

# Where Am I? Redux

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## Abstract

Activation of the brain's putative retinoid system has been proposed as the neuronal substrate for our basic sense of being centered within a volumetric surround — our minimal phenomenal consciousness (Trehub 2007). Here, the assumed properties of the self-locus within the retinoid model are shown to explain recent experimental findings relating to the out-of-body-experience. In addition, selective excursion of the heuristic self-locus is able to explain many important functions of consciousness, including the effective internal representation of a 3D space on the basis of 2D perspective depictions. Our sense of self-agency is shown to be a natural product of the role of the heuristic self-locus in the retinoid mechanism.

## 1. Introduction

This paper proposes that we should consider the core self to be a real biological part of the human brain and, as such, an integral part of the human body in the physical world. It also proposes that the *phenomenal self* and the *phenomenal body* do not necessarily occupy the same locations in our phenomenal world. This aspect of human experience has various interesting consequences that are supported by close observation, theoretical implications, and some recent experimental findings. Some of these findings will be presented and discussed in the sections below.

Where does the sense of your being in the *center of a spatial surround* come from? How are the worldly locations of your currently experienced objects properly related to your own location in 3D space? The answers to these questions will touch on the very foundation of our notions of phenomenal consciousness and self. Here is a very brief overview of what I believe is a credible neuro-scientific account that can answer these questions.

To understand the biological roots of conscious experience, we must first understand the importance of the following principles:

- a. We are not conscious unless we have an experience of *something somewhere in relation to our self*.
- b. Experiencing *something somewhere* requires an internal representation of our surrounding 3D volumetric world from an egocentric perspective.
- c. We have no sensory transducers that can detect the 3D volumetric space we live in.
- d. Therefore, the human brain must have an innate biological structure that can provide us with a volumetric analog of our personal world from an egocentric perspective.

If we define consciousness, from the subjective point of view, as a transparent phenomenal representation of the world from a privileged egocentric perspective, it is reasonable to ask “where is the *self* in this phenomenal world?” We can also ask interesting questions about the correspondence between our phenomenal self-location and our self-location in the physical world. One striking implication of the retinoid model is that our sense of self is not necessarily confined within the sensed boundaries of our body, as will be shown below in the out-of-body findings. The phenomenal world and its contents are not anchored to the physical location of the body. The phenomenal world is always experienced from the egocentric perspective of the self which is not necessarily contained within one’s phenomenal body, and in this sense, our phenomenal world is anchored around our self-locus, the origin of egocentric space. As we shall see, the question “Where in my phenomenal world am I?”, and the question “Where in the physical world am I?” can have two different answers.

We are born with a system of brain mechanisms whose activities *constitute* the scope of our entire phenomenal universe. We are also innately endowed with a specialized cluster of neurons that *constitute* the location of our *self* as the fixed central reference of our phenomenal surround in all conscious experience. The self is commonly described as an observer, but in the view presented here the self is not an observer; it is the perspectival *origin* of all of our phenomenal experiences. I suggest that significant progress can be made in solving the puzzle of human consciousness on the basis of the following theoretical approach:

1. We have no sensory transducers for 3D space. Our brain alone must provide an effective innate biophysical substrate for our direct and undeniable

experience of a 3D volumetric spatial surround. In order to behave adaptively in our world, we must be able to experience our environment from an egocentric perspective. This demands that the brain processes that constitute our phenomenal experience of the world must be able to represent all salient aspects of the world within egocentrically organized brain mechanisms (Revonsuo, 2006; Trehub, 1977, 1991, 2007).

2. An organization of particular kinds of neuronal mechanisms comprising what I have called the *retinoid system* has particular structural and dynamic properties which can manifest a coherent egocentric 3D space that includes a neuronally tokened locus of the self. The primitive token of the self (I-token) is symbolized as **I!**, and takes the neuronal origin of 3D retinoid space as its referent (Trehub, 1991, 2007).
3. The cluster of neurons which constitute the self locus are spatially fixed at the spatial origin of the retinoid system, and are tonically excited during the conscious state. However, a copy of the tonic excitation pattern of the fixed self locus can be spatially translated by activation of shift-control cells (Trehub, 1991) so that a compact “spotlight” of added neuronal excitation can be selectively directed to fall on any region of retinoid space. This mobile replica of self-locus activation is called the *heuristic self-locus* (Trehub, 1991, 2007); it is symbolized as **I!\***. Excursions of the heuristic self-locus constitute the neuronal basis of selective attention.

## 2. The Retinoid System and Visual Space

The world appears to us as a stable, coherent arrangement of objects and environmental features in a spatially extended layout. But on any given visual fixation, our window of sharp foveal vision registers clearly a region of only 2 to 5 degrees of the scene in front of us. Saccadic eye movements present us with a sequence of scattered glimpses of our spatially extended visual environment where all sharply defined visual stimuli are superposed on the fovea. How can the visual system disentangle its fovea-centered images and construct an integrated brain representation of its surrounding environment, not in a fovea-centered frame, but in an egocentric spatial frame? As an answer to this question I proposed the existence of a dynamic representational system of brain mechanisms that I designated as the retinoid system (Trehub, 1977). Its putative structural and dynamic properties enable it to register and appropriately integrate disparate foveal stimuli into an egocentric representation of an extended 3D frontal scene, as well as perform many other useful perceptual and higher cognitive functions. Neuronal details of the retinoid system have been modeled and tested in computer simulations and psychophysical experiments (Trehub, 1977, 1978, 1991, 2007).

