Questions related to language from the TGD point of view

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Abstract

Taylor Reed Ramsey made 3 highly inspiring questions of how the TGD view of cognition might relate to the basic structures of language. The questions relate to adelic physics, the hierarchy of Planck constants, and the genetic code. In the sequel I will respond to these questions.

1 Introduction

I received from Taylor Reed Ramsey a set of 3 highly inspiring questions of how the TGD view of cognition might relate to the basic structures of language. Ramsey is an independent researcher working on a long-form project about how external symbolic systems — writing, in particular — restructure human cognition. The questions relate to adelic physics, the hierarchy of Planck constants, and the genetic code. In the sequel **Q1**:, **Q2**:,... refers to the question and **Q1**:, **Q2**:,... to the corresponding answer.

2 A question related to language and adelic physics

Q1: In your adelic vision, cognition is p-adic and a system's cognitive complexity corresponds to the dimension of the extension of rationals it realizes, with evolution as the growth of that extension. Humans also install external encoding systems — alphabets, numerals, calendars — in childhood, and these measurably reorganize cognition within a single generation.

Could a writing system be modeled as a macroscopic, learning-heritable selection over p-adic cognitive representations — a culturally fixed extension of rationals (or preferred Galois structure) governing which representations a brain's magnetic body can run? Would an alphabetic versus a logographic script differ at the level of the extension or the Galois group?

A1: Before answering the questions, I will discuss one of the key questions that I have been pondering is how the extensions of rationals defining cognitive hierarchies on one hand, and p-adic hierarchies relate to each other?

1. The extensions E of rationals appear as coefficients field for the functions $(f_1, f_2) : H = M^4 \times CP_2 \to C^2$ and $g = (g_1, g_2); C^2 \to C^2$ appearing in the general solution of classical field equations. The solutions in turn can give rise to extensions of E so that the situation is very complex.

2. When the extension E of rationals is realized in terms of roots of polynomials, one can assign to it Galois group. This is not true for an abstract extension defining the coefficients of f and g. For polynomials of a single variable ordinary notion of Galois group can be applied and the situation can in some cases reduce to this. For the general case, the roots are not points but 4-D surfaces $(f_1, f_2) = (0, 0)$ of H for which roots correspond to different regions.

3. The maps f, which are prime in the sense that they do not have composition $f = g \circ f_1$ could be interpreted as representing the substrate whereas the maps g would represent cognition giving information about f via the roots of $g \circ f$ which correspond to space-time surfaces $f = (c_1, c_2)$ where (c_1, c_2) is a root of g. In computer science one speaks of substrate independence.

4. The Galois group as a group of flows transforming roots as different space-time regions to each other makes sense [L3]. Note that also the space-time surfaces satisfying $(f_1, f_2) = (c_1, c_2)$ are possible and correspond to the roots of $(f_1 - c_1, f_2 - c_2)$. These surfaces emerges as roots of $g \circ f$, where $g : C^2 \to C^2$ is a holomorphic map. One can say tha the hierarchy of maps g provides information of the map $f = (f_1, f_2)$ as roots of $g \circ f$.

   This generalized Galois group characterizes space-time surfaces. There is a temptation to assume that this kind of group characterizes space-time surfaces representing DNA and RNA. The description of pair creation in TGD is in terms of a particle turning backwards in time in a 3-D vertex acting as 3-D edge of space-time at which the arrow of geometric time changes.

   This inspires the proposal that the replication of space-time surfaces is also behind biological replication. If so, these cognitive structures would be inheritable and inherited via DNA replication. In particular, the abstract representation of the writing system would be realized already at the level of dark DNA at the level of the magnetic body, and it would be possible to learn the writing system. One could even see writing and speaking as expressions of the genetic code analogous to expression in terms of proteins.

Some comments concerning the question whether a writing system could be modelled as a macroscopic, learning-heritable selection over p-adic cognitive representations — a culturally fixed extension of rationals (or preferred Galois structure) governing which representations a brain's magnetic body can run.

