

New Physics View about Language: Part II

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Abstract

In our previous paper entitled “New Physics View about Language”, published as part I, we suggested that language can be viewed as conditioning and association and their connection with memory. Part I was devoted to the new physics behind the proposal and provided by Topological Geometroynamics (TGD) and TGD inspired theory of consciousness.

Here, in part II, we will accomplish the task with more in-depth discussions. Briefly, we suggest that emergence of language can be seen as a dramatic increase of the effective Planck constant h_{eff} also characterizing genes, which happened following some mutations of FOXP2 and possibly other genes involved in language and speaking. The increase of h_{eff} accompanied by a small mutation to guarantee energy resonance for the communications between biological body and magnetic body could be the mechanism explaining the importance of FOXP2 and similar control genes. This novel perspective can contribute to our understanding of language evolution.

We also discuss a realization of embodiment as a mechanism giving meaning to language expressions and a proposal for understanding grammar and syntax in terms of the many-sheeted space-time of TGD.

Keywords: Topological Geometroynamics, magnetic body, dark matter, biochemistry, genetic code, energy resonance, language theories.

1 Introduction

The variety of human languages is impressive: speech and written language, sign languages based on gestures, the language of mathematics and computer languages in which emotional expression is absent. One can also regard music as a kind language expressing emotions and creating them. Also pictures define linguistic representations. Human

language is special in that it involves conceptualization, metaphors, and analogies representing abstract concepts in terms of objects and actions of the external world.

One might understand the semantic aspect of language in terms of association and conditioning. Language acquisition involves showing the object and uttering the word describing it or assigned to it. This suggests that conditioning and association happens so that mere word generates an imagined percept of the object. Conditioning and formation of associations are assumed to relate to the increase of synaptic strengths leading to a generation of association pathways. In computer science pattern recognition and completion models it mathematically. The learning of language and language understanding is probably more than this, however.

Language acquisition must rely on conditioning/associations between language expressions and experiences. It seems that embodiment is the mechanism, which associates to a linguistic expression and imagined sensory percept and/or motor action making possible the emergence of meaning. What is needed is long term memory and also some kind of standardization of percepts so that they consist of standardized mental images. Pattern recognition and completion could give this standardization.

Since sensory and motor imagination could be seen as almost sensory experiences and almost motor actions, this suggests that new communications between auditory organs and sensory and motor areas emerged. This would be essentially a new form of conditioning and the same mechanism could apply to all kinds of conditionings.

1.1 How the mutation of only a few genes led to the emergence of language and cultural evolution?

Only a few mutations for relatively few genes seems so have led to human languages. Why few point mutations of relatively few genes could have transformed biological evolution to cultural evolution? What happened for these genes? In the biochemistry framework it is difficult to imagine an answer to this question. Here TGD could come in rescue.

Forkhead box protein P2 (FOXP2) encodes a transcription factor involved in language acquisition and speech [Grigorenko 2009]. In addition to FOXP2 a limited number of genes are involved in speaking [Mozzi et al 2016]. All vertebrates possess FOXP2, however it is estimated that some 120,000-200,000 thousand years ago, some mutations occurred only in humans which aided humans to start initial forms of speaking [Balter 2002].

Today it is clear that crucial mutations occurred in the non-coding part of the genome controlling the expression of genes coding for proteins [Mozzi et al 2016] which lead to language evolution. Therefore, the evolutionary step was associated with control of existing genes. Humans are also distinguished from animals by their learning abilities.

Number theoretic physics [Pitkänen 2017] is essential for understanding evolution as an increase of algebraic complexity. Evolutionary hierarchies would correspond to hierarchies of algebraic extensions of rationals. The dimension n of extension defines effective Planck constant $h_{eff}/h_0 = n$, the larger the dimension, the larger the scale of quantum coherence

at corresponding level of magnetic body (MB) associated with the system. One can also say that n is analog of IQ. One can assign a value of h_{eff} characterizing their evolutionary level also to genes. The genes with larger h_{eff} would serve as control genes. The increase of h_{eff} for genes would mean an evolutionary step. Perhaps a dramatic increase of h_{eff} occurred to FOXP2 and some other genes as human language emerged.

Second mechanism could be energy resonance in the coupling of the analogs of DNA, RNA, tRNA, and amino acids consisting of dark proton triplet with their chemical counterparts. The coupling would be between the entire gene and its dark analog and codon sequence would play a role of address. In both cases small changes of the gene could spoil or produce an energy resonance. This sensitivity would make genes an ideal control tool but would also serve as a general mechanism also for genetic diseases. The increase of h_{eff} accompanied by a small mutation to guarantee energy resonance could be the mechanism explaining the importance of FOXP2 and similar control genes. For a detailed description, we refer readers to our paper part I [Pitkänen and Rastmanesh 2020].