For visual processing, the retinoid system registers information in visual space and projects afferents to higher visual centers. It organizes successive retinocentric visual inputs into coherent representations of object layout in 3D space. It also receives input from higher visual centers and can serve as a visual scratch pad with spatially organized patterns of excitation stored as short-term memory. The mechanism of temporary storage is assumed to be in the form of retinotopically and spatiotopically organized arrays of excitatory autaptic neurons. These are cells which have their own axon collaterals in feedback synapse with their own dendrites or cell body (van der Loos and Glaser, 1972; Lubke et al, 1996; Tamas et al, 1997). An autaptic cell that receives a transitory suprathreshold stimulus will continue to fire for some period of time if it is properly biased by another source of subthreshold excitatory input. Thus a sheet of autaptic neurons can represent by its sustained discharge pattern any momentary input pattern for as long as diffuse priming excitation (excitatory bias) is sustained (up to the limit of cell fatigue). If the priming background input is terminated or sufficiently reduced, the discharge pattern that represents the stimulus on the retinoid will rapidly decay (see Trehub, 1991, Fig. 2.5). The problem of registering and combining disparate foveal stimuli into a proper unified representation of a larger real-world scene can be solved by a layered system of interconnected retinoids acting as a dynamic postretinal 3D buffer (Trehub, 1991).

## 2.1 Retinoid Space as Our Phenomenal World

A key feature of retinoid space is that it is organized around a fixed cluster of autaptic cells which constitute the neuronal origin -- the 0,0,0 (X, Y, Z) coordinate of its 3D spatiotopic neuronal structure. All phenomenal representations are constituted by patterns of autaptic-cell excitation on the Z-planes of retinoid space. I have proposed that the fixed spatial coordinate of origin in the Z-plane structure can be thought of as one's *self-locus* in one's phenomenal world, and I designate this central cluster of neurons as the core self (!) (Trehub 1991, 2007). Our phenomenal world is all of the current content of our consciousness, and because retinoid space is to be taken as a neuronal structure that is a real biological part of the brain, my working definition of consciousness is this:

*Consciousness is a transparent brain representation of the world from a privileged egocentric perspective.*

Brain representations are *transparent* because they are about one's world and are not experienced as the activity of one's brain. The brain representation is *privileged* because no one other than the owner of the egocentric space can experience its content from the same perspective. Notice that this working definition is framed in terms of brain processes assumed to *constitute* the

subjective/phenomenal property of consciousness. Since, in this theoretical model, retinoid space is the space of all of our conscious experience, vision should be understood as only one of the sensory modalities that project content into our egocentrically organized phenomenal world. All of our exteroceptive and interoceptive sensory modalities can contribute to our phenomenal experience, as shown in Figure 1.

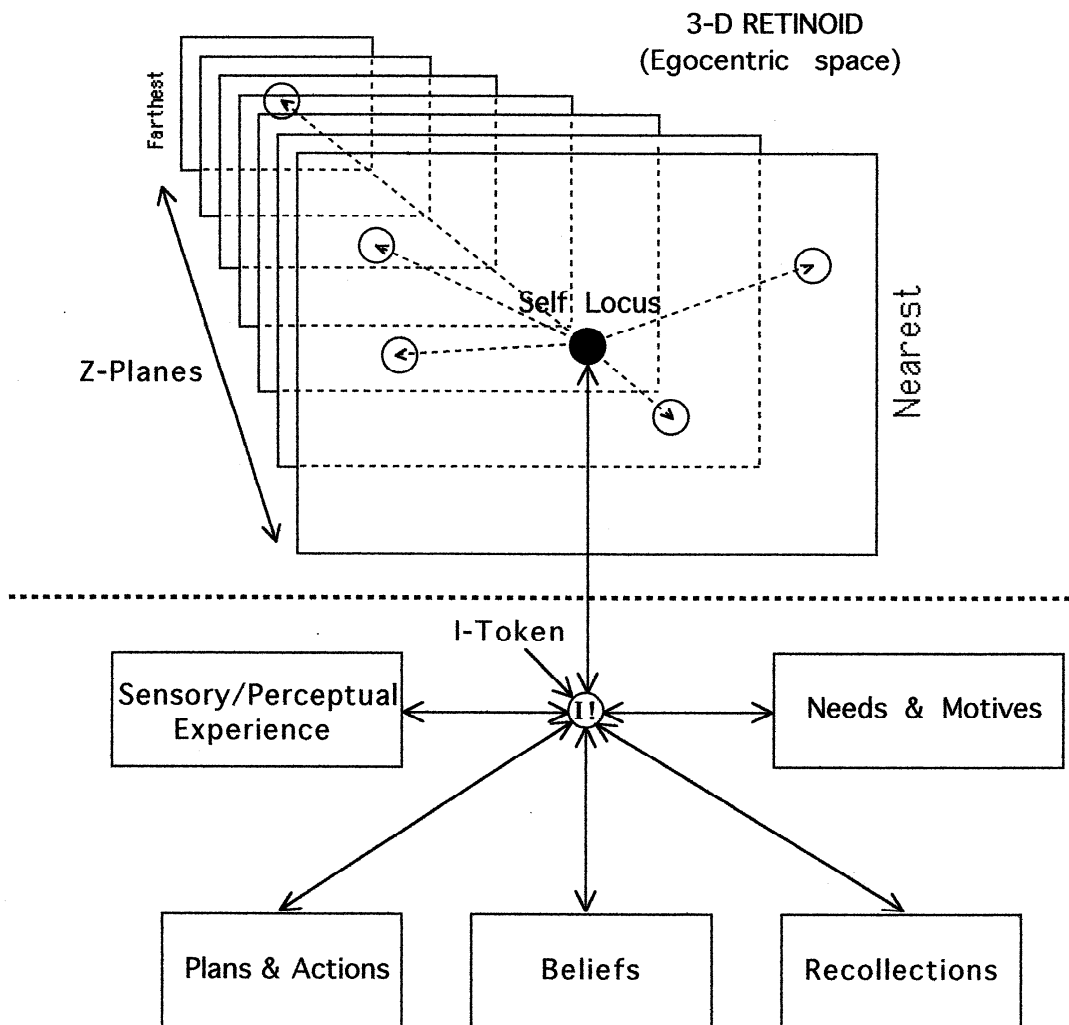


Figure 1. The self-system. The self-locus anchors the I-token (!! ) to the retinoid origin of egocentric space. !! has reciprocal synaptic links to all sensory/cognitive processes.

