A theoretical proposition for retinal detection of a field potential unfolding from the light array to form the basis of spatial and orientation awareness within the phenomenon of vision. Propagated through the colliculocortical pathway, the perceptual structure (tectal vision) would form the basis of multisense spatial awareness and orientation through the integration of field potentials.

Introduction: If we are attempting to explore the subjective realm of consciousness it is essential to gather a reliable body of intuitive insights from those that work in the experiential realm to set along side, guide and inform scientific experimentation that is essentially indirect. Vision as we experience it, is prior to science. In contrast intuitive record (art work such as paintings) can form a direct connection to our relationship with the real. From direct intuitive exploration of phenomenal field (vision) it is apparent that its function and capabilities are dependent on two independently computed and composed data-sets each presenting different ‘takes’ on the actual setting under observation (real setting). These data structures together with the dynamic of information exchange have been artificially modelled in a unique system of visual presentation known as Vision-Space (as opposed to picture space – reliant on the fundamentals of optical projection). As such we maintain that Vision-Space (VS) models visual awareness.

The requirement for two independent structures to be operational within phenomenal field suggests that the data potentials underpinning perceptual structure are both extracted from the light array incident upon the retina. These twin potentials contain specialisms that can only be associated with the dual characteristics of photon/particle and coherent/wave potentials of photons. It is not clear if the retinal cells are working at a quantum level in this respect. It is likely that the retina functions as a light ‘conversion’ membrane involving a process akin to decoherence moving from a micro scale of operation through to a macro (classical physics) level mechanism of neurons and synapses where the processes maintain both potentials in decohered form. While decoherence may indicate that quantum process is not involved in the physical signal’s progression to visual perception, the shadows of micro/macro interface and the consequences of decoherence become embedded within the system’s duality of primary functions and in the dynamic of information exchange that we

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1 Merleau-Ponty, The Primacy of Perception that; “Science manipulates things and gives up living in them. It makes its own limited models of things; operating upon these indices or variables to effect whatever transformations are permitted by their definition, it comes face to face with the real world only at rare intervals.”

2 There are multiple facets to VS contained within two patents (one issued the other pending).

3 Penrose & Hameroff, Hameroff & Watt 1992 suggest quantum coherence processes do play an active role in consciousness through microtubules.


5 We would expect a continuous analogue signal to be in operation (along side the digital) with a unique neural computational process involving approximations. These issues with respect to the nature of the types of computation involved raw data-processing and in the generation of awareness are beyond the scope of this paper.
experience as the ‘presentation’ of vision. These consequences ‘live’ within us as neural pathways and the functions of mind generated to mediate them. The phenomenon of vision and hence the processes of VS appear to be watermarked with the reality issues associated with particle physics but in proxy. The suggestion is that our intuitive understanding of the visual data structures, the dynamic of information exchange occurring within the phenomenon of vision and our intent in the world (modes of attention) are highly pertinent to the understanding of visual processing right back through the visual system to retinal receptors.

It is understood that the dorsal and ventral streams can be traced back to the retina and both are contained within optic flow serving the cortical and subcortical pathways. Retinal processes down through to receptor level are involved in the development of these pathways. The main areas of the brain influence the setting up and calibration of retinal cell structures themselves, vision is clearly not a one-way process at both the phenomenological level and the neural level that supports it. It is also apparent from intuitive examination of phenomenal field that even the experiential ‘object’ in ‘space’ delineations between central and peripheral vision broadly align with the ‘what & ‘where’ characterizations understood to underpin the two visual pathways.

**Retinal processing:** Indicators from the experiential suggest that retinal processing structures contain a specialised function capable of ‘sifting’ the light array, of decohering the light input, resulting in the separation of a dual potential for subsequent analysis and propagation through the visual pathways. Where the current theoretical model typifies the sampling of a ‘retinal picture’ (retinotopical mapping) based data-set (one for each eye) together with supporting processes to enhance and clean the signal of contaminating ‘noise’, the intuitively observed structure of phenomenal field would suggest that this ‘noise’ element contains a second order data-set potential. This data potential would then be passed to the subcortical pathway through the superior colliculus (SC) as the basis of retinotectal vision to ultimately provision spatial awareness and orientation within peripheral vision. The cross correlation functions observed in ganglion cells are known to be the result of quantal noise events taking place in the rod receptors. If this noise, paired away from the photon dependent data-potential for optimal absorption, were just a waste product then why is it preserved through retinal processing to be observed playing a role in ganglion cell output? A question raised by Greschner et al 2011.

