Research Essay

On the Objections against TGD Inspired View of Qualia

Matti Pitkänen [1]

Abstract

In the TGD framework, state function reduction is identified as a moment of consciousness. The basic objection against the identification is that sensory mental images have a finite duration. One can imagine two ways of identifying qualia: as an outcome of quantum measurement or in terms of a change/transfer of quantum numbers. Both the resolution of the objection and the two alternative identifications of qualia will be discussed in the context provided by the recent view of TGD. For definiteness, the discussion will be restricted to color qualia since it provides an opportunity to discuss how the new physics predicted by TGD would be involved with qualia.

1 Introduction

I have considered the problem of qualia several times and have proposed several models for qualia [2, 11]. I have not been quite happy with the details of the original proposal. A lot of progress in the understanding of TGD has taken place since I considered qualia from the TGD point of view for the first time, and it is appropriate to take a new look at the situation.

The model of qualia relies on TGD inspired theory of consciousness [4, 3], which relies on zero energy ontology [9, 12, 16, 20]. ZEO can be seen as a generalization of quantum measurement theory solving the basic problem of standard quantum measurement theory.

It is good to start by describing the basic ideas related to the TGD inspired view about qualia. The obvious idea is that qualia can be assigned with a state function reduction (SFR) as measurement of observables [2].

1. The first class of basic qualia would correspond to infinitesimal generators of the fundamental symmetries. Spin, color and electroweak quantum numbers would represent fundamental qualia. Supersymplectic group for the product of light-cone boundary and CP_2 would act as isometries of the "world of classical worlds" and this would give rise to dynamical symmetry groups [6] and corresponding qualia.

2. Momentum and position are certainly fundamental observables. $M^8 - H$ duality [13, 14] has an interpretation as a generalization of momentum position duality of wave mechanics forced by the replaced of point like-particle with 3-surface whose orbit defines space-time surface as analog of Bohr orbit realizing holography forced by 4-D general coordinate invariance.

   The associativity of the normal space of the 4-surface of M^8, mapped by holography to H, is the number theoretic dynamical principle [13, 14]. It is expected to fix the holography apart from a finite non-determinism suggested by the non-determinism of minimal surfaces of H proposed to be the images of the 4-surfaces of M^8 in H. The twistor lift of TGD at the level of H leads naturally to these minimal surfaces [7, 17]. The twistor lift of TGD emerged originally at the level of H but turned out to have a counterpart at the level of M^8. These minimal surfaces are also extremals of Kähler action except at the singularities, which are analogous to the frames spanning a soap film and serve as seats of non-determinism already in 2-D case.

[1]Correspondence: Matti Pitkänen http://tgdtheory.com/. Address: Rinnekatu 2-4 A8, 03620, Karkkila, Finland. Email: matpitka6@gamail.com.

At the level of M^8 momentum eigenstates correspond to states for which mass shells are determined by the roots of the polynomial defining 4-D surface of M^8 by holography. This surface is mapped by $M^8 - H$ duality to a space-time surface in H as a minimal surface with singularities in H [18, 19].

Measurement of momentum produces a state localized to a set of points of mass shells of M^8 corresponding to quark momenta. The measurement of position as a dual variable for momentum gives rise to a superposition of this kind of states with coefficients $exp(ip \cdot m)$ mapped by $M^8 - H$ duality to a state within a single causal diamond (CD) H localized to the point. These two state bases correspond to H-picture and M^8 picture.

Twistor lift of TGD generalizes this duality also to the spin and electroweak spin and one can say that spin 1/2 state with a given quantization axis corresponds in M^8 to either point defined by the discrete direction of quantization axes at unit sphere. In the twistor space of H it corresponds to a wave function at the twistor sphere CP_1.

3. There would also be geometric qualia related to the shape and size of objects. The flag manifolds defined by Cartan groups of symmetry groups and having interpretation as a space for the choices of quantization axes would represent example of geometric qualia, which I have called flag manifold qualia [2, 10]. The flag manifold $SU(3)/U(1) \times U(1)$ for color group defines twistor space for CP_2 and the model for honeybee dance involves this space as discovered by topologist Barbara Shipman [1].

   The twistor space CP_3 for Minkowski space has interpretation as a choice of the origin of Minkowski coordinate and spin quantization axis. Points of M^4 separated by light-like distance would be equivalent. The product of these twistor spaces appears in the twistor lift of TGD [8, 7, 18, 19]. The space of the quantization axis for weak isospin corresponds to a sphere but the breaking of weak isospin symmetry at the level of geometry of CP_2 could fix the quantization axis.

4. What about qualia such as acceleration? Acceleration corresponds to the rate of change for momentum. Momentum is a relative notion by Lorentz invariance and always relative to some system. This requires two systems. I have proposed that the relative motion of the magnetic body and biological body is behind the experience of acceleration that is force.