Thus a blind person can have as keen a phenomenal sense of a surrounding volumetric space as a fully sighted person. And the pain of a banged thumb will be felt in a particular location within the egocentric space of one's body envelope just as the visual image of the strike of the hammer is consciously located in relation to the sudden pain in the thumb in one's egocentric space.

## 2.2 The Heuristic Self-Locus

Psychologists commonly speak of the "spotlight of attention" as a selective attention function that plays a critical role in our cognitive activity. But how can the brain actually perform selective attention? I have proposed the minimal structure and dynamics of a neuronal shift-control mechanism that can utilize the fixed tonic excitation of the retinoid's self-locus neurons (II) to move a "spotlight" of excitation to any targeted region of retinoid space. I have designated this projection of self-locus excitation the *heuristic self-locus* (II\*) because it should be understood as an exploratory brain event that aids in learning, discovery, or problem solving (Trehub, 1991, 2007). The source excitation of the core self (II) at the 0.0,0 retinoid origin is sustained during all excursions of the heuristic self locus (II\*). We can think of II\* as a mobile agent of the core self that can "scout" any region of our current phenomenal world for its affordances in preparation for adaptive action. But the heuristic self-locus has an additional important function; its movement through retinoid space traces contours of neuronal excitation that are analogous to the traces of a marker on a display board. Such traces are imaginative productions that can serve as internal models to be overtly expressed as useful artifacts.

## 3. Dennett's Thought Experiment

In a book chapter titled "Where am I?", Dennett (1978) posed an interesting thought experiment in which his brain is placed in a life-support vat with all cranial nerves effectively connected by radio links to his otherwise intact body. He describes it this way:

*The Houston brain surgeons encouraged me. 'Think of it,' they said, 'as a mere stretching of the nerves. If your brain were just moved over an inch in your skull, that would not alter or impair your mind. We're simply going to make the nerves indefinitely elastic by splicing radio links into them.'*  
*...[later]...."I gather the operation was a success," I said. "I want to go see my brain." They led me (I was a bit dizzy and unsteady) down a long corridor*

*and into the life-support lab. A cheer went up from the assembled support team, and I responded with what I hoped was a jaunty salute. Still feeling lightheaded, I was helped over to the life-support vat. I peered through the glass. There, floating in what looked like ginger ale, was undeniably a human brain, though it was almost covered with printed circuit chips, plastic tubules, electrodes, and other paraphernalia. "Is that mine?" I asked. 'Hit the output transmitter switch there on the side of the vat and see for yourself,' the project director replied. I moved the switch to OFF, and immediately slumped, groggy and nauseated, into the arms of the technicians, one of whom kindly restored the switch to its ON position. While I recovered my equilibrium and composure, I thought to myself: "Well, here I am sitting on a folding chair, staring through a piece of plate glass at my own brain . . . But wait," I said to myself "shouldn't I have thought, 'Here I am, suspended in a bubbling fluid, being stared at by my own eyes'*

If you think this is too weird to correspond to any kind of experience *you* might have, try doing this: Stand up straight and close your eyes. Do you know where you are? "Of course." you say "I'm in the same place I was in when I closed my eyes." But suppose you had no recollection of where you were when you closed your eyes. Now, where would you be? Notice that this is a common nightly occurrence --- a normal condition of sleep during a dream. Consider where you think you are as you dream. You experience yourself in some strange or familiar place, but you are rarely in your bed or wherever you were when you fell asleep. It is the visual objects and features contained within your dream space that determine your phenomenal location. In fact, the same is true in your waking state. The objects and features that fill your phenomenal space when you are awake and alert control your sense of where you are in the world. The personal location of phenomenal space is determined by exteroceptive sensory input, the most effective being visual input.

#### **4. The Out-of-Body-Experience**

Now suppose that while you are in a normal waking state the *content* of your phenomenal space is not composed of the objects and events in your real-world location, but rather on a contrived situation beyond your control – a realistic visual simulation of a world seen from a perspective that is different from your own natural perspective. In this case, you would experience yourself not where you really are but in the false location determined by the sensory input of the simulation program. In this case you would be phenomenally transported without the need for brain surgery and fancy radio links as in Dennett's thought experiment. Your immediate sense of location would be determined by the weight of the evidence provided by the visual content of your altered sensory input. While your real body is in one location in the physical world, the phenomenal

location of your body would be somewhere else. If the phenomenal body can be separated from its place in the real world, can the phenomenal self be separated from its phenomenal body?

Recent experiments utilizing a virtual reality paradigm provide compelling evidence that the phenomenal self can, indeed, be separated from one's phenomenal body. In the out-of-body experience (OBE), the sense of personal location as the egocentric origin of experience is separated from the phenomenal location of one's own body. The experimental procedures of OBE severely disturb one's normal sense of worldly location by touching a visible virtual body in the same place and at the same time as one's own body is touched. In one study, participants had the feeling that a virtual body perceived to be in front of them was actually their own body which they somehow were able to see from some distance away (Lenggenhager et al, 2007). A more complex study by Petkova and Ehrsson (2008) showed that under certain conditions participants felt that their body swapped places with another body or even with an artificial "body". The OBE experiments reported by Lenggenhager et al (2007) and by Petkova and Ehrsson (2008) tell us something very important about the nature of the phenomenal self as a part of the cognitive brain. They demonstrate that where we feel our body is located in space can be significantly different from where we feel our self, the subjective "observer" of our body, is located.