In general, correlated activity between retinal ganglion cells (RGCs) can be produced by a combination of two factors: shared noise arising in common circuitry such as shared photoreceptors, and shared signal arising from stimuli with spatial correlations. It is unclear

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6 We would suggest that decoherence underpins all sensory segmentation of signals (including audition) rendering them in the same form prior to posting within perceptual structure that we (sentient being) generate. This in turn suggests that decoherence is a key biological function. Some have sought to link the semi-entangled state of indeterminacy with vision, consciousness and art-work, an approach to which we do not ascribe.

7 Noise deriving both from within the raw signal and from the noise produced by neural firing through a process of redundancy.
Obviously the scenario of there being a dual data potential within the light array put forward in this paper will require a fundamental shift in our interpretation of the retinal neural pathways and their functions, one where we even consider the impulse and passive processes observed in the eyes’ receptors to be pertinent. For reasons that need not concern us at this point, the supposition is that the passive process will be largely associated with the dorsal, ‘where, spatial’ pathway and the impulse process more closely associated with the development of the ventral stream and the detailed registration of ‘what and objective form’ within macular vision. As ever, these delineations are but characteristics of pathways that interlock and interweave like entangled webs throughout visual process. Nevertheless, we will be making an outline theoretical case for the retina’s separation and propagation of these two independent data potentials enfolded within the incident light array that would subsequently discharge from ganglion cells the through geniculocortical and colliculacortical pathways.

**Experimental considerations:** Before we embark on this theoretical exercise it is necessary to introduce another factor, or to be more precise, to consider an aspect or formulation of one of the data potentials to be separated from the light array. We are all familiar with the photon and the arrival of photons over time that can be considered responsible for an impulse based data potential from receptor through to the ganglion cell output.\(^8\) This is seen clearly and cleanly at the fovea and it is supporting retinal processes where direct connections are made from the cone receptors through the bipolar cells to the ganglion cells. Less clear is the format of the proposed coherence function and its signature within the receptive fields across the remainder of the retina. We suggest that a full data-set signature will only become apparent in an assessment of responses generated from across the entire spherical geometry of the retina and therefore across receptive fields. Studying small areas of the retina in isolation is likely to inhibit the propagation and detection of this data-set potential. The second important point is that this potential is contained within the light array that comes directly from a *real setting*, the real setting being the spatial arrangement of object forming the scene illuminated under normal (daylight) lighting conditions. It will either not be contained, or incompletely referenced, in other forms of stimuli presented to the retina, eg. photograph and film media or photons fired from an artificial light source including a diffuse light field. We suggest that these environmental considerations are extremely important with respect to the setting-up of experimentation designed to induce appropriate

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\(^8\)This pathway would be more closely associated with X cells dealing with high definition data fed through the Geniculocortical pathway.
natural response behaviour in retinal receptors and across receptive fields. We don’t see ‘pictures’ in either eye! Vision is not a matter of deconstructing a picture in order to transport it to some perceptual screen. We must endeavour not to make assumptions with respect to the nature of the stimuli presented to the retina without envisaging what the potential implications are of such restrictions and how they may impose upon the system under investigation. Whenever possible, the visual system needs to be presented with the order of stimuli (real settings) that it evolved over billions of years to comprehend. The visual artist chooses ‘still life’ set-ups as a means of investigation into phenomenal field for a reason.

**Disorder:** In addition to the environmental factors we also need to consider the probable data formations incident on the retina together with the probable receptor cell function required for their detection. These considerations should enable us to optimise the experimental setup designed to verify the assumptions. It is entirely valid to do this as we can refer ‘with meaning’ to our intuitive investigations into phenomenal field as the output from the system under investigation. We now also have the artificial imaging output (stimuli) from the VS imaging system that can be psychophysiologically tested. The information structure ‘blur’ does not appear within phenomenal field, neither does motion blur or depth of field. The phenomenon of vision is entirely non-photographically rendered. The data structure ‘blur’ is rarely used by visual artists as they explore and develop strategies to portray the nature of experiential reality in paintings (intuitive record). These optical data structures listed above occur only with respect to the fundamentals of optical projection (rectilinear propagation of light) and would play no part in the proposed coherence data-potential. Work by leading computational vision scientists such as Prof Jan Koenderink identifies that the structure of data within peripheral vision is disordered not blurred:

"We argue that locally orderless images are ubiquitous in perception and the visual arts"

"Blur" is technically a convolution with a non-negative, localised kernel (like defocussing a camera or projector). In the limit of infinite blur you end up with the average over the image, a uniform field. "Disorder" implies spatial shuffling. It destroys spatial resolution but leaves the histogram invariant. In the limit of infinite disorder you obtain a texture with the same histogram as the image"

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9 Visual art of the author and others such as Turner, Cezanne, Van Gogh, Degas, Bonnard, Monnet
10 Psychophysics, Neuropsychology, Neurophenomenology, Visual Art etc
Fig 1. Painting by the author 2010 (field represented by size of brush strokes)

