of music. DNA would have a representation in terms of a collection of 3-chords made of three dark photons with frequencies in proportions allowed by the harmony.

2. The model of harmony based on icosahedral and tetrahedral geometries predicts a large number of harmonies representing emotional states, moods. The music of light makes possible communication between DNA, RNA, amino-acids (AAs), even tRNAs and their dark variants DDNA, DRNA, DAA, DtRNA. Communications are possible if the three chords can resonate note by not: ideal situation occurs if the harmony defining the mood is same in sender and receiver. Emphatics are those, who experience also the sufferings of the other people. Moods can be transferred from RNA to DNA and here they can induce epigenetic change leading to a change in behavior.

3. The painful conditioning of snail would induce a new mood of RNA of snail (probably rather depressive!) and this would in turn infect the DNA of the snail (strong emotions are infective) and the mood of DNA would induce the epigenetic change leading to the avoidance behavior (see `http://tinyurl.com/yb4nuumr` and `http://tinyurl.com/ydhxen4g`). Emotions would be behind the learning and learning would take place at DNA level as epigenetic changes changing the gene expression. Habitutation would involve epigenetic changes and adaptation involve only activation of appropriate inherited genes.

It must be added that TGD also leads to a vision about the role of neurons in many aspects different from the neuroscientific view although agreeing with the basic facts and explaining quite a number of anomalies [L3] (see `http://tinyurl.com/yczv2o5b`).

1. The notion of magnetic body (MB) containing dark matter as $h_{eff}/h_0 = n$ phases of ordinary matter is central. The networks having as nodes objects consisting of ordinary matter (molecules, organelles, organs, even organisms) connected to a network made of flux tubes containing dark matter would give rise to both cellular and neuronal networks. Magnetic flux tube connecting two nodes would serve as a correlate of attention and communication pathway using supra currents or dark photons. Also classical signals can propagate along it.

2. The primary function of nerve pulse activity at the level of CNS would not be communication between neurons but building of communication pathways from flux tubes along which dark photon signals can propagate with maximal signal velocity. The situation would be same in travel phone connections: the communication pathway would be created first and only then the communications with light velocity would begin. Synaptic transmission would build a bridge between otherwise non-connected flux tubes. This would give rise to long waveguides. Dark photons transforming to ordinary photons would yield bio-photons, which have remained mysterious in standard bio-chemistry since their spectrum is not consistent with the discrete spectrum of lines produced if they were generated in molecular transitions.

3. Sensory experiences would be basically at the level of sensory organs and sensory percepts would involve pattern recognition involving repeated feedback signal from brain an leading a standard perception nearest to the sensory input. The new view about time provided by zero energy ontology allows to circumvent the counter argument inspired by phantom leg phenomenon.

4. Nerve pulse patterns would frequency modulate the generalized Josephson frequencies assignable to the membrane proteins acting as Josephson junctions and generating dark Josephson radiation as part of EEG propagating to the MB of the system. Thus nerve pulse patterns would code information but this information would be sent to MB.

5. It is quite possible that the proposed RNA level mechanism is the microscopic mechanism behind strengthening of synaptic connections believed to be behind neuron level learning although also here new findings suggests that situation is not quite it has been believed to be (see `http://tinyurl.com/ybglebph`).

This did not say anything about cognition yet. TGD leads also to a view about mathematical correlates of cognition requiring profound generalization of the mathematical structure of theoretical physics. Real number field is tailor made for the description of the sensory world but how to describe the correlates of cognition. Here p-adic number fields come in rescue and in TGD framework one ends up to a unification of real physics and their p-adic analogs to what I call adelic physics (see `http://tinyurl.com/ybepht6d` and `http://tinyurl.com/ybzkfevz`).

1.4 How does brain predict future?

Quanta Magazine is a real treasure trove. The gem was at this time titled "*To Make Sense of the Present, Brains May Predict the Future*" (see `http://tinyurl.com/yb84wn7u`). The article gives links to various research articles: here I mention only the article "*Neural Prediction Errors Distinguish Perception and Misperception of Speech*" by Blank et al [J1] (see `http://tinyurl.com/y7edd3v`) .

According to the article, brain acts as a prediction machine comparing predictions with what happened and modifying the predictions accordingly. Sensory perception would not be mere 3-D sensory time=constant snapshot as believed in last century but include also a prediction of future based on it that would be outcome of sensory perception and brain is able to modify the prediction by using the difference between prediction and reality.