So if our sense of self-location is not necessarily anchored within the envelope of our physical body, where in the world is it anchored? The answer is that it is anchored at the origin of the egocentric space of our own natural virtual world (Revonsuo, 2006; Trehub, 2007). This virtual world exists in parts of the human cognitive brain and is constituted by the neuronal structure and dynamics of the putative retinoid system (Trehub, 1991, 2007). When the virtual world of the retinoid system is tricked by the substitution of contrived visual and haptic input instead of veridical input, the self is naturally located at an egocentric coordinate consistent with the layout of objects and events within that other virtual world. This is illustrated in Figure 2. If the subject (person-1 in Fig. 2) shakes hands with person-2, wearing the head-mounted camera, the subject has the feeling of swapping bodies with the second person, in effect shaking his own hand (Petkova and Ehrsson, 2008).



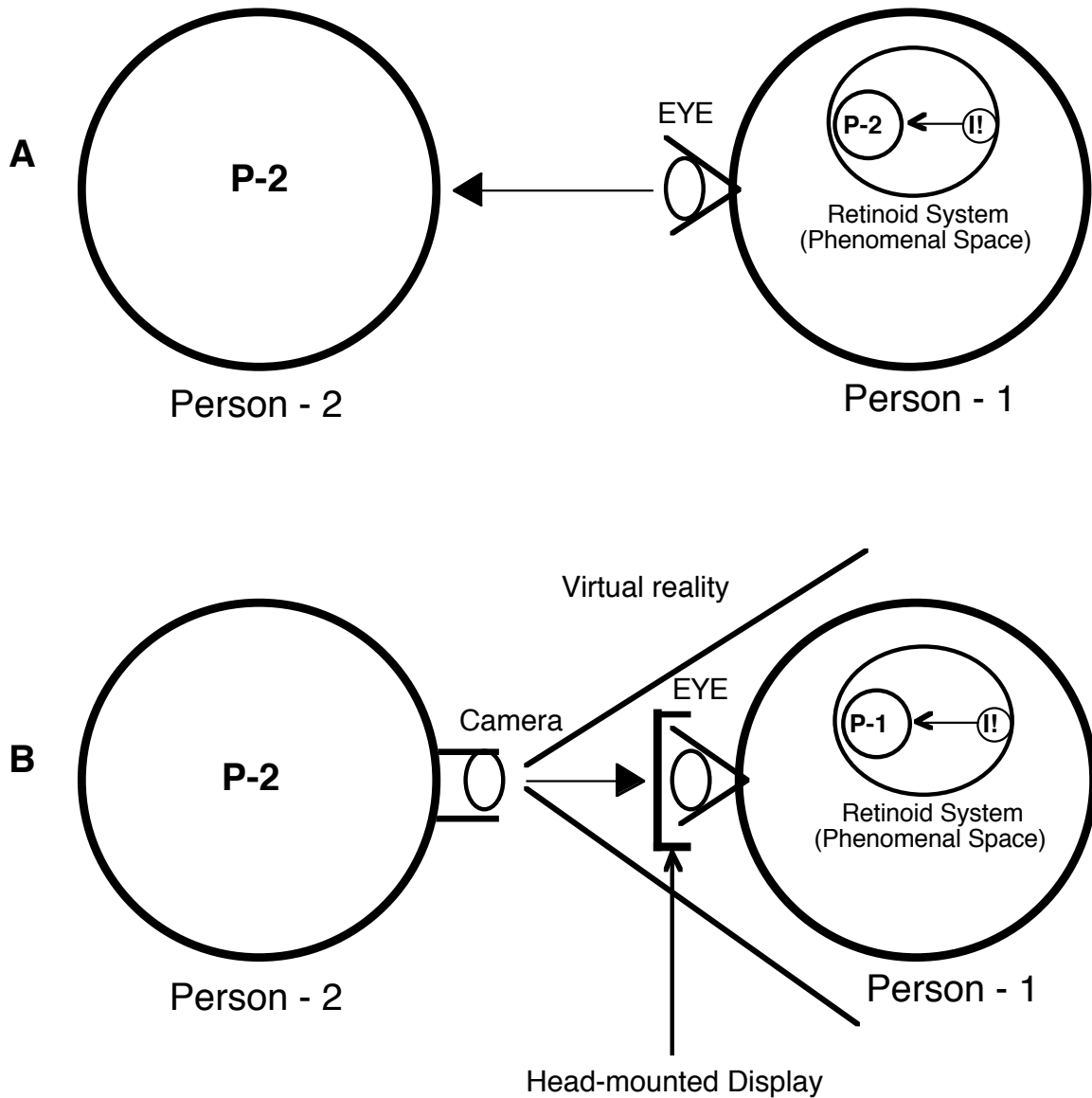


Figure 2. Out of body experience (Petkova and Ehrsson 2008)

**A.** A second person (**P-2**) is directly viewed by the first person (**P-1**). **P-1** has a phenomenal representation/experience of **P-2** as someone in the space that is separate and in front of his/her self (**I!**).

**B.** A “second person” (**P-1**) is viewed by **P-1** via a head-mounted video camera on **P-2**. **P-1** has a phenomenal representation/experience of his/her own body that is separate and in front of his/her self (**I!**). In shaking hands with **P-2**, **P1**

feels as though located in the body of **P2** and grasping another hand. At the same time, the phenomenal perspective of the self (**I!**) remains separate from one's illusory body.

## 5. Why 2D Perspective Works

The previous examples are natural consequences of the neuronal structure and dynamics of the retinoid system. It turns out that the power of linear perspective depictions can be explained by these same retinoid properties.