   In wave mechanics, force would be represented as a commutator of the Hamiltonian of the system representing the magnetic body (MB) and biological body with the momentum related to relative motion. The measurement would give an eigenstate of this operator with a constant force. If the scaling for the entire system determines the analog of the time evolution, one should decompose this scaling to single particle operators associated with the magnetic and biological body and the part representing the force when time evolution corresponds to scaling instead of translation. Eigenstates of this term would result in the measurement of force.

The basic objection against the identification of state function reduction (SFR) as a moment of consciousness is that sensory mental images have a finite duration. One can imagine two ways of identifying qualia: as an outcome of quantum measurement or in terms of a change/transfer of quantum numbers. Both the resolution of the objection and the two alternative identifications of qualia will be discussed in the context provided by the recent view of TGD. For definiteness, the discussion will be restricted to color qualia since it provides an opportunity to discuss how the new physics predicted by TGD would be involved with qualia.

2 How can the perception of quale have a finite duration?

There is a philosophical problem related to the fact that the experience of, say, color has a duration. One could argue that the idea that color sensations correspond to SFRs, that is, a single moment of consciousness, is not consistent with this. One can imagine two ways to overcome this objection.

2.1 First option

One could argue as follows.

1. It is not possible to experience that one is not conscious so that the illusion of finite duration of sensory quale is created.

2. The "small" SFR as the TGD counterpart of a weak measurement in quantum measurement theory based on zero energy ontology (ZEO) begins as a cognitive measurement cascade in a Galois group of extension of rationals associated with a rational polynomial defining a given space-time region [15, 20].

   This cascade corresponds to a decomposition of the representation of Galois group for a functional composite polynomial $P_1 \circ ... \circ P_n$ for which Galois group of the algebraic extension has decomposition to a semidirect product of relative Galois groups G_i associated with pairs P_i, P_{i+1}. This yields a product of irreps of G_i.

3. The cognitive cascade as a quantum correlate of analysis, is followed by measurements in quark spin and momentum degrees of freedom for the quark states defining the irreps of G_i. One can argue that the duration of the qualia mental image corresponds to the geometric lifetime of this sequence since eventually a BSFR, which means the death of the qualia mental image occurs. By the above argument, the steps in this sequence would not be experienced separately.

4. There is an objection against this view. ZEO [12, 16] motivates the proposal is that we are during sleep living in an opposite direction of time and *classically* it is impossible to receive signals from that period since the signals travel in an opposite time direction (TGD predicts that also signals with "wrong" time direction can be received and sent but are rare and the process involves BSFR at the level of system representing mental images as subself). However, when we wake up in the morning, we remember that we were conscious yesterday and realize that we do not remember anything about the period of sleep. Could the same argument apply to mental images related to qualia?

2.2 Second option

One could also argue as follows.

1. State function reductions (SFRs) (actually "small" SFRs responsible for the "flow of consciousness"") *initiate* a conscious experience of say some quale realized as subself, mental image. The next "small" SFR would end this experience and initiate a new one. If SFR is "big", the mental image dies and reincarnates with the opposite arrow of time and experience disappears from the consciousness of self.

   Mathematicians would say that a delta function is replaced with a step function as far as interpretation is considered. Nothing at the level of mathematical formalism has changed.

   The structure of conscious experiences reflects the structure of the physical states. In this spirit, one could argue that SFRs serve as a holographic data at the ends of the duration of the conscious experience, which determine the conscious experience associated with the duration itself. One would have have holography of consciousness.

2. Is this interpretation consistent with the fact that change is necessary for qualia as already basic physiological facts show? For instance, if the saccadic motion of the eye is prevented, the perceptive field becomes dark first and after that the visual consciousness disappears. This finding can be consistent with the new view since the lifetimes of the qualia mental images as subselves are certainly finite.

Critical reader could ask whether the two options are only slightly different verbalizations of the same basic intuition and perhaps regard the latter verbalization as mathematically clearer. The latter option looks clearer than the first one although it does not literally conform with what I have been telling for three decades about SFRs as basic building bricks of conscious experience! It can take decades to express really clearly what you have understood!

3 Two alternative identifications of qualia

One can consider two alternative identifications of qualia: as an outcome of quantum measurement or as a change/transfer of quantum numbers.

3.1 Quale as an outcome for a measurement of quantum numbers?

Quantum measurement theory suggests the identification of qualia as resulting in quantum measurement and therefore labelled by eigenvalues of the measured observable. Qualia would therefore characterize the quantum state emerging in SFR (most naturally SSFR) and one might say that qualia are determined by the properties of the state.

How does this relate to the long held TGD based view that since SFRs are the basic building bricks of conscious experience, conscious experience cannot be regarded as a property of a physical state as physicalists argue. Hence "consciousness" is a misleading term. Holography of consciousness suggests the interpretation that conscious experience and qualia are about the properties of the state emerging in SFR but are not its properties.

Consider color vision as an example.