1. Genetic code would provide one realization for cognition and could be behind the written and spoken languages. The number of letters of language is typically somewhat larger than the number of amino-acids (20). On the other hand, the lower bound for the number of tRNAs is 32: could the phonemes correspond to tRNA coded by 64 genetic codons. Note that the analogy between the letters of language and 4 letters of the genetic code fails as a strict analogy.

2. If the genetic code is a cognitive representation based on functional composition of polynomials of degree 4 representing the code letters, the genetic inheritance would be behind the ability to learn language although the correspondence between the language and genetic code would be very flexible. The generalization of p-adic number fields to function fields would be involved and polynomials with degree 4 (not prime) would be prime polynomials

in the Galois sense. One could say that the cognitive representations could be inherited. This could reduce quite concretely to gene replication as a replication of the corresponding space-time surfaces.

You also asked whether the alphabetic and logographic writing system correspond to different Galois groups. The basic question is what differentiates these writing systems.

1. The first view is that they could correspond to reductionistic ("western)"" and holistic ("eastern") views of genetic codons. In logographic writing codons and entangled triplets of letters represented as states of dark protons would not reduce to product states defined by letters. In the alphabetic writing system this would be the case. I will later return this.

2. In a model for the genetic code [L8] based on functional composites of maps $g_i : C^2 \to C^2$, $i = 1, ...4$ characterizing the 4 letters of the genetic code, codons as holistic entities would correspond to deformations of functional composites of 3 maps g_i, which do not reduce to functional composites of polynomials of lower degree with the same Galois group. They are primes in the Galois sense, which is weaker than the purely number theoretic characterization in terms of the polynomial degree. They would correspond to the logographic writing system. In absence of the small deformation they would however decompose. This would be the reductionistic representation and could correspond to the alphabetic writing system. The Galois groups would be indeed different.

3 Bioharmony model of the genetic code, Galois groups, in relation to alphabetic/logographic writing systems

Q2. Your bio-harmony model derives the genetic code from icosahedral (A5) and tetrahedral (A4) symmetries read as Galois groups, with codons as 3-chords. Is there a linguistic analog one tier up — does a script's phoneme–grapheme inventory carry a comparable harmonic/Galois structure, so that an alphabet stands to dark-photon/EEG communication roughly as the genetic code stands to dark-nucleon chemistry? Could different scripts then correspond to different harmonies, and so to different baseline cognitive or emotional 'moods' at the population scale?

A2. I am not quite sure what you mean with the notion of script so that the following might involve misunderstandings.

1. Genetic code at the bit level is the same for all variants of the realizations of the genetic code in terms of frequency triplets providing the codons as 3-chords with emotional tone and allowing representation of moods. This representation would be analogous to computer code: there are no emotions. Music would also express emotions.

   The frequency triplets are differences of frequencies for a dark proton triplet. The transition between two states of dark proton triplet induces the frequency triplet as 3-chord. A full 3N-resonance means that the sender and receiver make opposite transitions. Resonance could be also partial.

   In the icosa tetrahedral realization of the genetic code, dark proton triplets are located to the triangular faces of 3 icosahedra and a tetrahedron. The transition transforming codons to each other would correspond to the transfer of dark proton triplet between two triangles determined by the Hamiltonian cycle. I have not previously considered the meaning of the predicted correlation between the state of the dark proton triplet and its location to a particular triangle.

2. The dark codons are (quantum) dynamical unlike the chemical codons. A possible interpretation is that the dynamics of dark codons is free so that they form a kind of R&D unit and perform processes analogous to quantum computations whereas chemical codons are frozen and represent the analog of classical computer program code.

   Dark codons are proposed to control chemical codons by energy resonance. The chemical codon would receive the control signal a 3-resonance when the frequency differences for the transition of dark codon correspond to resonance energies for the letters of the chemical

codon. For a gene one would have 3N-resonance. The ordinary codons could also react only to the sum of the cyclotron frequency differences. In both cases, it is possible to have 1-1 correspondence if the frequencies for the letters depend on the position of the letter in the dark codon. These two ways of the chemical codon to react to the control signal could correspond to the reductionistic and holistic views of codons at the level of ordinary codons.