Perspective drawing as a way of inducing a sense of depth in a display on a 2D surface is a relatively recent achievement in the history of human artistic endeavor. It wasn't until the 15<sup>th</sup> century that the geometrical method of perspective was widely used in drawing and painting. How is it that a 2D drawing can have a virtual third dimension that appears to extend into the space in front of the observer?

### *Independent planar motion in a 2D display*

Consider the illusion shown in Fig. 3. If you move your head a bit, the central figure seems to slide erratically over the background pattern. The 3D retinoid model explains/predicts this phenomenon on the basis that our brain represents the foreground and the background on two different Z-planes in its egocentric space (see Fig.1). The "sliding" inner figure is on a neuronal Z-plane that is closer to the self-locus (in depth) than the background pattern. Micro-saccades shift the locus of the central (closer) figure in small erratic steps with respect to the background. This gives the illusory experience of one visual surface sliding over another surface, even though both surfaces are presented on the same plane in the 2D pictorial image.

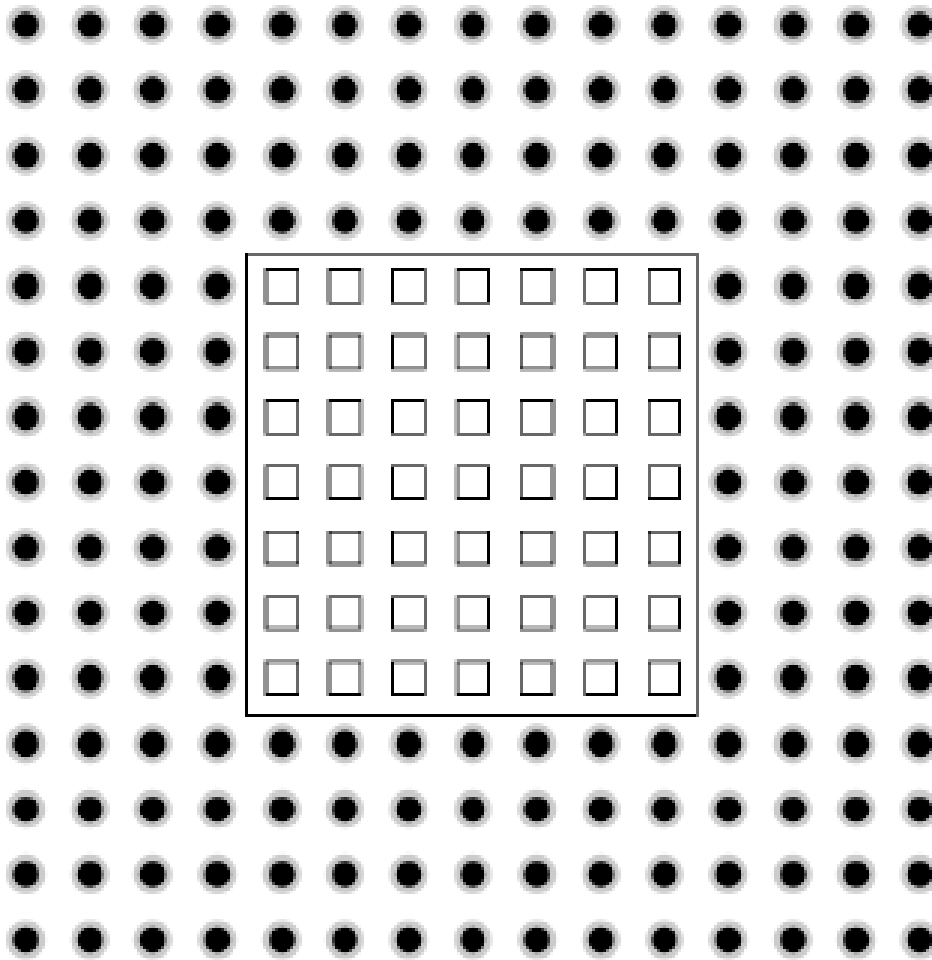


Figure 3. Pinna & Spillmann (2005)

*Illusory enlargement of size in a 2D perspective drawing*

Two objects that project the same visual angle on the retina can appear to occupy very different proportions of the visual field if they are perceived to be at different distances. What happens to the retinotopic map in primary visual cortex (V1) during the perception of these size illusions? Using functional magnetic resonance imaging (fMRI), Murray et al (2006) show that the brain's retinotopic representation of an object's size changes in accordance with its perceived

(phenomenal) size. A distant object that appears to occupy a larger portion of the visual field actually activates a larger area in V1 than an object of equal angular size that is perceived to be closer and smaller. The results demonstrate that the retinal size of an object and the depth information in a scene are combined early in the human visual system to enlarge the brain representation of the object.

Viewing a 2D perspective display similar to Fig. 4, in a psychophysical test, subjects were instructed to adjust the “near” disc to match the size of the “far” disc”. In making the perceptual match with the far disc, subjects were found to increase the size of the adjustable near disc approximately 17%. When the subjects viewed the same perspective display while undergoing fMRI imaging it was found that the area of V1 activated by the far disc was proportional to the enlargement perceived in the psychophysical phase of the study. This experiment demonstrates that the human brain has biological machinery that can transform a 2D layout of objects in the physical world into a 3D layout in the person’s phenomenal world. In this transformation, an illusory enlargement of the “more distant object” in a perspective drawing is reflected in a corresponding biophysical enlargement of the brain’s representation of the object. This finding is explained/predicted by the retinoid model because it has the neuronal mechanisms that can accomplish this task. When the perspective drawing is viewed, the heuristic self-locus traces the converging perspective lines through the depth of the retinoid’s Z-planes. As this happens, the excitation patterns on the depth planes are successively primed and objects are represented in the retinoid’s Z-plane space from near to far. Because of the retinoid’s size-constancy mechanism (see Trehub 2007, p. 318) the brain’s representation of the “far” disc in the 2D display is enlarged relative to the “near” disc, and this is reflected in the relative size of fMRI activation in V1. Thus what has been a puzzling illusion is explained in the retinoid model as the result of the natural operation of a particular kind of brain mechanism.