Fig 2. *Pine tree near Aix en Provence*, 1995-97, Paul Cézanne, Oil on canvas, the Hermitage, St Petersburg, Russia
Fig 3. *Self portrait*, 1889 Van Gogh, Oil on canvas, Musée d’Orsay, Paris

Fig 4. E. Degas Mademoiselle Malo, Pastel on paper, Barber Inst of Fine Art, Birmingham, UK
© The Barber Institute of Fine Arts, University of Birmingham
Disordering a photographically rendered data-set involves randomising pixels in a specific way, within a given/proscribed area. When applied to a field structure it generates a form of spatial texture. A radial texture field set out from a fixated point in the scene increases with respect to the distance from the setting out point (Fig 6.) creating space as a ‘medium’ and not the end result of conceptual analysis of second order cues such as how one object may occlude another, although multiple cues will re-enforce one another.

Fig 6. Self similar sunflower pattern and its possible articulation as a field potential set out from fixation.

The computational characteristics of the disorder field can be used within digital media to provide spatial and orientation cues. We believe these cues and structures to play a significant role within the phenomenal of vision. Ninety percent of phenomenal field is not a pointlessly degraded form of macular vision where motion is ‘tracked’. It forms the highly specialised data system provisioning spatial awareness forming a simultaneously understood field where movement is understood in ‘flow’ from within the structure into which we (the perceiving organism) are spatially factored. This ‘take’ on reality comes with its

12 Vision-Space stimuli are currently be psychophysically tested (statistical analysis) at Cardiff Metropolitan University by researcher Joe Baldwin
own unique form of attention. This spatial mechanism does not create ‘pictorial depth’ it generates a highly computationally efficient simultaneously understood field of proximal awareness.

Fig 7. Picture space, photograph (optical projection)

Fig 8. Vision-Space, monocular phenomenal field (perceptual structure).
There other perceptually significant transforms involved in VS media relating to perceptual structure but these are not dealt with in this paper. For moving image examples of VS media using post process software, see www.pacentre.org
Retinal detection of disorder within the light array would require simultaneous firing or summation over a short time interval within a restricted area (stochastic processing?). The linkage to “disorder” as a possible coherence function will be discussed in another paper. There are obviously similarities here with the physiology of retinal receptive fields, their layout across the retina and their local field potentials (LFP).

There is, in fact at least one clear place where action at the single quantum level can have importance for neural activity, and this is at the retina.
Roger Penrose: The Road to Reality P.516

**Retinal cell function:** With these factors in mind we can return to the physiology of the eye, its biological processes and the known properties of retinal firing to trace the hypothetical dual data potential, from detection through development to their respective streaming from ganglion cells to specialised areas of the brain for visual cue development. The resulting structure (perceptual structure) can then be assessed with respect to environmental stimuli integration across ecologies such as audition.

There would appear to be significant qualitative distinctions about the processes and output potentials involved in passive and active processes in retinal photoreceptors and transference cells. The suggestion is that these processes allow for the sampling of the incoming light array in uniquely independent ways. This variance in approach to data dissemination is reflected in the nature and ‘content potential’ of the resulting data-sets subsequently transmitted through the visual system via independent visual pathways contributing in essentially ‘distinct’ ways to awareness within phenomenal field. We argue that this independence results in different ‘takes’ on the real setting under investigation.

The ‘passive’ induction function would require a mass integrated response (analogue and indirect in nature?) from multiple receptors forming receptive fields that are then integrated from across the entire retina. Taken together it would be possible to propagate a singular homogenous, holistic spatial impression of the real setting. Detail would be sacrificed for efficient and fast proximal awareness of spatial relationships and sensitivity to movement. Seen in isolation from the remainder of the total data-set, independent local summations from retinal receptors and receptive fields segmenting this potential from the light array, would be largely meaningless. The combined data-set (closer to an all possibilities field, phase space) taken from across the spherical retina would require subsequent penetration (action/intent on behalf of the perceiving organism) to denote a setting out point to ‘retrieve’ the spatial information from the enfolded data potential. This suggests that the data potential would be in an unresolved state at the retina to coalesce further down the associated visual pathway.

The ‘active’ induction function produces isolated impulses (digital and direct in nature?) establishing specific points of reference that require assembly through
time and hold individual reference with respect to the stimuli - high definition and perhaps closer to being pictorial in nature? This signal would be cleaned, amplified, collected and could undergo first stage feature analysis early on in the associated visual pathway (even at the retina).

Taken together these processes (implicit and explicit) outline the data potentials involved in us as perceiving organisms, being objective. These processes involve the perceiver in an active relationship with the real macro setting and the transference agent, light and so the micro condition.

