Opinion And Perspectives

Cognitive Operations in the First Person Perspective. Part 1: The 1st Person Laboratory.

Wolfgang Baer §

Abstract

A long tradition of authors has suggested that consciousness is incorporated in a processing loop that connects mental sensations with physical causes. This paper assumes the cognitive loop hypothesis and is divided into two parts.

The first part introduces the 1st Person Laboratory as an environment that can be used to identify and examine such loops by analyzing cognitive operations that are performed and experienced in the 1st Person perspective. We will show that the physical cause of sensations is a model of physical reality not to be confused with physical reality itself. By carefully documenting the activities performed by a 1st person when interacting with his own model we will define the functions required to identify sensations as real tangible objects inside the 1st Person Laboratory and establish the everyday feeling of reality we use to run our lives.

Second we will then use the architecture of these functions as the blue print for the construction of a robot designed to identify tangible objects outside the 1st Person Laboratory. This will automate the symbolic instructions defining our processing loops by implementing their processing functions with independent physical systems. When treated as symbols, the meaning of these systems will then be available as observable visualizations of our true reality belief. Because they are also objects these same symbols implement the physical interactions that process our experiences around the cognitive cycle. This exercise will show that a robot, like any physical system, is conscious of some primitive experiences defined by the loop from which it is built. Whether such a robot will have human experiences, will depend upon whether its stable loop configurations contain processing paths that resemble our own evolution.

With this paper we hope to convince the reader that he/she is a processing loop containing observable experiences, including the sensations defining his/her body, in the display phase of the process. Furthermore, the architecture of operations we, 1st Person beings, perform when conscious of real objects is offered as a framework for a comprehensive knowledge processing theory from which quantum and in turn classic physics that can be derived as approximations.

The development of such a theory will give new tools to both physicists and the bio-chemical scientists dealing with aggregates of physical entities by providing direct access to forms of action from which conscious machinery is built at macroscopic scales.

Key Words:.Consciousness, Process Ontology, Cognitive Loops, First Person Perspective, Quantum Brain

***Quantum Biosystems* 2011; 3 (2): 26-44**

Address: Associate research Professor of Information Science – Naval Postgraduate School – Monterey, California 93924

e-mail: baer@cs.nps.navy.mil

1. - Introduction

The study of cognitive thought by William James (1890), Whitehead (1978), Atmanspacher (2006) and Hofstader (2007) has suggested that the "*Hard Problem*" of consciousness (Chalmers 1997) and its "*Explanatory Gap*" (Levine, 1983) can be bridged by postulating the existence of a physical processing loop that transforms mind into body and back again. Evan H. Walker (2000) identified closed measurement loops as the ubiquitous conscious processes suggested by William James. Walker further suggested the two branches of such loops could be described by complementary solutions, ψ and ψ^{+}, to the Schrödinger equation. I suggested that in order to contain a primitive consciousness, such physical loops must be closed cycles containing an interval of time, be built of action, and their body nodes must be an explanatory model of what caused the experiences in the mind node (Baer, 2010a). Whether conceived as closed cycles in time or two complementary branches of a creation and annihilation process, it now seems probable that the best model of the conscious process is an action loop between physical occurrences at one node and observable experiences on the other. If correct, then the world that you see, the sound that you hear, the touch that you feel and everything you experience including the experience of your body, is only the display phase of a larger activity that we have drawn as the cognitive cycle in figure 1. We cognitive beings would then be such a cycle and conscious awareness is what we do.

The problem with the depiction of such a cycle is that it cannot be understood objectively since the meaning of the body node cannot actually be observed. If we are such an action loop then there is no separate "*we*" outside to see us as the loop drawn in figure 1. All we can experience is shown in the mind node. We can never experience the true cause of our sensations unless we conceive of an operation that transcends the loop we believe to be.

Though transcendental and religious traditions claim to provide a mechanism of transcendence through meditation or prayer, our scientific approach seeks to achieve understanding while remaining firmly anchored within one's everyday 1st Person experience. Consequently, this paper examines our ability to understand ourselves as a cognitive cycle when limiting operations to those that can be performed in the 1st Person perspective.

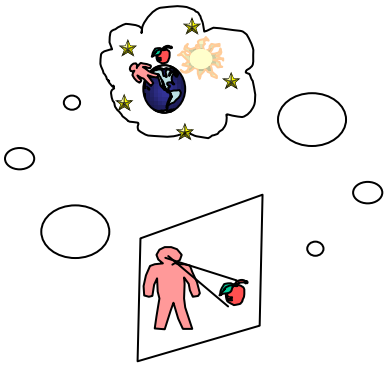


Fig. 1 The Cognitive Cycle

1.1 - Paper Outline

Our examination will proceed as follows. First we first introduce the 1st Person experience by presenting the left eye view originally drawn by Ernst Mach (1867) in figure 2. The nose and mustache are drawn in the foreground. Mach's body is shown reclining on a chair with feet propped up in front. A bookshelf is shown on the left fading into the peripheral visual field. The right hand is seen holding a pen.