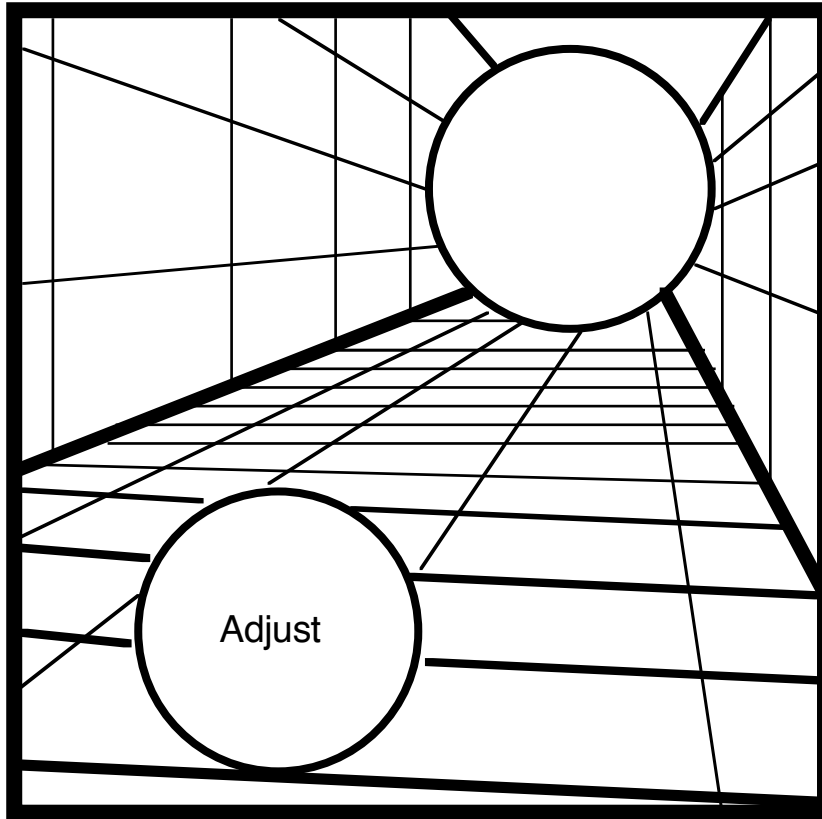


Figure 4. Perspective illusion of size (Murray et al 2006)

## 6. Looking Ahead: The Heuristic Self-Locus

When we are in an alert conscious state, we are constantly directing and redirecting our heuristic self (!!\*) into and all about our phenomenal world. A part of us, in a distinctive phenomenal sense, may be far beyond our body. Whether or not our body is brought to the location of our heuristic self-locus depends on many factors, some of which may be beyond our control.

For any non-reflexive action, it seems that a part of *you must precede your body*. You might think this is a totally bizarre idea, but properly understood, you might find it the most natural way of understanding our adaptive behavior in the world we experience.

Imagine walking through an unfamiliar street looking for the new house of an acquaintance. You have been given the address and the fact that the house has a white picket fence in front of it. You first look left and right to see the house numbers nearest you. You find that the nearest number is much lower than the address you seek. You walk ahead and find that the numbers are getting higher so you continue in the same direction. As you approach the address you are trying to find, you look ahead for a house with a white picket fence. Through all of this, your attention together with your phenomenal experience of the neighborhood has been directed and redirected to include many different objects in the 3D space around you. Remarkably, despite your vivid impression of walking within a 3D spatial surround, *you have no direct sensory input of the volumetric space through which you move*. As counterintuitive as it might seem, all evidence points to the conclusion that your undeniable *experience* of a surrounding world, full of objects and events, is a fantastic construction of some kind of biophysical machinery within your brain.

To return to the example of your looking for a particular house in an unfamiliar street, Fig. 5 shows a cartoon display of your retinoid representation of the street and its houses from the perspective of the self-locus (I!). As you stand in the street, your attention (i.e., your *heuristic self-locus*) is serially projected through retinoid space to selectively target the houses in view and find the one with the picket fence and the right address. In the example shown, heuristic self-locus excursions (1- I!\*, 2- I!\*, ...) from your self-locus (I!) to the targets of interest “capture” each house in turn and translate a copy of its retinoid image to the normal foveal axis where it can serve as an input to a synaptic matrix for recognition/analysis (Trehub, 1991, 2007).