**Picture being:** “a real representation, an ordered record, such as a video-signal, a photograph, an activity pattern in a neural structure. The order of the picture is purely conventional and exists only with respect to an external agent.

**Images:** “always contain more than pictures because the whole structure of the receiver (a lifetime’s experience) is summed up in them.” Abridged quote Prof Jan Koenderink.

The suggestion is that these independent processes help to strip out/differentiate/unfold different data potentials from within the light array. We can then perhaps expand the notion of an implicit and explicit line of neural interrogation of the light array. To detect and understand the propagation of the implicit potential requires a non-explicit methodology of approach, a non-reductionist more hands off diagnostic methodology,13 With respect to developing a computational model for each we can perhaps suggest appropriate mathematical tools as process drivers? It is likely that the computational approaches associated with passive responses will require synthesis (integration) where active will require analysis (differentiation).

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13 We detect the requirement for a new order of psychophysical testing with new approaches to experimentation, Experiential Psychology.
If we look at the various component cells that make up the retina it is clear that most of these structures could equally serve both process functions. The delineation of data-sets can’t be clearly assigned to independent regions of the retina or cell types or to how they fire or are connected to one another. As stated above, these processes form entangled webs, however it is possible to become sensitised to the different nature of each and thus start to render visible their signatures and general characteristics as we assess the detailed scientific investigations that have taken place and how they may relate to the main theoretical proposition.

**Receptors (Rods & Cones):** Shapley & Enroth-Cugell (1984) suggest that the invariant coding of the reflectance of objects, over a range of illumination, is the primary objective of retinal coding. Neural adaptation in the retina is seen to efficiently remove background noise to leave a largely contrast based response to the real setting. The proposed tectal image would be based on a purely spatial articulation stripped from contaminating detail such as reflectance and contrast, the inverse proposition! The same process of ‘cleaning’ the incident light array would serve the purposes of both data-potentials. One way of thinking about ‘noise’ would be to link it to the meaning of garden ‘weeds’. Just plants growing where they are not wanted by ‘us’ (the gardener’s pre-conceived plan for the plot).

Receptor types are traditionally considered as representing independence of function. Inter-cell (horizontal communications) junctions and lateral connections at every stage of visual processing within the retinal layers, start with the individual receptors themselves (between rods and rods, cones and cones and rods and cones). Gap junctions occur on cones (3-5) and rods (up to 10). 14 These connections have no known basis in theoretical models of the visual system and suggest just another way in which ‘noise values’ could be delineated and added to processes currently thought to be designed to ‘clean’ incoming data of meaningless contamination. If we consider the slow wave form of rods as being easily distinguishable from the fast wave forms of cones, the observed mixing of these responses would appear to be counter productive and counter intuitive. One consideration is that the rods need to utilise the faster cone pathway to transmit spatiotemporal data in advance of its regular pathways. As this suggests, there is also evidence, even at this level in retinal activity, for a dual pathway with different dynamic signatures for the known rod pathways themselves. Perhaps this could also be evidence of dynamic decoherence in action where the upper and lower components of the wave function are supressed? It is now largely acknowledged that even at the cell receptor stage activities and functions are not self contained and free from influence from cell neighbours and cell type neighbours. Vertebrates invariably have dense rod photoreceptor populations that are linked to their hunting and movement abilities at night where sensitive scotopic vision cone response is not possible. The suggestion is that the rod system also plays an important role in daylight spatial vision operating in association with cone visual systems developing a

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14 The exception being S cones that remain isolated through to the ganglion layer.
tonal spatial field potential via the SC and adjacent sub cortical structures of the thalamus. Experimentation of rod receptors at scotopic light levels (Mastronarde, 1983) also indicates that cross correlation functions originate from quantal noise events. These noise events were thought to have been stripped from the incoming data to purify the rods detection of individual photons. However, the so-called noise potential is still being actively involved in influencing signals from retinal ganglion cells. The suggestion is that in normal lighting conditions ‘noise’ events at the retina form an integral part of the incoming input from the light array and that receptors have evolved to isolate the inherent dual potential from the light array thus initiating to separate investigative processes that run in parallel. Interestingly, if decoherence has occurred at the receptor cell level by creating ‘preferred states’ then these are now ‘robust’ and less likely to be further influenced by the environment, where the environment is now receptor/synaptic noise (the perceptual processes/mechanisms of the sentient being). The resulting signal potentials should remain ‘clean’ for subsequent processing.