This drawing is intended to be a copy of the typical everyday view of a normal human. The items seen in the view are taken as everyday objects in a space in front of the observer's nose. This defines the everyday reality of moving objects in space and provides the 1st Person Laboratory within which all direct experiences occur.

Our first analysis will show that the feeling of reality is an illusion that can initially be attributed to the projection of an expected touch sensation into the optical images we experience. Through

this projection we identify optical images as real objects.

Once this illusion (Note A, 2011) is recognized, the feeling of reality evaporates and we normally seek to

Fig. 2 - The 1st Person Perspective

replace it with a new reality which is again projected into one's sensations.

This new reality is used to operate one's logic until it also is recognized as a sensation. Then a further search is initiated. We continually find ourselves holding on to, and often defending, a reality belief only to recognize it as another illusion after further examination.

Escaping from this entrapment can only be performed through a transcendental operation whereby we get out of ourselves and look at ourselves from a god's-eye-view. Unfortunately, as long as we are limited to the 1st Person perspective, a god's-eye-view can only be achieved symbolically. We will therefore examine the process of making and using symbolic representations of physical reality in our attempt to explain ourselves and the environment we perceive. We will discover that the processes involved when building and using models or theories of physical reality are more fundamental than any specific theory contained within such processes. Hence, if we concentrate on the architecture of operations with which our observable experiences interact with our explanatory models we can achieve a deep understanding of the metaphysical context for both mind and body. Once the architecture of cognitive operations is defined symbolically we will conduct and analyze a series of experiments designed to establish the metaphysical underpinnings of ourselves and the rest of the universe as cognitive cycles.

Our methodology will involve a two step sequence. First we will ask a 1st Person to execute cognitive operations identified in our symbolic architecture and second we will automate these activities so we can learn how independent physical entities can achieve cognition.

When a cooperating 1st Person executes the instructions encoded in a symbolic loop, the process of conscious awareness is demonstrated because the 1st Person is assumed to be conscious. Unfortunately we, being the collective 1st Person, will not know how these instructions are executed since the complexity of translating our experiences to observable explanatory symbols is hidden. Because all symbols are also objects, the required symbol manipulation can also be automated by harnessing the intrinsic behavior of appropriate symbols to do the work instead. In short the blueprint for thinking can be implemented in a computer that will do almost all the work called for in the cognitive cycle. By automating the symbol manipulation process we will achieve an external view of conscious operations required for understanding. Viewing a cognitive loop as an external process view will take almost all the mystery out of consciousness. The only thing left to build a conscious computer for real is to close its time line around the Universe (Moldoveanu, 2007).

Closing this last gap will require a reformulation of the metaphysics underlying our scientific endeavor that recognizes the Universe as interacting cognitive loops. We will need to adopt a pan psychic philosophy. Physics must recognize that the simplest piece of matter takes a step in time through a cognitive action process that incorporates primitive consciousness. By reducing the loop to a trivial function that even a rock can execute we will show that all material is conscious at a primitive level. However, if their conscious experience is to be anything like our own both its spatial structure and its evolutionary history must be similar to our own. Thus human

consciousness will depend the detailed construction of the cognitive loops within which primitive awareness is incorporated.

2 – The First Person Laboratory

The picture shown in Figure 2 above depicts the optical perspective of Ernest Mach looking out through his left eye. We will modify this picture to depict the 1st Person view of a typical scientist's laboratory in order to examine what experiments actually look like in the only perspective we can experience directly.

The artistic detail of Mach's drawing can be reduced to simpler icons as shown in Figure 3. Here Mach's body is reduced to a nose, an arm, and one hand. At the same time we have added objects that will become useful in the following discussion.

These include a coordinate frame attached to the corners of the laboratory room, a coordinate clock, and an apple that represents a typical object under study. In the everyday 1st Person perspective all these appearances are taken, to be real objects that influence each others behavior. That behavior has been coded into the classic physical laws. Classic physics describes the relation between appearances in our display not the reality that made them. For example, Figure 3 might be explained by assuming a force, applied by the hand, imparted an upward velocity to the apple which is now in free flight controlled by its internal inertia and the force of gravity accelerating the mass toward the floor. By plotting the position of the clock pointers against the motion of the apple, Newton's law of motion can be verified to great accuracy and the result of such experiments applied to predict the actual behavior of all similar appearances within the 1st Person Laboratory experience.