In TGD framework one can go even further [L3] (see `http://tinyurl.com/yczv2o5b`). Sensory organs are the seats of sensory mental images constructed by repeated signalling between brain (maybe also magnetic body) and sensory organ using dark photons propagating forth and back with maximal signal velocity and contributing to the sensory input a virtual part. Nerve pulses would create by synaptic bridges connecting flux tubes to longer flux tubes acting as waveguides for dark photons to propagate. Sensory mental image would be essentially self organization pattern nearest to the actual sensory input. The percept itself would be artwork, a caricature selecting and emphasizing the features of sensory input important for the survival.

The term predictive coding used about the process reveals that the view about how brain achieves this relies on computational paradigm. This is one possible view. Personally I do cannot regard classical computation as a plausible option. A more neutral view relies on rather obvious assumption that that temporal sequences of associations giving rise to predictions. But how does this happen?

Neuroscientists speculate about deep connections between emotions and learning: the dopaminergic neurons are indeed very closely related to the neural reward system. If the difference between the predicted and actually perceived is large the reward is small - one might also call it punishment. "Surprise" would be rather neutral word to express it. Big discrepancy causes big surprise. The comparison of predicted and what really happened would be essential. This is was one of the first predictions of TGD and might apply to simple emotions but - as I have proposed - emotions such as experience of beauty, compassion or love need not correspond to emotions need not be mere reactions.

The finding suggests a connection with the ideas about the fundamental role of emotions in learning. I have already developed this theme in this article.

1. The first finding made for snails [J2] (see `http://tinyurl.com/ycqxyeqk`) was that RNA somehow codes the experience and induces epigenetic change at the level of DNA in turn inducing a change in behavior. The popular article " *Scientists Sucked a Memory Out of a Snail and Stuck It in Another Snail*" tells about the finding (see `http://tinyurl.com/y92w39gs`).

   This led to a TGD based model based on the notion of bio-harmony for music of dark photon triplets representing 3-chords predicting genetic code correctly. Music expresses and creates emotions: same would happen already at RNA level. DNA would get in the same mood and by resonating with the 3-chords of RNA music and changing its harmony/mood coded by resonance frequencies of nuclei, which would slightly change. Epigenetic change would take place as a consequence and change the genetic expression in turn changing the behaviour.

   This brings in something genuinely new: TGD based view about dark matter, realizations of genetic code by dark proton sequences defining the dark analogs of DNA, RNA, tRNA, and

amino-acids at the magnetic flux tubes of magnetic body of living system plus realization of the genetic code.

It must be emphasized that magnetic body is 4-D and corresponds to a preferred extremals connecting to two 3-surfaces at the boundaries of causal diamond. Hence the basic objects are deterministic time evolutions, analogous to programs or behavioral patterns. The sequence of associations assignable to percept could be seen as space-time surface, a predicted space-time time evolution.

2. Just a couple of days before writing this I learned about slime molds (see `http://tinyurl.com/ydc8gh4d`) , which are monocellulars, which contrary to expectations learn new behaviours [I1, I2]. Nervous system is not therefore necessary for learning. Emotional RNA could be at work also here.

3. RNA would be naturally also behind the learning in CNS as a change of synaptic strengths generating effectively different synchronously firing neuron groups representing mental images and new sequences of associations providing predictions. The mismatch between prediction and real percept would we represented in terms of dopamine concentration and this in turn would generate at RNA level emotion, which would be negative for mismatch and induce corresponding DNA emotion generating epigenetic change in turn changing synaptic strengths in turn changing the prediction as a sequence of associations regarded as temporal sequence in turn changing the behavior! Long sequence of causations!

Also the speculated unification of motor control and sensory perceptions is mentioned in the popular article. In sensory perception internal environment as a model for external environment is updated. In motor action it is external environment. Connection with arrow of time? Motor action as perception of changing environment where own biological body is part of environment. In TGD framework sensory perception and motor action would be time reversals of each other at the level of sensory mental images. This view is allowed by ZEO and encouraged by the discovery of Libet that volitional act is preceded by neural activity by a fraction of second.

Motor action would be generated by a negative energy signal to the geometric past which would correspond to mental images with reversed arrow of time in TGD inspired theory of consciousness. This duality would mean that in opposite time direction motor action would be a perceptions about say hand moving in desired direction! The counterpart of predictive coding would take care of comparisons and modifying the predicted "sensory percept" so that it corresponds to reality. This sounds strange but maybe the motor actions is just passive perception from the point of view of time reversed self!

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Books related to TGD

Articles about TGD

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