**Horizontal cells:** Are under the influence of neuromodulatory factors from within the retina and even back down from the main visual areas of the brain. They introduce a form of lateral inhibition giving rise to a center-surround structure to retinal receptive fields. Most species have two or more kinds of horizontal cell and through type dependent gap junctions with neighboring cells make multiple long and short-range interconnections involving feedback potentials forming networks across the entire outer plexiform layer. Detecting a coherence-based signal from the light array would require significant temporal coordination in addition to a unique processing capability. Horizontal cells have an array of morphologies that can be specific to species. The A type horizontal cell has been associated with colour discrimination in fish but the B type connection to rods only with brightness but are also known to respond to any wavelength of light. In mammalian species the B type also connects to cones but their physiology serves to electrically isolate one area of the cell from the other, thereby separating a cone-photoreceptor relationship within the cell from its rod-photoreceptor relationship. The S potential horizontal cell recordings (linking cones and rods) identify that cone receptors first spike and then show a ‘rod influenced after effect’. A combination of data-sets in one packet, one data potential carried or piggybacking on the other?

**Bipolar cells:** They receive the synaptic input from either rods or cones, but not both, and they are designated rod bipolar or cone bipolar cells respectively. However, as we have seen the inputs for either rods or cones contain influences

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15 A type cells are axonless, B type cells have axons. Dendrites of A and B types connect to cones but only B type cells connect to rods.
16 Yamada and Ishikawa 1965, gap junctions were identified as “fused membrane structures” specialized for electrical transmission.
17 Steinberg 1969 distinguished rod and cone signal separation in S-potentials cells in mammalian retina.
18 Given that the evolution of the eye saw the lens structure coming after the chamber and the potential ‘implicit’ field capability we should in fact think about the spike element to be piggybacking on the wave function?
from either the other cell type or contain a dual data potential/pathway. Again, they act, directly and indirectly with input from horizontal cells that even have the ability to influence their receptive fields, to then transmit data potentials to the ganglion cells.

**Amacrine cells:** There are many types of amacrine cells that are thought to serve to integrate, modulate and interpose a temporal domain to the visual message presented to the ganglion cell. Both amacrine and horizontal cells are also thought to segregate motion and colour potentials and these can be broadly aligned to specialisms within peripheral (implicit) and central vision (explicit) respectively and hence have associations with the two principle visual pathways. It would seem plausible that the various types of each kind of cell would be broadly assigned to pathway specialisms.

**Ganglion cells:** In total there are thought to be 11 types of ganglion cells with very different receptive fields (dendrite arboration) in terms of their circumference and their penetration within the inner plexiform layer. Much work has been conducted to confirm that these types perform specific physiological functions. We would suggest that the wide field-cells about which comparatively little is understood, operate in a unique way as coherence based data detectors (making use of noise) mediating spatial signals and motion in flow compiled post retina in the mid brain structures like the Superior Colliculus (SC). These cells are known to be suppressed by contrast a 'form' (what pathway) related attribute. Other arboration forms within the ganglion cell set with smaller receptive fields are associated with detail, form and motion tracking. Ganglion cells release directly to the optic tract and are largely of two types; midget (small receptive fields and linked to small groupings of cones and rods), forming part of the P-pathway (parvocellular) sensitive to colour and shape, and parasol (larger overlapping receptive field linking to relatively more rods and cones), forming part of the M-pathway (magnocellular) sensitive to depth but not colour. In the fovea a single ganglion cell will communicate with as few as five photoreceptors whereas in the extreme periphery, a single ganglion cell will receive information from many thousands of photoreceptors. It is actively considered that the variety of response experienced within the centre-surround receptive fields of ganglion cells represent several distinct mechanisms the most significant probably being its ability to perform spatial tuning. Contrast sensitivity to light and dark phases suggests an ability to tune optimally to coherence based signals. Differences in a cell’s ability to perform spatial summation distinguish X (associated with detail/what) from Y cells (associated with space/where). The SC is fed with ganglion cells types X, Y and W, Y and W

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19 Influences including spatial opponency.
20 This number could be stretched to 13 on a technicality. 18 types of morphological types in the human retina.
23 Cell types: 66,8,9,10,11
24 In the primate the W pathway (cat) is analogous to the K (Koniocellular) pathway also associated with modulation between layers in the LGN.
cell types have been associated with spatio-temporal low frequency response profiles and extreme sensitivity to moving stimuli W. Waleszczynk et al 2004\textsuperscript{25}. This makes the W cells projecting to the SC a prime candidate for the transmission of a coherence based data-set. It is understood that collicular cells receiving cortical stimulation from W cells do so at latencies consistent with convergence of afferents both direct from the retina and indirectly from Y cells from the LGN.

**In summary:** We would suggest that the principle function of retinal receptor cells is one of decoherence through which we as sentient beings are able to make sense of the world of real settings through the medium of light. Another, but very different way in which decoherence would play an active role in the *appearance* of the physical world!

