PAC
Perceptual Awareness Centre

Muller cells and an independent mechanobiological function to vision

Intro:

Implicit visual awareness indicates that there is a 'ghost process' in the system that current instrumentation fails to detect and so account for. At a conceptual level, we are adrift and so are not engaging properly.

It's apparent that implicit spatial awareness presents as a system of proximity cues forming a radial field structure around the locus of fixation. This could not be detected, propagated or present using the system of electrical and chemical conductance associated with intensity receptors and neurons firing action potentials down the visual pathways. This field structure has nothing to do with processes akin to optical projection.

Unfinished painting - Fowey, Cornwall, 2016.
Radial structure and size to brush-marks in all directions from fixation generates a field structure providing a reference to the implicit spatial proximity cues available within the condensed phenomenon. The painting also contains vertical binocular stereo splice and alternation zones.

Below: The extent of visual field captured by a camera

The proposition is that the detection of photons and intensity related issues leading to neuronal spiking activity is distinct from mechanobiological activity involving passive transduction.

> "Overall mechanobiology describes the relationship between a cell and its environment; how a cell can detect, measure and respond to the rigidity of its substrate and how these processes apply to larger biological systems." https://www.mechanobio.info/what-is-mechanobiology/

Research into mechanobiology is concentrating on and with good reason, cell to biological level impact areas. We are suggesting that there is a linkage from cell to experiential phenomenon, a linkage to awareness and hence visual art.

We need to consider an alternative computational system initiating in the retina and dealing with information in the light array that our current instrumentation has not been designed to interface with and which presents on an experiential basis as implicit contextual spatial awareness.[1] Currently we consider contextual vision only in terms of its proximity to central vision: peripheral. We then view its contribution being nothing more than a degraded form of focal vision.

The story would be that a recoverable spatial medium becomes embedded in light as it travels through local environmental space. We would be looking to mesoscopic physics and the scattering of light as it travels through a medium as a means to visualize the physics involved.[2] The 'environment' for the sensing glial Muller cell in the retina is light. Environmentally 'conditioned' light with enfolded spatial data would initiate a mechanobiological response ultimately ensuring that perceptual space *presents* as a medium, a medium that implicitly factors us into the environment.

Nano scale activity at the retinal cellular level involving pre-stressed tension would initially passively interact with light quanta, again through mesoscopic physics. The 'environment' for the Muller cell involves direct exposure to light so it 'senses' it directly as pressure? Muller and astrocyte cells organize to form the basis for a mechanobiological system to function in accordance with the phase orientation of light with the glial network across the main areas of the brain generating the basis for perceptual structure and core aspects of subjective awareness.[3]

Where previously the articulation of contextual vision was limited to the strategies developed by visual artists as they intuitively studied the phenomenon, I make an attempt to trace what I hope to be a credible story referring to aspects of current neuroscience that may relate to this 'implicit' aspect of experiential reality. By

[1] Mechanobiology of brain function http://youtu.be/WIHbUGeg5UY
[2] Implicit data, a function of mesoscopic physics? http://youtu.be/x1IocBTFbo4
[3] Retinal Receptor Functions 2 http://youtu.be/-vDAn2a1Se8

advancing this investigation into the phenomenon of vision and then applying it to the base Vision-Space technology, it will be possible to develop new paradigm perceptual technologies expanding into all areas of human activity.[4]
Initial perceptual technologies will:

1. Identify testable scenarios to help our understanding of aspects of visual processing that currently remain out of our reach.
2. Indicate a useful approach methodology for realizing aspects that make the phenomenology of vision viable.

This project work implies a change in the prevailing ontology from the exclusive deployment of 3rd party observation to one acknowledging the role of the sentient being in the formation of reality. If reality is a relationship we form with the real then the prediction is that this undertaking will bring the sciences and the arts into step and hence deepen our understanding of that relationship.[5]

Light, Mechanobiology, phase & phase space

The proposition is that there's a system of passive transduction working with coherence and a phase like propagation through the network of glial cells (Muller and astrocytes) of the retina, to set alongside the more familiar intensity related data potential associated with cones, rods. In the phase related system the pre-tensioned glial network operates prior-to the detection/formation of 'bits' and calculation. Pre-stressed tension exists as it does for the spider and web combination. The spider awaits deflections sensed as vibrations in the state of its web where the web becomes an extension of its sensory system. Vibrations are generated by situations of 'more' or 'less' stress collectively providing notification of a probable event in its extended sensory system together with locational information; directional if not spatial. Impressions register upon a pre-tensioned system. We are sensitized as well as sensing.