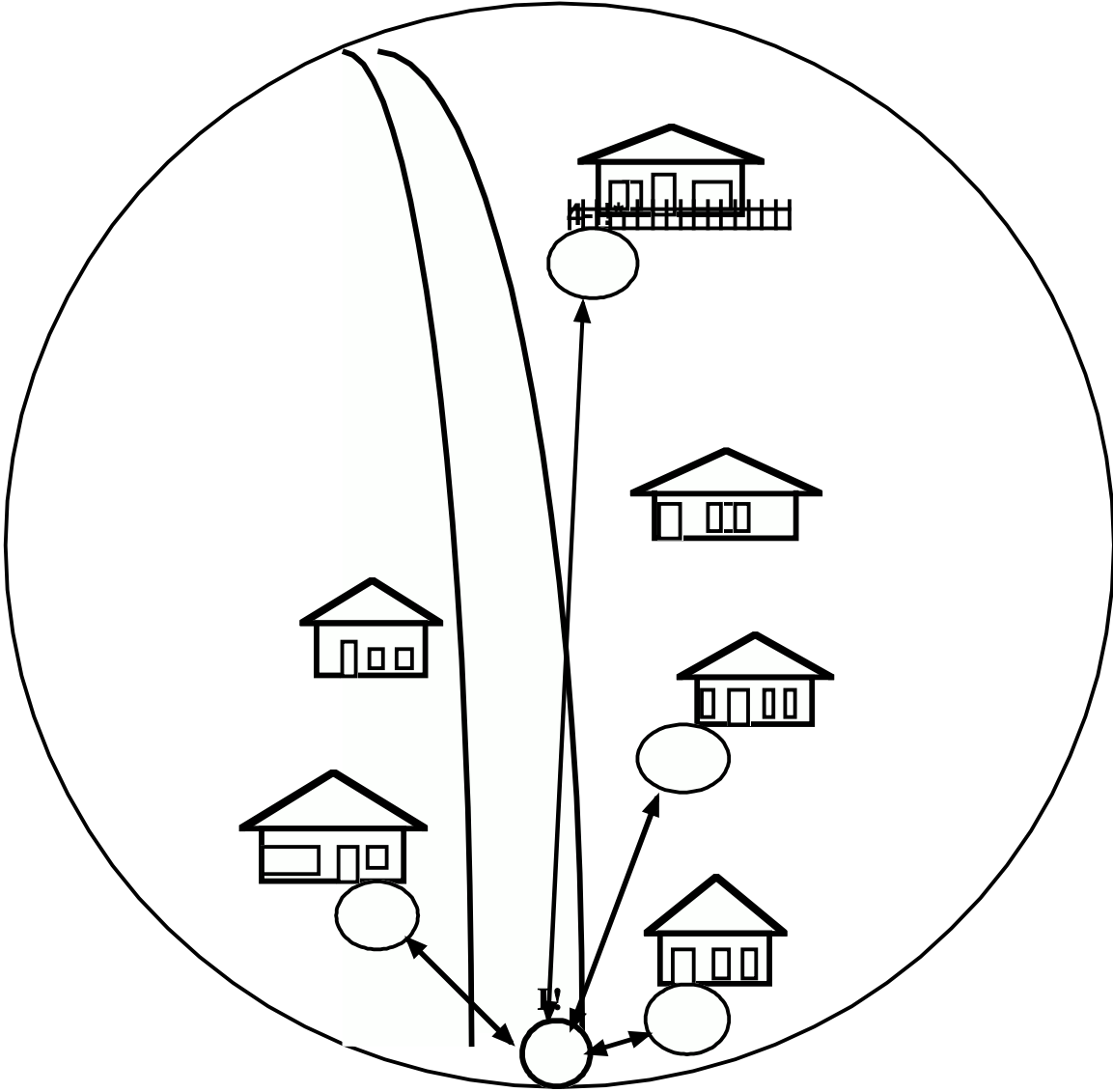


Figure 5. Looking ahead

Our sense of personal agency is not an illusion. Before we engage in goal-directed action our heuristic self-locus (I!\*) is already reaching out at targets of interest and at affordances around us in our phenomenal world. We think of ourselves as active agents because at a very basic level our core self *is* an agent of action. It is interesting to recall that belief in an active/agentive eye was common among ancient philosophers. For example, Plato wrote in the fourth century B. C. that light emanated from the eye, and seized objects with its rays. In terms of the retinoid theory of the heuristic self-locus as the mechanism of selective visual attention, this belief in a “grasping” visual emanation is not far-fetched for those who thought that the eye was the locus of visual perception.

## 7. I! as the Foundation of the Phenomenal Self-Model

The self-locus in the brain’s retinoid mechanism is represented by a neuronal token which is designated as I!. Any subjective state of belief, according to the theoretical model, must be a sentential proposition in a neuronal structure synaptically coupled to I! (Trehub, 1991, 2007, 2009). Since the phenomenal self model (PSM) (Metzinger, 2003) will consist of a complex set of internal images personally validated by a corresponding set of propositional beliefs, PSMs cannot be constructed without attachments to I! which is synaptically attached to the self-locus --- the cluster of autaptic cells at the 0,0,0 coordinate in the retinoid model.

Here is an example. Suppose John is asked “Can you walk through that doorway without ducking your head?” and John, sincerely believing that the doorway is higher than he is, answers “Yes, I can.” In order to hold this belief, John must have a PSM of his own upright height that locates the top of his head below the top of the doorway. Suppose, however, that John is a 7’4” basket-ball center who knows that he must duck his head going through the door, and his answer “Yes, I can” is said in jest. Since his response in this case is not his sincere belief, the neuronal proposition <I can> would not be accompanied by a coupled discharge of the I!-token. His PSM is I!-validated, but his false assertion does not have the validation of I!. Notice that in the case of a delusional belief, the 7’4” center might sincerely assert that he doesn’t have to duck his head because his delusional PSM is that of a much smaller person. If so, his sincere but false response would be coupled to the discharge of I!. This shows that I! (or its equivalent) is necessary for the construction of a sincere PSM. It might be interesting to contrast the phenomenal self model with the preconscious (reflexive) self model, but this is beyond the scope of this paper.



## 8. The Functions of Consciousness

When we are asked to define any named concept, we normally select an identifiable object or event in our phenomenal experience as the referent of the word that names the concept. In this respect, the concept of *consciousness* is uniquely different because any and all of our phenomenal experience qualifies as a proper referent. A clear implication of this state of affairs is that from the first-person perspective consciousness is comprised of all of our phenomenal world, and from the third-person perspective consciousness is whatever creates our phenomenal world. I think it would be fair to say that the most important function of consciousness is to present us with a coherent phenomenal world. If we are to explain the origin of consciousness we have to explicate a brain mechanism that can create a phenomenal world.

The putative retinoid system is certainly a strong candidate for such a brain mechanism. The evolution of the brain that resulted in the development of the retinoid system opened up an entirely new kind of biological event – the neuronal representation of a surrounding world! If we take neuronal activity within the egocentrically organized structure of retinoid space to constitute conscious experience, we can see that, first of all, consciousness serves the critical function of providing us with *our* world – a personal world in which we are tasked to cope and thrive.