2 A TGD inspired vision about language

2.1 The role of MB

The proposal is that new layer of MB assignable to larger part of MB outside body was involved with the emergence of language. There are several arguments in favor of this proposal.

1. The model for how mutation of few genes like FOXP2 lead the evolution of human languages to be discussed relies on the idea that the value of h_{eff} assignable to dark variants of language genes increases. This means the emergence of new layer of MB having onion-like structure. What emerged was grammatics and syntax as hierarchical structures represented as many-sheeted space-time structures distinguishing humans from other animals could have emerged: these tructures can be assigned to MB and they have also interpretaton in terms of extension of rationals leading to n -sheeted structures. The new level of hierarchy would have emerged at the level of the MB including also dark gene first: flux tubes inside flux tubes inside labelled by values of h_{eff} .
2. The development of language led to a cultural evolution and could have been a quantum leap in the evolution of collective levels of consciousness: emergence of new levels in the hierarchy of extensions of rationals. Maybe the emergence of gene with large h_{eff} meant that it receives control commands from this collective level of consciousness possibly assignable to community, social group, or even larger structure. Recall that the size scale of MB assignable to EEG frequencies is of order Earth size. The basic structure of language are indeed very "social". Subjects, objects, verbs expressing what they do to each other, relations between these entities,

attributes (adjectives) characterizing their states. Also the notions of plural and singular.

3. One can also ask how it is possible to distinguish between sensory input created by living beings and having meaning from that produced to dead matter. Also humans give emotional meaning to bird's song and vocal signals and gestures of animals but not to the sounds of dead Nature. For autists this ability might be very weakly developed. The natural answer to the question is that all communications are also communications between magnetic bodies, quite concrete touching, makes it possible to distinguish natural sounds from speech and signals with represent communications. Communications require attention and the flux tube connections between communicators would be correlates for the attention.

Mere mimicry does not require interpretation of the signal as communications. Some birds can mimic the sound of even a car. Second author [Pitkänen] told about his astonishment when finnish bird "talitiainen" (great tit, Parus Major) mimicked the fate motif of Beethoven's symphony No. 5. His neighbors used to listen to classical music!

There should be also a fundamental difference between the communications of ordinary sounds and speech to brain. The communications of speech could be via the large part of MB outside body whereas ordinary sensory data would be communicated via small part of MB to brain.

4. In language acquisition the role of parents, in particular mother, is crucial. One might of course argue that just mimicry and rewards are enough. But how the child knows that mother is trying to teach her that the word "apple" corresponds to the object that the mother is holding at ther hand. Is the fusion and entanglement of MBs needed?

The acquisition of language by child might also involve the MBs of child and Mother at least fusing to a larger structure. This might help the child to understand that the purpose is to learn to reproduce the word associated with the object that word describes. It could also make possible to learn the grammatics and syntax by becoming a part of larger self already learned these notions.

5. Speech communications happen magically in a good company when people are friendly and benevolent. Many shy people tell that that in a company of good friends they suddenly find themselves able to talk fluently. As if someone would be using them as instrument.

2.2 Genes and language

2.2.1 What is the role of FOXP2 and other control genes?

The question that led to the writing of this article was whether the mutation of the genome leading to FOXP2 gene and other similar genes responsible for control of the genome did lead to the evolution of human language. How? The aforementioned mechanism distinguishes between linguistic and ordinary associations by no means. What did happen?

Evolution in TGD framework means the increase of number the increase of the complexity of extension of rationals and thus increase of its dimension $h_{eff}/h_0 = n$ defining a universal measure of intelligence and also a measure for the temporal and spatial scale of quantum coherence. A possibly dramatic increase of h_{eff} for FOXP2 gene and other key genes is a natural hypothesis explaining why the complexity of the language evolved and led from signals to sentences requiring longer time scale of quantum coherence and also the emergence of complex hierarchical structures naturally assignable to the new extension as extension of the original one.

The larger the value of h_{eff} , the larger the scale of the layer of MB. This suggests that a new level of collective consciousness essential for communications emerged. This layer would be associated with the system formed by the systems communicating using language. This would explain the ability to distinguish between sounds produced by inanimate systems and sounds produced by living systems and having meaning.