The utility of the laws of physics to predict and control our 1st Person sensations is undeniable. Their success does not force us to adopt naïve reality and believe the experience in front of our noses is independently real but rather suggests that we would like to remain in the comfort, security, and success provided by our historic understanding of the sensory display with which we are endowed. In this paper we will identify the reason for the comfortable feeling of reality associated with our everyday 1st Person perspective with the solidity of expected touch sensations displayed in the dark space surrounding ourselves when we close our eyes. Only by recognizing this world in front of our noses,- this 1st Person real feeling experience,- as a multi-modality registered display of optical, auditory, and expected touch sensations, can we properly set the stage for more fundamental questions. What exactly is this experience we are conscious of? What causes it? How will it evolve? How can we influence its evolution?

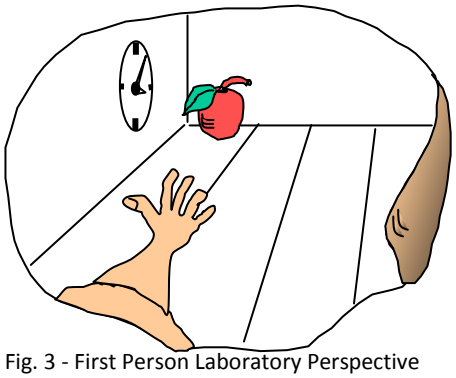


Fig. 3 - First Person Laboratory Perspective

2.1 – The Feeling of Reality

The drawing of the 1st Person Laboratory is produced by mapping the world of appearances in front of our noses to a subset of those appearances located on the page in front of us. To the extent that it is a faithful reproduction, the drawing is designed to create the illusion that we are looking at the original. This illusion is enhanced by the quality of the drawing and is broken only because we can look beyond the page and note the difference between the two. In one case we are looking at a flat optical image built of colored ink. In the other case we are also looking at a similar optical image but endowed with the feeling of material solidity associated with our real world environment. The sensory nature of this solid feeling can be examined by closing one's eyes and noting the black space around oneself.

This space is filled with what has been described as white ghostly sensations that

outline the objects we believe to surround us (Webster, 2009). These sensations define the location of touch sensations we expect to encounter if we move our body so as to have contact with the objects.

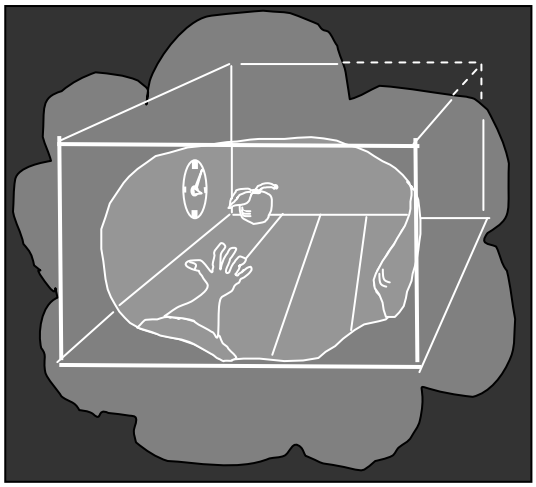


Fig. 4 - Expected Touch Sensation in the 1st person perspective

Figure 4 depicts these sensations within a thought bubble. What is expected to be touched if one probes the space in front of one's nose including the walls surrounding one's location are outline in white. The fact that this feeling of reality can extend centrally outward to one's immediate environment and eventually to the earth sun and stars is not shown on the picture.

But such an extended mapping of the expected solid world one would expect to encounter if one were to move one's tactile sensors out there is implied. For the sake of illustration in this paper the 1st Person laboratory walls also represent the limits that the 1st Person scientist cannot get out of and might be identified with his externalized skull (Lehar, 2003).

The survival importance of a display that presents the location of potential collisions cannot be overestimated and hence this display is often taken for reality itself. The fact that it is an internal display of information can best be illustrated by rapidly spinning around in a swivel chair to produce a dizzy effect. After a few rotations, inertial signals from the semi-circular canals will rotate the expected touch sensations. If one rapidly stops the spin and opens one's eyes, the world will seem to spin. The expected location of surrounding objects will continue to twirl around while the optic display is stationary. The two conflicting sensation displays will generate discomfort until the motion of fluid in the semi-circular canals settles down and the two sensation channels re-register. A similar false expectation effect can be observed when exiting a freeway after traveling at a constant high speed for a long time. The feeling that one is moving very slowly or even backwards is due to the latency between the expected locations of objects calculated for high speed motion which no longer predict their position when the automobile stops.