3. The representation of codons as 3-chords would add to the representation of emotions and emotional intelligence. Human moods are a phenomenon involving short time scales and the bioharmony characterizing can change in short time scales. An interesting question is whether moods appear at the whole body level so that every cell would involve the same Hamiltonian cycles or whether the cycle depends on the body part.

   Moods are expressed by gestures and by art. Writing expresses emotions but only via the generated associations. Therefore I would not be the first one to assign a "cultural" mood to the writing system.

Cultures might express themselves in writing systems differently.

1. At fundamental level genetic code would relate to the completely exceptional tessellation of hyperbolic 3-space (surface of $M^4 \subset H = M^4 \times CP_2$ with constant value of light-cone proper time analogous to cosmic time). The proposal is that it is completely universal and that the human language is only a special case appearing at a very high level.

2. The numbers for the letters of written language are consistent with the idea that they are basically coded by genetic codons: the most plausible interpretation as tRNA codons was already mentioned. It is important that the letters in western language do not have meaning, at least they do not have meaning at our level of self hierarchy.

   The time scale for the transcription is measured in a fraction of second and this is true also for speech. This supports the idea. Perhaps sequences of dark genetic codons realized as temporal patterns at the magnetic body are transformed to speech.

3. The following observation related to alphabetic and logographic writing systems might be highly relevant. There are languages such as China in which this composition of words to letters does not occur (correct me if I am wrong). To my understanding the letters are originally pictures representing words.

   Could this correspond to the use of 64 genetic codons as basic units without a decomposition to 3 letters? Codons correspond to entangled dark proton triplets rather than unentangled product states for protons. No (no state function-) reduction of codons to a product state would occur in Eastern languages!

   That I Ching has 64 symbols would support this intuition. Eastern philosophies are holistic, western philosophies are reductionistic. Could this difference make itself manifest already at the level of the basic symbol system of language.

4 Does the notion of cognitive qualia make sense?

Q3: Number-theoretical universality and the adele give an object holding the real (sensory) norm and all p-adic (cognitive) norms at once. If a self could realize an adelic rather than single-p-adic representation — sensory and all cognitive views simultaneously available and self-consistent — what would its qualia structure be? Would it coincide with the high-h_{eff}, maximally negentropic states you associate with expanded consciousness? (Leibniz's characteristica universalis seems to gesture at the same object.)

A3: Interesting questions. I cannot give a clearcut answer to them. I have spoken about sensory qualia. One can of course speak of cognitive qualia and ask how the two kinds of qualia correspond to each other. I would tend to see cognitive qualia as names for sensory qualia, as symbols representing them.

One thing is certain: p-adic number fields and its functional analogs define a hugely simplified picture of sensory reality. Cognition simplifies and abstracts the essential features.

Instead, I try to explain (and to understand at the same time!) what cognition, and in particular, linguistic cognition, in TGD might be. The general structure of TGD suggests 3 approaches to cognition. One approach is at the level of the space of space-time surfaces, "world of classical worlds" (WCW), the second approach is at the level of the 8-D imbedding space $H = M^4 \times CP_2$ and the third approach is at the level of 4-D space-time surfaces.

4.1 WCW level

WCW is the space of space-time surfaces obeying holography= holomorphy principle and analogous to 4-D Bohr orbits for particles identified as 3-surfaces. I have assigned p-adics and adeles with cognition. In the recent form of TGD a generalization of p-adic number fields and adeles to their functional counterparts emerges at the level of WCW.

1. Holography = holomorphy principle (H-H) [L3, L5, L4] dictates the classical dynamics of the TGD space-time surfaces as a universal dynamics independent of variational principle. Space-time surfaces with Minkowskian signature corresponds to roots for a pair of holomorphic (in generalized sense) complex valued functions $f = (f_1, f_2) : H = M^4 \times CP_2 \rightarrow C^2$ are roots. To each solution one can assign an infinite hierarchy of new solutions $g \circ f$ where g is holomorphic map $C^2 \rightarrow C^2$. Here maps g allow functional composition and their iterates define analogs of Mandelbrot fractals and Julia sets as space-time surfaces.