The emergence of this new level would have meant emergence of many new things: of speech, of longer time scales of memory and planned action, of a new level of cognition, of imagination in longer time scales, and of cultural evolution.

Second mechanism related to the emergence of FOXP2 and other similar control genes could be energy resonance in the coupling of the analogs of DNA, RNA, tRNA, and amino acids. The coupling would be between the entire gene and its dark analog. Whether the energy resonance occurs for all cyclotron energies of codons separately or for their sum remains an open question. For both scenarios small changes of the gene can spoil or produce an energy resonance. This sensitivity would make genes an ideal control tool but would also serve as a general mechanism also for genetic diseases. The increase of h_{eff} accompanied by a small mutation to guarantee energy resonance could be the mechanism explaining the importance of FOXP2 and similar genes.

2.2.2 What about the development of speech organs and brain areas related to speech?

The development of speech required development of speech organs and brain areas for understanding of language and language production. How important was their role or was the mutation of certain genes responsible for language control enough to initiate the evolution leading to the development of speech organs and needed brain areas?

One can consider the emerge of a layer of MB with a considerably longer scale perhaps assignable to some collective level of consciousness - perhaps even the entire species. MB

as a TGD counterpart for magnetic fields in Maxwellian theory indeed has layers or order of Earth size and even much larger. The proposed emergence of a big layer of MB with a large value of h_{eff} could relate closely to Sheldrake's proposal [Sheldrake 2011] about learning at the level of species. How this new layer could have affected the evolution of speech organs and new brain regions.

1. MB is the key player in TGD. The TGD Universe allows conscious entities and they tend to have ideas as we know. Did MB at some level of hierarchy get an idea about expression of information using temporal sound patterns coupling to dark photons with specific frequencies? That would be a representation of bio-harmony in a new much longer spatial and time scale: did this evolutionary step correspond to the emergence of a new even larger value of h_{eff} to the dark matter hierarchy. Maybe the realization of this new faculty would have been a fractally scaled up variant of earlier realizations making this easier. Did MB make a plan which was eventually realized after a lot of trials and errors?
2. What this plan could correspond to? Here p-adic physics enters into the game. p-Adic dynamics for p-adic variants of space-time sheets obeys the same field equations as real space-time sheets. It however allows breaking of a strict determinism of real number based field equations: this non-determinism would correspond to the freedom of imagination.

p-Adic data could give rise to full space-time surface as dynamical patterns but they could correspond only to a piece of its real counterpart. Imagination would be non-realistic. Imagined motor actions and sensory inputs would correspond to this kind of partially fulfilled entities: signals would not reach sensory organs or muscles.
3. How this would apply to MB's plan to create sound producing organs? This plan could proceed by trial and error to become more realistic and gradually find a complete realization. The reduction of the planning to trial and error at dark gene level - would be an enormous simplification and could have meant mutations increasing the value of h_{eff} bringing in larger layers of MB related to the brain areas and speech organs.

2.3 Meaning from embodiment in the TGD framework

The notion of embodiment is central for the understanding of how speech gets its meaning. The simplest sentences represent sensory inputs or motor actions. But also very abstract expressions have metaphoric representations in terms of subject and objects and verbs representing actions. Embodiment means that language expressions are transformed to virtual sensory inputs and virtual motor actions creating imaginations of the real ones. This requires formation of associations as generation of sensory and motor mental images.

For instance, the sentence "Alice talks to Bob" creates virtual sensory and motor mental images in which Alice indeed talks to Bob. Mental images representing Alice and Bob and "talks" are generated and could correspond to interaction between two mental images. Basically remembering sensory percept in which Alice talks to Bob is enough to provide the meaning and the linguistic decomposition is a model. For instance, the heard speech generates internal speech helping in understanding.

The experience or imagined experience as virtual almost experience with input from MB rather than environment is associated with the expression of language. When the language has been learned, a mere language expression generates memory mental images about the experience associated with the expression. The mechanism is naturally pattern recognition and completion as a general mechanism of association and conditioning also in neuroscience and artificial pattern recognition.

2.3.1 Questions

In the TGD framework the questions are the following ones:

1. How memories are represented and how they give rise to conscious memory mental images? ZEO leads to a general proposal for how memory mental images are represented. First communication of sensory input to the part of MB containing a subself representing memory mental image, call it M. M receives the signals and experiences BSFR analogous to motor action involving a signal to the direction of geometric past to subself representing "Me Now". This signal is transformed to a nerve pulse pattern generating a virtual almost sensory mental image.