In the case of our perceptual structure, a system facilitating the collapse of a complex wave function without the formation of the 'bit' is one where a 'calculation' as such is not really performed. The possession of the fact never arises! The data potential remains implicit, simply presenting following the collapse a shadowy form or impression via the related mechanobiology. The process governing complex phase to shadowy form suggests a collapse to phase space around a locus with everything surrounding the locus relating to it, the act of making the locus

[4] Vision Space presentation 1: The structure of monocular vision
http://youtu.be/AO71a8LzZSg
Vision Space Presentation 2: The incorporation of binocular stereo information
http://youtu.be/xLY60lm86Mk
Vision-Space: Process of information exchange within phenomenal field
http://youtu.be/8hmgutPGJmQ

[5] The painter, reality and the real https://youtu.be/gzzBYOs6mc8
The painter, reality and the real – Part 2 https://youtu.be/hbFtIIHOQ9Y

condenses implicit spatial awareness around it. We appear to be able to trigger the web or set a locus within our perceptual structure, which can perhaps be thought of as controlling an attractor? All of this is suggestive of dynamical systems and self-organizing criticality(SOC)?[6]

> "……cellular response to stress may differ depending on the level of tension in the cell, much like tuning a guitar string alters the tone it creates when strummed." Ingber, D.E.

There has to be something very significant that's being passed over? There has to 'something' going on between the pre-stress tension and incoming forces that makes an impression on the state of awareness of the biological system. Interactive phase space must be the seat of phenomenal responsiveness – of feeling.

Attractors forming in phase space set internally generated waves that set/calibrate internal cell tensions and hence response to external forces. There has to be a switching process associated with phase transition capable of interfacing with electrical and chemical signaling.

This of course poses a host of question not least of which is; how could such signaling develop into control function specific activity facilitating a mechanobiological contribution to vision? Perhaps we need to think about this differently; is sensory awareness conducted at a biological level as a series of function specific ecologies? Is sensory awareness a series of differentiated systems that are brought together and integrated? What if they are all resonating within one system from the start, but with add-on specialties developed over evolutionary time to suite our ecological niche?

> "Thus, tensegrity may represent the 'hardware' behind living systems." Ingber, D.E.

Maybe there's not such a gulf between the hardware and the software?

> The observation that gradual variations in a single control parameter (cell shape) can switch cells between distinct gene programs (cell fates) is reminiscent of a phase transition in physics. Sui Huang in my group, therefore, explored the possibility that cell fates can be viewed as 'cellular states' and that the switches between these states may represent biological phase transitions (Huang, 1999; Huang and Ingber, 2000). To explain this type of qualitative behavior, he viewed the cell's molecular signaling machinery as a dynamic information-processing network. In this manner, he was able to describe the collective behavior of the cell's signaling molecules and their relationship to cell fate switching without focusing on the properties of the individual molecular components. This path led to the suggestion that cell fates can be viewed as common end-programs or 'attractors' that selforganize within the cell's dynamic regulatory networks (Huang, 1999).[7] Ingber, D.E.

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[6] Vision-Space: Awareness is a dance mediated and augmented by 'mind' within a multidimensional space https://youtu.be/-DCx5kLS2MQ

[7] Tensegrity II. How structural networks influence cellular information-processing networks, Ingber, D.E.

Do I see all of this as evidence of quantum reality being in play? I don't see quantum reality at a conceptual level but I can understand why others do. On an experiential level I deduce that light has a duel orientation with respect to the macro space we inhabit and that we are equipped to process both orientations. Our instrumentation can be organized to reveal aspects of this duality but it does not correctly interface with it or mediate the situation. The result is that we can't rationalize a situation from the records the instrumentation makes. Quantum reality issues are the failure to mediate one! What occurs to us as experiential visual reality is the result of a system that makes quite a good job of the undertaking. Our relationship to light is sophisticated. The camera's isn't.