Multiple variations in firing patterns have been observed from what at first appeared to be the simple centre-surround process of neural firing. Within these variables it is entirely plausible that distinct data-sets are segmented from the light array. It has also been observed that adaptation of the light input (changing its nature) affects the rod-influenced aftereffect of S-potential horizontal cells suggesting that if the stimuli fails to contain such a variable that would otherwise have been present in normal circumstances, the firing patterns at the retina reflects this deficit. An Off centre and On surround could theoretically perform measurements with characteristics reliant on coherence such as the registration of disorder (distribution pattern) in the input light array to produce values that would first find articulation within a local field potential (LFP) but then require integration within a pan-retinal response. This collective response could form the basis for the proposed enfolded field potential. Hence horizontal cells connecting receptors to bipolar cells feeding ganglion cells could serve both, the summation of a data potential but also act as a filter to isolate what is referred to as ‘noise’ (a waste product) to be synthesised to constitute the basis of separate coherence based data-potential.

At the ganglion level we also see two distinctive forms of firing (correlated or synchronized and uncorrelated) that are starting to be considered to provide distinct modes of visual signaling (Meister et al. 1995, Schnitzer & Meister, 2003; Schneidman et al. 2006; Greschner et al 2011). It is understood that the correlated firing serves the purpose of networking interactions from ganglion cells promoting a wave like data-set to the visual system. The cause/derivation of this synchronized activity is thought to be a combination of shared ‘noise’ from photoreceptors and *noise from the stimuli*. These correlated firings also give rise to LFP's.\textsuperscript{26} While ganglion cells are largely considered to be ‘feature detectors’, this form of approach to understanding their function may well apply to just one segmented ‘take’ from the light array (one data-set potential).

\textsuperscript{25} W. Waleszczynk et al (2004) Motion sensitivity in cat’s SC. W cells with heterogeneous receptive fields could be associated with ambient vision and perceptual space - local movement in the environment (Rowe and Palmer 1995).

\textsuperscript{26} LFP are a type of electrophysiological signal. A ‘summation’ given off by a volume of dendritic synaptic tissue.
Preparing the second ‘take’ developing from the redundant noise potential into spatial awareness and orientation cues, would be reliant on an aspect of correlated firing only coming together under convergence processes as an integral data-formation further down the visual pathway. At that point all the relevant inputs from across the retina that collectively form the integrated implicit data-set would then be ‘realised’ within a grouped field data-set formation on a neural basis (not related to optical projection) 27. This field potential would then be expressed as tectal vision but also used to underpin and support a multi-sense perceptual structure.28

We would suggest that the ‘noise’ triggering integration across ganglion cells in the retina forms just part of a synthesized data potential ‘unfolded’ through the magnocellular/dorsal associated pathway within the subcortical mid-brain structures. This would entail the SC receiving not a 2D topographic and retinotopic map along side its gaze direction/saccadic eye movement data, but a distinct mode of signaling from ipsilateral views from left and right eyes generating a unique form of spatial field awareness. This data-potential now manifest as a neutrally generated field would not be on the familiar 1,2,3D curve prevalent in current visual media imaging techniques. If we have to ‘visualise’ this data-set it may not be unlike the vector field (required to produce VS images) illustrated in the lower left portion of Fig 10.

27 Neural adaptation (modification of the raw data received) occurs at all levels of the visual systems (including receptors) confirming a considerable degree of neural plasticity (a basic biological function). Much of this activity is thought to be confined to just improving the ‘quality’ of the traditional optical picture and the efficiency of retinal signal or delivering ‘constancy’ in perception (eg. light and dark adaptation. eg. constancy of colour perception despite the effects of aging.) Adaptation mechanisms are appreciated to paly a role is removing spatially temporally redundant signal components (background signal).

28 An example of aggregation from multiple traces from ganglion being required further along the visual system in order to determine spatial awareness might be illustrated by the output from directionally selective ganglion cells?
This sort of structure would then account for the retinotectal vision identified by Sherman 1977(?) and possibly associated with the well known accounts of so called blind sight. This visual field potential would then be aligned with the ecology of audio spatial field in the lower layers of the SC. The resulting neurological structure would then be capable of supporting multi-sense integration29 in the form of a perceptual structure that ‘we’ the perceiver would be responsible for generating and controlling from the Thalamus. The Thalamus has been linked by Engle (1999) to consciousness via synchronized sweeping gamma waves.30 As mentioned earlier, to stimulate the retina to reveal a full strength data potential responsible for formulating (in early life) and optimizing perceptual awareness through perceptual structure (in everyday life) would require a suitable stimuli, not diffuse light or white noise, not a photograph, not a stream of photons, not film/video footage; but a real setting lit under normal daylight conditions! In addition, it will be necessary to consider the spherical geometry of the retina and the degree to which laying out flat, small sections of retinal tissue are likely to adversely affect the outcome of experimentation.