The general proposal is that in biology at cellular level motor actions are generated as time reversed signals from MB to dark genome inducing neural activity by a signal to cell membrane. The signal from MB to genome would take place by dark photon representation of genetic code and induce BSFR. This mechanism would be quite general.

Genes with N codons must be represented as a dark $3N$ -photon signal behaving like a single particle like entity. This is not possible in standard physics but adelic physics relying on number theory makes this possible. The notion of Galois confinement [Pitkänen 2020_a] allows dark photon $3N$ -plets representing genes as sequences of N 3-chords of bio-harmony - kind of music pieces - serving as dynamical units analogous to baryons as color confined units formed from 3 quarks and thus behaving as dynamical units.

The signal would generate a sequence cyclotron resonance peaks at the genome giving rise to a sequence of ticks at dark genome. They must in turn generate a signal to the cell membrane received as a sequence of ticks inducing the sequence of nerve pulses. This seems to require realization of genetic code at the level of the cell membrane level proposed [Pitkänen 2018_a]. The general principle would

be the same as in computer language LISP manipulating lists: only identical genes serving as addresses can be in communications by cyclotron resonance. Not only the notion of cyclotron radiation but also the notion of generalized Josephson radiation [Pitkänen 2014_c] must be further generalized: dark Josephson photons are replaced with dark 3N-photons.

2. Where the sensory signal to MB is generated? Its generation at neuronal or cell membranes as generalized Josephson radiation is not plausible since the time scales do not fit together. The modulation of Josephson radiation by nerve pulses patterns produces ripples rather than slow frequency modulation. A more plausible proposal is that the sensory signal to MB is generated at the basal ganglia of sensory organs as a generalized Josephson radiation with frequency modulation generated by the sensory input.
3. What is the basic quantum mechanism of association of the memory mental image B to a sensory input A? In the neuroscience framework it would happen in the associative regions of the brain by new pulse patterns and by learning based on changes in synaptic contacts. Now this would take place at analogous regions of MB to which sensory input is sent as a signal and induced cyclotron resonance for 3N-chords.

A pattern recognition at the level of MB would be in question. This involves a completion of the sinput pattern - sensory mental image - to a pattern representing memory mental image associated with it. This requires a generalization of the existing vision about pattern recognition to quantum level. Also this step could involve resonance leading to a fusion of the associated mental images by entanglement. This fused pair of mental images would generate a dark 3N-photon signal propagating to the brain as a generalized cyclotron radiation.

2.3.2 Association to memory mental images gives meaning to linguistic expressions

Association of the auditory input to memory mental images would provide linguistic expressions with meaning.

1. Association is a way to assign meaning to linguistic expressions by embodiment. Language expression is associated with an imagined sensory experience or motor activity. Also internal speech is imagined speech as imagined motor activity and generated by written text.

Association requires wake-up of memory mental image by the speech signal, which in turn generates a virtual sensory brain or lower level of layers of MB . In ZEO memory mental images are in the geometric future of "me Now" so that BSFR must take place: the memory self "dies" when it sends the message as a dark photon signal.

The signal eventually arrives in the brain and generates a nerve pulse pattern needed by dark photon communications generating the virtual sensory to virtual sensory organs.

Memory mental images at MB are woken up in ordinary memory recall presumably taking place at the hippocampus [Bird and Burgess 2008]. The frequencies involved are theta frequencies suggesting that the layers involved of MB have the size scale of Earth. In the case of speech the frequencies are in the range 150-300 Hz which suggests that layers corresponding to these frequencies are involved. Also longer time scales such as minute time scale are involved and much bigger layers of MB could be involved.

2. The signals could be sent to the MB from sensory organs:

- (a) Ganglions associated with sensory organs are analogous to brain nuclei and would be the primary receivers of the sensory input. Nerve pulses are generated by neurons above them. Ganglions must play an important role in the generation of sensory experience and motor activities. Ganglions in the brain are called basal ganglia. They could serve as receivers of virtual sensory input and motor output from the brain.

The neuron structures above ganglions also generate nerve pulses and these give rise to communications to the brain along flux tubes associated with neural pathways by dark photons signals. These communications would represent ordinary sensory communications, in particular sounds as mere sounds without meaning. They would also give rise to language acquisition via association.

- (b) The view about communications to MB as Josephson radiation modulated by membrane voltage variations suggests that the frequency modulations of membrane potential at frequencies of speech are involved. The earlier proposal that nerve pulse patterns could induce this modulation. They however would correspond to ripples of long wavelength waves. Of course, also axonal membranes involve oscillations of the membrane potential inducing the modulation but this modulation of generalized Josephson energy involving also difference of cyclotron energies is much smaller than that caused by nerve pulses.