The lack of directly observable 'incidents' attributable to an environmental cause triggering activity within the retina may lead observers to consider such activity to be spontaneous, internally generated and without pertinence. The contrary would identify the Muller cell as having a unique relationship to light with its activities being essentially 'covert' in the context of our current instrumentation. Passive transduction is not going to register as 'an event', the 'event' being the fleetingly perceived outcome that occurs to the sentient being following collapse. The proposition is therefor that there are two independent data potentials originating at the retina and that we need both to form our relationship with the real - reality.

Muller Cells and the glial network

The Muller cell would perform a dual purpose, passively transducing in the form of pressure changes the phase related data from light as it passes through the cell while simultaneously channeling and condensing the light spread to the photo intensity receptors (cones and rods) at the back of the retina. This process of 'channeling' light through the thickness of the retina is known to avoid unhelpful scattering due to its cell structures. Tissue related interaction with the retina would generate meaningless scattering or in other words unwanted noise for the intensity receptors. The structure of the retina as a medium is irrelevant with respect to the conductance of data pertaining to the outside world.

However for this story to unfold, the structure or fabric of the brain in the form of the network of glial cells would need to function as an active or 'booted' receiver resonating at least to some extent with a form of analogue mechanistic level activity incident from the retina. We would personally 'directly feel' implicit spatial awareness as a sensitized structure as opposed to remotely 'detect' it. We would be 'at' the retina as well as receiving reports channeled through it. The paradoxical, if not counter intuitive implication is clear, core phenomenological capabilities would ultimately rely on what may be considered a rather un-esoteric mechanobiological process. In fact the more you look into mechanobiology the less un-esoteric it becomes!

So the proposition is for a system of substantial, complex and yet highly intricate mechanobiological activity within and throughout the glial network making a direct and formative contribution to the phenomenon of vision.

Mediation and mind

It is further proposed that dedicated interconnected activity between the two systems initiating at the retina and carrying on through the visual pathways, assists in the correlation of the two main data potentials. This capability may be linked to:

1) Chemical exchanges through horizontal gap junctions
2) Dynamical markers accompanying the main data potentials such as the tails associated with neuronal spikes.
3) Spontaneous activity including so-called 'dark light'.

Retinal function would then have isolated two independent data-potentials from the light array requiring different computational systems while initiating a dialogue or system of exchanges and interactions between the two processing streams. Taken together the initiation of these three activity lines would constitute the main function of retinal processing.

It is envisaged as part of this hypothesis that the system controlling the dialogue would mature into the main mediation mechanisms of mind. At the experiential level the main two data-potentials would have matured into distinct forms of awareness where they would be first coordinated, then modulated and alternated across phenomenal field dependent in part upon our intent in the world. The programming architecture for Vision-Space illustrates these processes in moving image media. For these reasons the demarcation between the mainly mechanobiological and synaptic activity is not going to be clear-cut. There is a 'what' and 'where' out there to be 'extracted' from light which is why there are a 'what' and a 'where' visual pathway. The need for extensive interaction between the two ensures that the delineation of activity occurring in these pathways can only be considered 'characterizations'. Also, its possible to derive data relating to 'what' is appearing within contextual vision just as it is possible to derive some spatial understanding of 'where' an object is located in central vision. It's a case of specialism ruling priority.

The nature of implicit processing has perhaps something in common to the approach to vision attributed to Gibson.[8] He suggested that mind directly perceives environmental stimuli.

Consciousness or a dynamic relationship between aware protagonists?

The two independent processes would generate implicit and explicit 'takes on the

[8] https://en.wikipedia.org/wiki/James_J._Gibson

real', different forms of awareness with distinct characteristics. Taken together with the mediation dynamic, they would form 'perceptual structure', the dynamical architecture through which we become aware of our environment. There would be three main protagonists to a typically functioning system of awareness. We would term the full performing complement 'consciousness' with the relationship equipping us to operate in our ecological niche.[9] Phenomenology asserts that reality is a relationship we form with the real and the suggested system perhaps identifies how this relationship manifests as experiential reality.