Within such a ‘neurally generated field’, eye movements could be coordinated efficiently providing vital spatial data for the observed ‘in-advance’ change in the shape of the physical lens required to hit a spatial target of our attention prior-to the saccadic eye movement being undertaken. The process of fixation would then involve a combination of drawing focus (optical lens) through cortically controlled functions and its alignment with the setting out of the spatial field from the neural field. This implies independent systems of awareness.31 While each form of awareness (one for each ‘take’) would support an independent form of attention, it would be the sub-conscious neural field that would be ‘prior to’ the physical drawing of focus. The sub-conscious form of awareness would be resolved prior-to conscious awareness of the issue (consideration of what is in the world). This phenomenon of decision-making prior to conscious awareness of the question has been observed and has lead to debates on ‘free will’. Awareness would involve considerations made ‘in’ time and ‘over’ time.

As indicated above, the development of the notional neural field associated with the development of an ‘implicit’ awareness is likely to be associated with the early evolution of the brain and eye and therefor controlled by older brain structures (earlier in the evolutionary process). In addition, the degree to which the ‘perceiver’ controls these generative processes through active participation in the setting out of the data-set dependent on ‘perceiver’s intent’ in the

29 Multisense integration in the SC has been well documented and shown to be lead by visual input and subject to environmental influences. MA Merideth & BE Stein 1986; DK Sarko & D Ghose 1212; I Yu, BA Rowlans & BE Stein 2010; MT Wallace et all 2004; A King 2008; JC Alvarado et al 2009; J Xu et al 2012.
30 Andreas K. Engel et al. in the journal Consciousness and Cognition (1999). This is disputed by some and the debate is ongoing.
31 We broadly associate these ‘takes’ on reality with left and right hemisphere realities – I. McGilchrist 2010.
environment suggests that in early development the eye’s receptors and retinal structures and circuitry will be dependent on instruction from the brain. Indeed, even before birth and the onset of sensory experience, neural activity plays an important role in shaping the vertebrate nervous system, (R. Wong et al 1998). The observed retinal wave phenomenon through early development is likely to be associated with this process of calibration.\textsuperscript{32} There is evidence for both an instructive role assisting with retinal development (the refinement of transient retinotopic maps and their elimination) driven by the brain and delivering the basic neural wiring and also for a permissive function extending beyond the set-up stage. The ‘collection’ of the proposed waveform data-potential will require neural ‘calibration’\textsuperscript{33} instructed from within (genetically sequenced) as well as from a supply function as part of the generation of vision from environmental light input. The potential for retinal waves to help define ganglion cell function and arrangement together with their respective dendritic layering in the inner plexiform layer has been examined with positive outcomes by Rachel Wong and her lab, 1990’s - 2005. It would seem logical that retinal waves were pre-calibrating dendritic growth prior to the onset of visually driven input so preparing circuitry to receive an incoming wave orientated aspect. This initial circuitry would be extensively horizontal in nature involving gap junctions between cells and cell types across a spherical retina and the resulting circuitry would lead to the SC and well as to the LGN.\textsuperscript{34} In addition we should expect to see the subcortical areas affecting performance of ganglion cells and even further forwards within the retinal processing mechanisms. Following the set-up process spontaneously driven retinal waves would be expected to fall away allowing the pre-wired circuitry to respond to the environmental light array. Research in this area is ongoing but restricted by the difficulties of experimental set-up.

**Implications:** The implications with respect to there being two distinct and independent data potentials relating to the physical world of real settings encoded within the light array would prove to be a significant finding! As important perhaps as recording photons deflected by the gravitational force of stars?

We can look to recent work undertaken by physicists Matthew Pusey, Terry Rudolph at Imperial College, London and Jonathan Barret Royal Holloway, London,\textsuperscript{35} for some support in us starting to seriously consider a formal break with the Copenhagen Interpretation of complementarity as a meaningful position with respect to the wave, particle duality of quantum mechanics. These issues have also been looked at by the author in a publication *Having the Courage of

\textsuperscript{32}The creation of VS media involves processes that imperceptibly modulate data-sets over time. (including binocular stereo views). The processes are very similar in appearance to retinal waves.

\textsuperscript{33}The calibration of multisensory integration processes has been observed to develop from stimuli even in anesthetized cats. J. Xu et al (2012)

\textsuperscript{34}There is some ongoing debate with respect to retinal waves afferent signaling to lamina-specific projections in the tectum. (Wong et al 1998)


The apparent collapse reflecting (body and brain) required to sensory input to the micro condition within the neural dynamic of mind required to mediate sensory input. A wet-wear physical processing system based on classical physics (body and brain) required to operate in a robust way commensurate with or reflecting quantum processes by-proxy.