   This brings in mind Turing's and Gödel's view of computation in which arithmetic operations involve a finite basis of primitive functions [L6]. One can identify maps f which do not allow compotion to $f = g \circ f_1$ as prime substrates. One can also decompose maps $g : C^2 \rightarrow C^2$ to "prime" g:s having no such composition.

   The space-time surfaces assignable to genes and genetic codons would provide examples of this kind of g:s.

2. One could identify f as a "substrate" and the function g allowing functional composition would define a cognitive hierarchy. The "thoughts"/cognitions are assignable to the substrate. Substrate and cognition would be rather independent. Any system can cognize, which looks rather radical an idea. This brings in mind the substrate independence of computer science.

3. For the functions g, one can generalize the notion of p-adicity and obtain function field counterparts of ordinary p-adics. The functional counterparts of p-adic number fields could relate to cognition. These p-adic function fields are mapped by category theoretical morphism to ordinary p-adics. Also the notion of functional adele makes sense. This generalization allows us to understand the p-adic length scale hypothesis.

4. There is a proposal [L8] for how genetic codons and genes could correspond to slightly deformed compositions of maps g assignable to letters. Although the degree of the polynomials associated with the letters is $d = 4$ and therefore not prime degree, they do not have functional compositions to lower degree polynomials (of degree 2). Codons would correspond to small deformations of 3-fold compositions of the letter polynomials having no functional compositions to lower degree polynomials with the same Galois group. The same would apply to genes.

4.2 Embedding space level

Icosa tetrahedral tessellation [L2, L7] is a completely unique tessellation of the hyperbolic space H^3 in the sense that 3 Platonic solids appear as its effective building bricks: octahedrons however define holes of this tessellation. This would make the genetic code universal. This realization would correspond to the level of embedding space $H = M^4 \times CP_2$. There is evidence for its realization at the level of clustering of water molecules [L8].

The sequences of codons and letters would define sequences of symbols giving rise to linguistic expressions. The proposal is that DNA/RNA gives rise to a representation of ordinary genetic code and a parallel quantal representation in terms of dark proton triplets associated with the magnetic body of DNA/RNA. Also temporal sequences as singularities at the level of space-time can be considered.

4.3 Space-time level

There is also an approach to the origin of language at space-time level. At space-time level it would basically relate to the small failure of classical determinism (no violation of field equations) for H-H principle [L3, L5, L4] exhibited already by 2-D minimal surfaces realized as soap films spanned by the frames: now space-time surfaces are holomorphic minimal surfaces: this irrespective of classical actions [L1].

The loci of non-determinism correspond to the failure of classical non-determinism as 3-D edges of space-time. These edges define 3-D features characterizing the entire space-time surface information theoretically. They form temporal sequences analogous to expressions of language. An attractive idea is that a finite number of these edges determines a collection of symbols forming the basis of language for a given space-time surface. The space-time surfaces allowed by classical non-determinism would define a set of sentences as these symbol sequences. There would be a connection with the WCW level since the singularities as edges of space-time are the seats for failure of generalized holomorphy.

What could be the counterparts of vowels and consonants in this framework?

1. The consonants emerged to the written language first and the vowels came later. Consonants could correspond to features as 3-D edges at between two space-time regions serving as analogs of vowels.

2. There would be an analogy with visual perception. At the lowest level boundaries define the basic features and the representation is analogous to a child's drawing. After that come colors and other visual attributes for the regions bounded by features. Vowels could be seen as analogs of colors.

3. A further analogy relates to the sequence of "small" state function reductions (SSFRs) defining self as a sequence. Each SSFR would be analogous to a consonant and the period of subjective time between SSFR and the next SSFR, with qualia represented as quantum numbers, would be analogous to a particular vowel. In singing the notes could correspond to colors and vowels and the moments, when the note is replaced with a new one could be analogs of consonants as boundaries. The rhythm in music would define a regularly spaced sequence of 3-D space-time edges dividing it to constant periods. It would also provide a clock.

   One could see the written and spoken language as a representation for the time evolution of self as a sequence of SSFRs.

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