Sensory-motor discrimination, learning, and imaging are easily accomplished by electro-mechanical devices as well as by simple organisms. Before the evolution of the retinoid system, all behavior was limited to basic sensory-motor adaptations. It is extremely important to appreciate the difference between (a) sensory detection/discrimination which can be accomplished by any competent non-conscious sensory apparatus (e.g., a photo-electric switch), or a creature such as planaria that has chemo-receptors to discriminate between noxious and nutrient concentrations, and (b) sensory representation of *something somewhere* within the coherent egocentric surround of a creature with a retinoid system that represents the world within which the creature must adapt. It is only the latter kind of adaptation (b) that signifies consciousness. In Fig. 1, the neuronal activity of all of the mechanisms shown below the Z-planes of the retinoid system is adaptive, but not part of our conscious experience. Only those pre-conscious activity patterns that are projected into egocentric retinoid space (above the dotted line) become part of our phenomenal experience. In the case of ambient light or dark, for example, the corresponding visual projections would fill our entire egocentric surround. The critical point is that there can be an evolutionary advantage to any kind of survival-relevant functioning, but *there cannot be consciousness without an egocentric perspective/subjectivity* – the ability to represent a volumetric surround including something somewhere with respect to ones self. Simply put, my argument is that there is *nothing that it is like* to be

conscious without subjectivity, and there was no subjectivity until the biological evolution of the retinoid system with the self as its locus of origin.

The self is commonly described as the observer of the world, but in this theoretical formulation the self is not the observer – rather it is the origin and *owner* of our observations. Each of our sensory modalities functions in its own specialized fashion as an “observer” of some particular features of the world. It is only after the multiple sensed features are projected in spatio-temporal register into the global coherent manifold of retinoid space that they become part of our phenomenal world. On reflection, we may think of our self as the observer of this world because all phenomenal features are represented relative to our self locus, but in fact it is the totality of a person’s preconscious sensory-cognitive apparatus that is doing the observing as acts of sensing, detecting, and recognizing before the products of these operations are projected into retinoid space where they are experienced as *something somewhere* from our own perspective.

The important notion of the self, not as an observer, but as the *owner* of everything that is represented subjectively is expressed this way by Droege (2003):

*“At the most basic level, representations function inferentially and computationally as mine if they are coded egocentrically. My sensations are those coded relative to the same locus point, viz. the subject of those sensations. The locus point of my egocentric map serves to indirectly identify which sensations are mine: they are sensations coded relative to me.”*

In terms of the retinoid theory of subjectivity, the egocentric map to which Droege refers is realized by the neuronal structure and dynamics of Z-planes in retinoid space.

In recognizing the dramatic biological change accounting for the first appearance of subjectivity, Metzinger (2010) writes:

*“The functional basis for instantiating the phenomenal first-person perspective can be seen as a specific cognitive achievement: the ability to use a centered representational space (Trehub, 1991, 2007, 2009).”*

Here, Metzinger emphasizes that the evolution of a particular kind of brain mechanism, utilizing the structure and dynamics of a centered representational space, was the necessary basis for the existence of phenomenal experience. The retinoid system provides just this kind of brain mechanism.

Where in the brain might the retinoid system be located? A reasonable answer is that its complex neuronal structures are connected but are distributed over several anatomical regions of the brain. Presently, our neuroscientific tools are not sufficiently powerful to answer this question with greater precision. While we may make some informed conjectures on the basis of current knowledge (e.g., Blanke et al, 2004; Ionta et al, 2011; Strehler, 1991), a serious treatment of the question of the anatomical localization of the putative mechanisms of the retinoid system would require the presentation of neuroanatomical and neurophysiological details that are beyond the scope of this paper.

## 9. Conclusion

Our phenomenal world is such an omnipresent and intimate presence that we fail to see it as the fundamental referent of our concept of consciousness. From the subjective first-person perspective (from within the brain), it is simply my being here in this world with all of its present and possible contents. From the objective third-person perspective, it is a transparent brain representation of the world from a privileged egocentric perspective. How does the brain create this singular kind of representation?

My proposal is that the retinoid system is the key to understanding subjectivity and our phenomenal world. The retinoid mechanisms provide the essential perspectival representation. Within the structure and dynamics of the retinoid system there are two critical aspects of a unitary neuronal self:

1. The self is the spatiotemporal origin of the phenomenal world in which we live.
2. The self is the fixed neuronal coordinate of reference (the 0,0,0 coordinate) for the brain mechanisms that represent the egocentric volumetric property of our phenomenal world; i.e., 3D retinoid space.

All illusions of 3D depth and motion that are induced when we look at two-dimensional figures are generated by the capacity of the retinoid mechanisms to segregate selected parts of 2D visual patterns onto separate Z-planes within the plenum of retinoid space.

Our phenomenal self-model (Metzinger, 2003) is a system of images and belief reflected in sentential propositions that can only be constructed on the neuronal foundation of the core self (II) (Trehub, 2009). The out-of-body experience can be seen as a natural response to particular kinds of contrived visual and cutaneous

stimuli because our sense of location in the physical world is determined by the perceptual contents of our retinoid space. Put another way, our phenomenal sense of where in physical space our physical body exists can be decoupled from our perspectival origin/self (!), and when this happens, we can have the feeling of experiencing our self from outside of our own body.

Further reflection on the role of the retinoid system as a successful explanatory model for these and other empirical findings (Trehub, 1991, 2007) leads to the conclusion that neuronal activity within the brain's retinoid mechanisms and the content of phenomenal consciousness are dual aspects of the same underlying reality (Velmans, 2009).

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