1. Sensory receptors (such as the eye) could be seen in this framework as a collection of subsystems (rods and cones), which together form a quantum coherent state. SFR would produce a collection of different outcomes and the experienced quale would be a statistical average of the outcomes. In the ensemble interpretation, the probabilities of various quantum number combinations (basic colors) would be given by the reduction probabilities. This explains color summation. In holography with a slight failure of determinism, one cannot exclude temporal averages.

2. "Color symmetry" was originally a joke inspired by the algebraic correspondence with visual colors. The proposal was that visual colors could correspond to quark colors. Perception would be measurement of color quantum numbers. This would predict 3 colors for quarks and 3 complementary colors for antiquarks. White and black are also considered as colors.

3. This sounds outlandish but makes sense in the TGD framework, where quarks are the only fundamental fermions in the recent formulation of TGD. Moreover, TGD predicts a hierarchy of effective Planck constants $h_{eff} = nh_0$, where n has a number theoretic interpretation as dimension of an extension of rationals associated with a polynomial defining a space-time region considered. n measures the algebraic complexity and serves as a kind of IQ.

   $h_{eff} = nh_0$ labels phases of ordinary matter and these phases behave like dark matter relative to each other. Field bodies carry these phases and magnetic bodies MBs with various values of h_{eff} can act as "bosses" controlling lower levels, in particular the ordinary matter at the bottom of the master-slave hierarchy.

4. Compton lengths are scaled up by n and MBs can carry dark quarks and gluons even in cellular length scales. Below the confinement scale which is the natural scale now quarks and gluons are effectively massless. One could say that we directly see quarks!

   This is true also for the weak interactions and the presence of dark weak variants of weak bosons at magnetic body (MB) could explain the chiral selection in living matter, which is very

difficult to understand in the standard model because the violation of parity in weak interactions is extremely small above Compton length of weak bosons. In living matter the Compton length would scale up at MBs and MBs acting as "bosses" would induce large parity violation even in cell scale.

3.2 Quale as a change of quantum numbers?

An alternative option has been that the classical flows of color quantum numbers could correspond to qualia. This led to the sensory capacitor model of cell membrane [2, 5].

1. Since the changes for quark quantum numbers correspond to gluons, there would be 3+3 colors corresponding to color charged gluons. Classically one could think that the flow of color quantum numbers between two subsystems in a sensory receptor could give rise to an experience of quale such as color. This led to the sensory capacitor model of cell membrane [2, 5].

2. At elementary particle level, the change of color quantum numbers for a single particle could be induced by an exchange of a gluon between quarks. But can one associate this flow with a quantum measurement of something? For quantum groups and Yangians the color charge operators are sums of single particle contributions and many particle contributions. Two-quark contributions would make possible opposite change of color quantum numbers for the members of a quark pair. Could the measurement of the quantum group counterpart of color charge give rise to this kind of change? The first option is the simpler and more natural one.

3. In the sensory capacitor model, one could model the situation as a pair of harmonic oscillator wells representing the plates of a capacitor characterized by Hamiltonian $H = H_0 + V$. The presence of the capacitor plates would be described by a sum $H_0 = -\hbar^2\partial_x^2/2m + kx^2/2 + k(x-d)^2/2$ of harmonic oscillator Hamiltonians describing a double potential well. The potential driving the particles between the plates would be described by $V = -qEx$.

   The commutator $[H, V] = \hbar^2\partial_x E/m = i\hbar Ep$, $p = i\hbar\partial_x/m$ and non-hermitian in plane wave basis at the limit of infinite distance between the plates.

4. p is a linear combination of creation and annihilation operator for the harmonic oscillator quanta and one can ask whether the analogs of eigenstates of p correspond to coherent states for the annihilation operator having in general complex eigenvalues. Instead of eigenstate, a coherent state for the negative energy part of force could be created at the plate which contains the particle in the initial state. The coherent state would be a harmonic oscillator state for which the origin would be shifted along the line connecting the plates. The probabilities for eigenstates would be given by the overlap of the coherent states as Gaussian with the original ground state or excited state at either plate.

5. A more realistic formulation could be as a quantum phase transition for a cyclotron condensate of quarks and antiquarks assignable to the opposite layers of the sensory capacitor carrying opposite color charges. This phase transition is analogous to a spontaneous magnetization, or rather its reversal, and would emit a burst of gluons changing the quantum numbers of cyclotron condensates at the layers.

   The TGD view about dark matter leads to the notion of dark N-particle as an analog of a Bose-Einstein condensate. A dark N gluon would be emitted.

   The description of the dynamics of this transition could involve the bilinear coupling of classical induced color field components $G^A_{\alpha\beta} = H_A J_{\alpha\beta}$ proportional Kähler form and Hamiltonians of color isometries with gluon field, and associated with a "massless" extremal (ME) connecting the plates. ME or MEs would serve as a classical space-time correlate for a mode of a generic radiation field with a fixed polarization and direction of propagation.

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