The oscillations ganglion membrane potential induced by sound waves could be involved. Frequency modulated Josephson radiation modulated by sounds would propagate to some part of MB. One can consider even the possibility that dark genes such as FOXP2 generate dark 3N-photon radiation. These dark genes could be also realized at the level of cell membrane.

What could be the radiation in the case of dark genes. Could it be generalized Josephson radiation assignable to an array of Josephson junctions defined by dark genes and their conjugates. Sound waves could induce frequency modula-

tions of oscillations of the voltage between the dark genes just by putting them into motion. Does the distance matter?

- (c) The signals would be received by frequency resonance by some layer of MB responsible for memories representing word-sensory/motor associations. What this layer of MB is and where it is located? The flux tubes should allow 3-N dark photon sequences. Their realization outside the biological body does not look realistic. This suggests that the part of MB can be assigned with the brain of the geometric future. Magnetic loops would return back to the brain of the geometric future. The longer the time scale of the memory, the longer the loop. The realization of sensory or in part of MB analogous to associative cortex. What happens in the part of the MB of the future brain representing the memory about association. The analogy of pattern completion of incoming sound signal to sensory input should take place and generate a virtual sensory input to the geometric past as a response along flux loops arriving at the virtual basal ganglia defining virtual sensory organs. Two long loops would be involved. From sensory basal ganglia to the highest motor and sensory areas? And from these to virtual sensory and motor organs.

- (d) The branching of axons suggests a branching of corresponding flux tubes. What could happen in this process? In branching the value of h_{eff} could be reduced for dark photons - for instance by frequency doubling. Frequency doubling would transform audible frequencies to patterns of nerve pulses with much higher frequencies. From long to short scales. h_{eff} hierarchy would be essential. A possible interpretation as a cognitive quantum measurement is possible. Cognitive quantum measurement as a cascade of measurements in the group algebra of the Galois group of extension would give rise to a gradual reduction of effective Planck constants for the factors of the tensor product.

This cascade could correspond to the branching of axons leading to the reduction of biophoton energy in visible or UV to energy above thermal energy and assignable to cell membrane. What happens in branching of the flux tube? Is energy shared to that of n dark photons with the same frequency and smaller h_{eff} . Or does a localization to a single branch occur. h_{eff} would be reduced and f would increase. E would be conserved. Also both processes can occur. Division into n dark photons with $h_{eff} \rightarrow h_{eff}/n$ with f preserved plus a reduction $h_{eff}/n \rightarrow h_{eff}/nm$ and increase $f \rightarrow mf$ increasing by factor m .

- (e) The communication via long flux loops to the small part of MB at the brain cannot correspond to this kind of process since the value of h_{eff} assignable to FOXP2 genes should be preserved. The communication could be to dark control genes such as dark FOXP2 generating signal to neuronal membrane - perhaps dark control gene also there - giving rise to nerve pulse pattern generating virtual almost sensory experience at the virtual sensory organs defined

by basal ganglia.

This feedback should have been present already before the emergence of language but in shorter scales and leading to lower layers in the hierarchical structure of the brain ordered by evolution. They would correspond to a hierarchy of increasing values of h_{eff} realized at the level of genome.

These long feedback loops could end also at lower layers inside the brain and also the hierarchy of cortical layers could relate to this kind of feedback hierarchy. The virtual sensory input to the basal ganglia inside the brain would give rise to imagined sensory perceptions and motor actions.

- (f) Interpretation as analog of Fourier transform [Wikipedia] is suggestive. The cyclotron resonance peaks would generate a sequence of ticks analogous to a Fourier transform of the incoming waves. Music-speech dichotomy suggests itself strongly. Speech could be analogous to a sequence of SFRs - ticks - and singing to superpositions of classical time evolutions connecting them. It is said that the right brain sings and the left brain talks. Could some brain regions sing in the sense that they receive or send the signal as dark cyclotron radiation and could some brain regions talk in the sense that this radiation would induce or be induced by internal speech as virtual motor action.

A holistic representation in terms of frequencies would be transformed to "reductionistic" representation as time series. The correlation function for ticks would have the frequencies in its Fourier transform: stochastic resonance or its analog. Eventually this association to a sequence of ticks could generate a nerve pulse pattern creating a neural pathway making possible virtual sensory input in various sensory areas.