36 Decoherence & Bohmian mechanics postulate (two) distinct mechanisms connected to apparent collapse, separation of components in configuration space and suppression of interference.


38 We are here ignoring inputs to the nature of awareness from the other senses and our interaction with environment that spreads the notion of awareness beyond the brain.

39 Thank’s Jan!
Fig 11. How our relationship with the real occurs?
There is no actual direct physical 3 way interaction between states

The debate between awareness aligning as classical or quantum mechanical becomes essentially meaningless (or integrated) as it would be classical in nature (decoherence providing a duality of data potentials channelled through neurons) but also reflective of quantum reality in the functional operation of mind as end-of-line mediator.

All three elements involved being manifestations of biological processes. The formative importance of the retinal membrane as a potential area of biophysical transition between the QM/Classical physics pertinent to the nature of consciousness has been acknowledged by a variety of researchers from both sides of the debate, e.g. Koch et al (2007) and Penrose. With respect to VS media and the observed nature of phenomenal field, the distinctions between consciousness as a standalone ‘state of mind’, elevated above the sub-conscious becomes rather irrelevant or miss-posed. Instead, on the experiential level, we start to address the nature of awareness as being dependent on a duality of independent ‘takes’ on the world with there own distinct forms of attention.
Fig 12. From physical chair to its perception (slide from Theoretical Overview © copyright PAC 2013)

It’s the independence of structure behind the respective forms of visual content and the requirement for mediation between them that makes us who we are. Consciousness would then be floating within the realm of general awareness, activity revealed by a distinct signature to the patterning of synchronised firing mediating modes of attention funnelling the content. What’s drawn to consciousness representing only a small part of what we are subconsciously aware of (again graded) from one moment to the next. In this definition of consciousness, it doesn’t even dictate what we do from one moment to the next as this is largely driven from the broader scope of awareness often prior to conscious acknowledgement. Consciousness can perhaps be considered as a train of thought running through the broader landscape of awareness like a river. It is only logical to suggest that consciousness and its mathematical configuration will be self-similar (fractal) in nature involving an attractor.

“Dysfunctions in the representation of the self lead to major psychiatric diseases. To understand one’s self will help others.” (Koch 2007)

VS would need to be investigated as the setting out point for a new form of illusionary space based on perceptual structure as picture space was paired with the former (central perspective and optical projection). VS systems would generate the stimuli that would pair with the developing theory establishing an

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If we consider the complexity of the multiple modes of synchronised coupling between areas of the brain, frequency bands and temporal alignment the task of tracking the proposed neural correlates of consciousness (NCC) is going to be at best an up-hill task. Perhaps we should be considering if there are any patterns behind the observed synchronised and sweeping neural activity and what the mathematics would look like while keeping an eagle eye on those engaged in making intuitive records of what they are encountering at an experiential level?
‘experiential ontology’ to the study of consciousness and the nature of reality.  

The suggestion is also that VS would urgently need to replace picture space as over exposure to the virtual environments that lie behind all our current display systems would be actively working to influence and unbalance perceptual structure by re-wiring our neural process especially at key phases such as early childhood and in old age. There are potential but as yet unresolved links of such visual deprivation to conditions like autism, ADHD and dyslexia. As vision is essentially a biological process we would have to consider that over exposure to a deficient stimuli would lead to neural process ‘turning off’ or falling into redundancy. This could well trigger an unbalance in our biological control mechanisms and be a factor in other mid-brain related conditions such as Alzheimer’s?

VS systems should allow us to determine what’s actually involved in us being objective. It holds out the potential to be a meaningful tool in the process of breaking into perceptual structure, the nature of consciousness and new perceptual technologies. We would need to consider ‘the meaning’ or relevance of all photographic media and data collection processes at all scales that reflect only our current understandings based on a singular data potential from the light array, including those of astronomical telescopes.

We would need to consider VS as representing a renaissance moment with all that would entail.

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41 “Research in the domain of visual perception has been particularly successful because the presentation of visual stimuli can be controlled precisely with current technology. Therefore, visual perception is ideally suited for investigating the dynamics of the processes ranging from the effects of unconscious stimuli to the generation of conscious perception.” Neuro-cognitive mechanisms of conscious and unconscious visual perception: From a plethora of phenomena to general principles, Markus Kiefer et al. 2011. We should note that if we expose the visual system to inappropriate stimuli without understanding the implications then the visual system will throw us clearly misleading information about the nature of consciousness.


43 Sparing of sensitivity to biological motion but not of global motion after early visual deprivation Bat-Sheva Hadad et al., 2012, Developmental Science 15:4 pp 474-481.