Consciousness would then be a collective noun, not a definitive term distinguishing a mental state operational in any particular area of the brain or existing within any given physical system or residing at any 'level' of existence. It would be an 'impression' drawn from a composite mechanism that works for us in our ecological niche. So we can appreciate when it's fully operational but can also determine (at least to some degree) when it's not and compromised in some way, as interaction with our environment will let us know! We wont relate to it in the same way. When all the key protagonists are nullified (general anesthetic) and inactive we can term the condition 'unconscious' but it's simply a state of unawareness enforced as contributing protagonists are 'suppressed'.

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[9] The protagonists http://youtu.be/516mjrU3aC0
Self Reference Pt 4, painting phenomenal field, accessing the umwelt?
http://youtu.be/g8rOhQhcl0A

Biography

Calcium Signaling in Specialized Glial Cells
Metea M.R., Newman E.A., Wiley-Liss, Inc. 2006

A Dialogue Between Glia and Neurons in the Retina: modulation of neuronal excitability
Newman E.A., Neuron Glia Biology, 2004, Doi:10.1017/S1740925X0500013X

Glial Modulation of Synaptic Transmission in the Retina
Newnam E.A., Glia 47:268–274 (2004), Doi: 10.1002/glia.20030

Calcium Increases in Retinal Glial Cells Evoked by Light- induced neuronal activity,
Newman E.A., The Journal of Neuroscience, June 8, 2005,
Doi:10.1523/JNEUROSCI.1354-05.2005

The Muller cell: a functional element of the retina
Newman E.A., Reichenbach A., TrendsNeurosci. (1996) 19, 307-312

Spontaneous Glial Calcium Waves in the Retina Develop over Early Adulthood
Zeb L. Kurth-Nelson, Mishra A., Newman E.A., The Journal of Neuroscience, 2009,
29(36):11339 –11346 • 11339, Doi:10.1523/JNEUROSCI.2493-09.2009

Light Guidance in Müller Cells of the Vertebrate Retina
Silke Agte, Dissertation - University Leipzig, 1980

Muller Glial Cell-Provided cellular light guidance through the vital guinea-pig retina
Agte S.,Junek S., Matthias S., Ulbricht E., Erdmann I., Wurm A. Schild D. Kas J.
Reichenbach A., Biophysical Journal: Volume 101 December 2011 2611–2619 2611

Substrate Elastic Modulus Regulates the Morphology, Focal adhesions, and a-Ssmooth muscle actin expression of retinal muller cells
Bu S-C., Kuijer R., van der Worp R. J., van Putten S. M., Wouters O., Li X-R., Hooymans J.M.M., Los L.I., IOVS j September 2015 j Vol. 56 j No. 10 j 5975

Functions of Optic Nerve Glia: axoglial signalling in physiology and pathology, AM Butt, M Pugh, P Hubbard and G James, 2004 Nature Publishing Group

Mechanics of the Brain: perspectives, challenges and opportunities
Goriely A., Geers M.G.D., Holzapfel G.A., Jayamohan J., Jérusalem A., Sivaloganathan S. Squier W., van Dommelen J.A.W., Waters S., Kuhl E., Published online: 2015

The Mechanobiology of Brain Function

Tyler W., Nature Reviews Neuroscience · November 2012
DOI: 10.1038/nrn3383 · Source: PubMed

More Than a Feeling: Discovering, understanding, and influencing mechanosensing pathways
Holle A. W., Engler A.J., NIH Public Access: Curr Opin Biotechnol . 2011 October ; 22(5): 648–654. doi:10.1016/j.copbio.2011.04.007.

Mechanotransduction – a field pulling together?
Chen C.S., 2008, Journal of Cell Science 121, 3285-3292 Published by The Company of Biologists 2008, doi:10.1242/jcs.023507

Tensegrity I. Cell structure and hierarchical systems biology, Ingber, D.E. (2003a), J. of Cell Science, 116, 1157-1173.

Tensegrity II. How structural networks influence cellular information-processing networks, Ingber, D.E. (2003b), J. of Cell Science, 116, 1397-1408.