Given language expression corresponds to a huge number sensory percepts, and one could argue that this requires a huge number of associations. In the computationalistic framework this would mean a huge amount of computer storage. The model for the generation of mental images predicts that the sensory mental images are standardized mental images generated by a feedback loop giving rise to a pattern recognition. Standard mental images allow also abstraction and conceptualization. One can even consider a quantum counterpart of the classical notion of concept. Concept as the set of its instances would be replaced by wave function in the set of instances giving a large number of different views about the concept.

2.4 Bio-harmony as a universal language

Bio-harmony [Pitkänen 2014_a, Pitkänen 2014_b, Pitkänen 2019_a] realizing genetic code for communications is an ideal candidate for a universal language: codon would represent 6 bits and the allowed 64 chords would represent mood at molecular level. There is quite a large number of fundamental moods. Both dark codons and 3-chords bound to units

by Galois confinement [Pitkänen 2020_a] can be combined to dark genes by Galois confinement. This language would be minimal. The contents of the message would be minimal - the address of the receiver same as that of sender - so that LISP like language would be in question. The communications would be based on 3N-resonance. U-shaped flux tubes from receiver and sender forming bridges by reconnection would be the topological aspect of the communications.

The space-time surface associated with n :th order polynomial in M^8 defining the extension of rationals has n sheets corresponding to the roots of the polynomial [Pitkänen 2019_b]. These many-sheeted structures would give rise to a geometric representation of hierarchical linguistic structures.

There is also an abstraction hierarchy defined by the functional composition of polynomials giving rise to representation of the Galois group of extension in terms of inclusion hierarchy of normal subgroups. Flux tubes within flux tubes within.... are possible. For extension of extension of ... with extensions having dimensions n_1, n_2, \dots one would have n_1 -sheeted structure with sheets replaced with n_2 sheeted structures replaced with.... Substitution of x in $P_{n_1}(x)$ with $P_{n_2}(x)$ with x replaced with.... would correspond to this replacement.

Cascades of quantum measurements for the states of the Galois group algebra to a product state in the tensor product of Galois group algebras of the hierarchy of normal subgroups would define cognitive measurements which could be crucial for understanding of language by analysis [Pitkänen 2020_b].

2.4.1 Speech is only one form of communication of binary and emotional information

Concerning production and understanding of speech, one must see the situation more generally in TGD framework.

1. Speech is only one form to communicate information and emotions. Also gestures define a language being based on motor expression. An interesting test is how complex gestures developed before speech and whether FoxP2 has anything to do with sign language. Does sign language have grammatics and syntax characterizing formal languages?
2. Music and singing is the second form of language and expresses emotions rather than bits. Here harmony is an essential notion. Some basic chords define the harmony expressing the mood. Bits/words do not matter, only the chords used.

This leads in TGD to the model of bioharmony in terms of icosahedral and tetrahedral geometries and 3-chords made of light assigned to the triangular faces of icosahedron and tetrahedron. The surprise was that vertebrate genetic code emerged as a prediction: the numbers of DNA codons coding for a given amino-acid is predicted

correctly. DNA codons correspond to triangular faces and the orbit of a given triangle under the symmetries of the bioharmony in question corresponds to DNA codons coding for the amino-acid assigned with the orbit.

Codon corresponds to 6 bits: this is information in the usual computational sense. Bioharmony codes for mood: emotional information related to emotional intelligence as ability to get to the same mood allowing to receive this information. Bioharmony would be a fundamental representation of information realized already at molecular level and speech, hearing and other expressions of information would be based on it.

The surprising findings that RNA is central in conditioning [Vogel, Boisseau, Dussutour 2016, Vogel and Dussutour 2016, Bedecarrats et al 2018] suggest that RNA somehow represents emotions crucial for conditioning [Pitkänen 2018_b]. Dark DNA and bioharmony for which emotions would be realized at molecular level would make it possible.

2.4.2 What does Universality mean?

There are two views about language: Universality (or computationalism involving only grammar and syntax) concentrates on the formal aspects whereas connectionism concentrates language as a conditioning. For the first option one speaks of language learning as learning of formal rules and this applies to written language and language of mathematics. For the latter option one speaks of language acquisition as an almost unconscious process of imitation. These two views would be fused together in TGD view.

1. There would be only one universal language at the fundamental level. For communications it would be defined by genetic code realized as 3-chords of dark photons forming in turn 3N-frequency composites serving also as units. This code has both the bitty aspect: codon corresponds to 6 bits and the emotional aspect defined by given bio-harmony characterizing that is by the 3-chords defining the bio-harmony and in this manner mood. Genome would define genotype of language and specific languages would be phenotypes.

This code is used in communications between various levels of the hierarchy. At least in control commands arriving from MB to genome. The analog of Josephson radiation from cell membrane mediating sensory data to MB would consist of a sequence of notes but if cell membrane realizes genetic code, also Josephson radiation could consist of 3N-frequency dark photon composites representing genes. Note that the notion of tick makes sense also for 3N-chords. The message would be sent as Josephson radiation or cyclotron radiation and received as ticks corresponding to state function reductions.

Of course, one cannot exclude the single note option - mere temporal pattern of ticks with varying time separations - for the messages to the genome could be the case of speech having constant pitch. For singing and speech mediating emotions the situation melody or sequence of 3-chords would be needed.

Since the language would be realized at DNA level, even plants could communicate using it. Plants are known to communicate and there is evidence that plants can cognize and even count [Broberg et al 2018]. In TGD framework also hormonal communications thought to be chemical would take place by biophotons: the hormones connected by flux tube to molecule in say hypothalamus would build the waveguides to second molecule in body for dark photons to propagate.

The basic new physics building bricks in this picture would be $3N$ -frequency cyclotron resonance transforming the oscillating signal from basal ganglia membranes to a sequence of ticks in turn inducing a sequence of nerve pulses generating the virtual sensory experience using stochastic resonance coding the frequencies of original signal to peaks in the frequency spectrum of the correlation function for the sequences of nerve pulses. Also dark $3N$ -photon Josephson radiation assignable to genes represented also at cell membrane level would emerge as a new concept.

2. The universal aspects of the language would be realized as a basic expression of dark genes realized in terms of $3N$ dark photon composites propagating along flux tubes. The content of the packet is the address to which it sent! This would be just like in computer language LISP. This would be the genotype of language, the universal language based on $3N$ -frequency-resonance between sender and receiver genes.

This would completely separate the meaning of language expressions from the basic communication mechanism. This is of course true also for kinds of communications. The sender and receiver provide the meaning for language expressions by sensory perceiving them. Understanding of how the meaning is generated is the key problem. This requires theory of consciousness and a new view about the conscious brain.

3. TGD view is based on dark $3N$ -photon resonance communications between genomes and possibly also the genomes associated with the cell membranes and microtubules realizing the genetic code. The sensory input together with the language expression would provide the primary sensory percept - just as in learning by example. When communicated to the brain and even MB a secondary virtual almost sensory percept and virtual almost motor action would be generated as imagined sensory inputs.

This would be the fundamental association giving meaning to the language. Conditioning would occur and when the mere linguistic input is received, the virtual sensory percept and motor output are generated. Does this require anything new: for instance, does it require that the associations are remembered in some sense or are the associations realized as in neuroscience in terms of synaptic strengths? One would have memory as a learned behavior.

First the sensory input generated by linguistic expression is communicated from the basal ganglia of sensory organ or virtual sensory organ to the sensory and motor cortices by using dark $3N$ -photon resonance. After this the virtual sensory input and imagined percept as almost percept is generated. How?: as dark $3N$ -photon

signals propagating in opposite spatial direction to sensory organs. The fact that nerve pulse conduction is in a single direction only suggests that also time reversal occurs in BSFR.

4. This general picture applies to the formation of associations and conditioning quite generally. This would be also the mechanism of imagination, which also sharply distinguishes humans from animals. The special ability of the humans to imagine would have emerged at the same time as the complex language. This could be due to the mutations of certain language genes like FOXP2 acting as genes for which the 3N-photon resonance is realized and one must understand how this could be the case.

The proposed notion of universality is not in conflict with the fact there exist large number of languages. The development of different languages is actually easy to understand as reflecting the fact that there is underlying universal language which is minimal in the sense that the content of the message is the address of the receiver. Language acquisition is a conditioning process associating sensory inputs and motor outputs to language expressions at a more fundamental level and the words are just labels for them. This is like general coordinate invariance in general relativity. Points of space-time can have infinite manner of different labelings in terms of numbers (which in case of language are words).

2.5 Geometrization and topologization of the grammar and syntax in terms of many-sheeted space-time

These aspects of speech make understanding of speech acquisition possible but what about intentional learning of speech involving learning of grammar and syntax, which have nothing to do with contents of speech? In computer languages and mathematics as language this aspect would dominate.

2.5.1 Fractal flux tubes networks and structures of language

The TGD proposal is that magnetic flux tube networks - possibly trees in case of speech and associated with nerve pulse patterns are in an essential role. Flux tubes are effectively 1-D and have orientation which corresponds to temporal direction of speech and spatial direction of written language. There are flux tubes inside flux tubes flux tubes giving rise to hierarchical structures corresponding to the parsing of language expressions. MB would as many-sheeted structure would geometrize/topologize grammar and syntax.

There are also 2-D and even 3-D flux tube networks but not accompanied by neural networks. These would be essential for the geometric and holistic aspects of cognition: visual cognition in particular. The meridian system of Eastern medicine could be associated with the MB. These flux tube networks would have been present before the emergence

of the neural system and would be possessed even by plants. TGD could reduce the structures of language to purely geometric structures. Sentences would correspond to many-sheeted space-time surfaces with their topology representing the parsing structure. Basic space-time sheets would represent words, and the gluing of them to larger space-time sheets by topological sum operation would build sentences. Topological sum of surfaces A and A_0 essentially means that A is inside A_0 . Also the ordering of the words matters: AB and BA are not the same thing. When A and B are inside an effectively 1-D magnetic flux tube A_0 , the ordering of the positions inside the flux tube makes it possible to tell whether A is before B or *vice versa*.

Non-associativity forcing use of brackets in mathematical expressions would be also important ($(A+B)C \neq A+BC$). For instance, $(AB)C$ would correspond to the structure formed from a pair A_0C of flux tubes by putting AB inside flux tube A_0 . $A(BC)$ would be obtained from the AA_0 by putting BC inside A_0 . Putting inside brackets means gluing at a larger space-time sheet. The reader is encouraged to imagine what these examples look like when represented in terms of flux tubes within flux tubes.

The hierarchy of extensions of rationals realized in terms of functional composition of polynomials defining space-time surfaces in M^8 as n -sheeted structures provides a number theoretical view about linguistic structures [Pitkänen 2019_b]. The functional decomposition $P_1 \rightarrow P_1 \circ P_2(x)$ replaces each space-time sheet of the n_1 -sheeted structure with an n_2 -sheeted structure associated with P_2 . This is like fractal zoom each sheet to n_2 sheets.

This is due to the fundamental theorem of algebra stating that a polynomial P_n of complex argument with degree n obtains all its values n times. The argument $y = P_{n_2}(x)$ of $z = P_{n_1}(y)$ has the same value for n_2 points x_k . This gives n_2 sheets at y . The value z is then obtained for n_1 points. Therefore n_1 sheets decompose to n_2 sheets.

2.5.2 How the structural elements of language can be understood?

One should understand what is behind the notions of subject, object, verb. How tense, case, singular and plural, pronouns, adverbs, etc. are expressed: at the level of genetic code or of conscious experience as contents of imagined sensory experience and motor activity associated with the experience? Are they coded already by the oscillation pattern of the basal ganglia membrane giving rise to imagined experience beside genuine sensory experience? This would be the most elegant option.

The same FoxP2 gene or its analogs could be involved. Consider tense as an example. How the tense would be coded to the oscillations of the ganglia membrane or to the position of these membranes in the brain - to what subself they represent. Who is talking and about what and when!

- "I see" would correspond to a real sensory perception.
- "I saw" corresponds to immediate personal memory: could this be a virtual almost percept produced by a memory and realized at different places as virtual sensory

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percept. Basal ganglia associated with a level higher than sensory organs responsible for imaginations and inner speech..

- "I will see" would correspond to sensory percept, precognitions in reversed arrow of time.
- "I have done" seems to refer to a remote past: different time scale and perhaps different value of h_{eff} .
- "I had done" is talk of another self above or parallel me in self hierarchy about me as sub-self as an outsider. Now the basal ganglia would be at some part of the brain containing mental images representing some outsiders, say community as sub-self.

One should also understand what makes the sentence a question or command. In written language formal tools to express whether the sentence represents a question, command or something else have emerged. The many-sheeted structure of space-time should express these aspects of language using fixed words as vocabulary at the basic level. For instance, the building bricks for "Did you do this?" and "Do this!" should have the same "genotype" but different "phenotypes" if the reduction to dark genetic code makes sense. The context represented by a mental image containing the standard mental images representing the words of the sentence would determine "phenotype" allowing to differentiate between the two cases. The geometric representation would be based on flux tubes. Context - the larger flux tube - would be associated with the mental image "I do not know" for "Did you do this?" and "I am the boss" for "Do this!": this context would determine the "phenotype" just like the environment affects the phenotype in ordinary genetics.

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