These simple observations show that expected touch sensations are internally generated. They only display one's knowledge of objects rather than their actual locations. The dark space within which optical, as well as auditory sensations are registered is often identified with the term mind. However the term mind should be reserved for a more comprehensive display of all experiences, including the display of the space itself, not simply the expected location of objects. We will call the more restricted use of the mind experience one's Expected Touch Space (ETS) and we will use a thought bubble to indicate its presence as a background sensation to the optical 1st Person view outlined in subsequent drawings.

2.2 – The Search for the Feeling of Reality

The projection of explanations into the sensation they are designed to explain, is a fundamental property of our thought process. Such projections are generalized extensions of the registration process between an optical image and its expected touch sensation mentioned above. In the next section we will argue that such projections are designed to re-establish the illusion of reality that was lost when recognizing the feeling of solidity as an internally generated sensation in our everyday experience. Operating under such a reality illusion is a general

characteristic of western thought including chemistry, biology, and classic physics.

An optical sensation registered with an expected touch sensation is usually considered to be real and is called an object. The veracity of the display can be verified by actually moving one's finger to the expected touch location and feeling an actual and usually much stronger sensation associated with touch or in extreme cases the pain of collision. The registration of optical and expected touch sensation can be disrupted when one has a condition of vertigo, while the registration of expected touch and actual touch is associated with the proper functioning of motor control feedback.

Once the nature of the display is recognized the feeling of reality previously associated with it is challenged. The challenge is answered by admitting the representational function of one's sensory display but at the same time defining a new sensation that is projected into the sensation bundle that marks the actual "*Ding-an-Sich*" the sensations are believed to represent. A classical physicist might for example mark the reality of an object by projecting a center of mass symbol into the optical sensation and say to himself:

"*I may be experiencing the qualia defining an apple but its appearance is evidence of a real object with real mass moving through real space in front of me*".

When confronted with quantum physics and Niels Bohr's contention that real objects are brought into existence through the measurement process, a new reality is found in the form of deBroglie's probability waves. The reality of localized mass is recognized to be an observable report from the display section of a measuring instrument while probability waves take the place of the new real reality. The visualization of this new reality is projected into the observable display produced by the measuring instrument as waves and the quantum physicist might say to himself:

"*I may be experiencing the observable photon hits defining an apple but their appearance is evidence that real deBroglie waves are present in the space occupied by those appearances*".

While it lasts, the quantum physicist might feel comfortable with his newly found feeling of reality but upon further investigation he too will find his belief is insufficient. The sensation associated with the expected touch, like the sensation associated with a classic mass, like the sensation associated with the visualization of probability waves are first and foremost a sensation caused by something he can never experience directly. The feeling of comfort in our current reality, destroyed by a realization that it is built on a sensation, followed by the search for a new reality, which is projected into the old sensations, is something we do over and over. The logic of our thought process needs to believe in something real. We will search for the feeling of reality and will always be disappointed in a futile and endless quest until we step back from what we are doing and realize that we must seek the answer to our fundamental question of what is really going on in a different way.

The question is how?

If we could get outside ourselves and watch the processes behind our display, the answer to our fundamental questions would be recorded in our observational experience. Cataloging and compacting that experience into laws would then lead to a new integrated mind-body version of classic physics. This is what naïve realists would like. Unfortunately, we cannot get out. The transcendental operations that promise to achieve a god's eye view of ourselves and our environment are either straight out deceptions or at best extremely difficult to attain. Rather than argue about the possibility of 1st Person transcendence we will modify our claim to one that says that we either cannot or do not want to get out. Thus, we seek our understanding while holding solidly to the everyday 1st Person experience we are accustomed to we must evoke the use of symbols.

3 - Symbolic Transcendence

By agreeing to address fundamental questions within the context of the 1st

Person perspective it will be necessary to introduce the use of symbols. We may not be able to get outside of our real selves but we can easily mimic a god's-eye-view with a symbol system designed to represent the reality we seek to understand.

The question of accuracy and utility of the symbol system, or model, we can build and operate in the 1st Person perspective will be left to later sections. For now we will remain theory neutral and investigate the implications of any symbol system designed to represent the explanation of our experience. This investigation will show how the operations of writing into, reading from, and manipulating symbols within any model contributes to a cognitive cycle independent of the theory encoded into its symbols. In this section symbolic operations will be reduced to their simplest form and examined individually in order to show how they contribute to the cognitive process.

Once we realize that both the optical and the expected touch space observables are internal displays and not reality itself, it is natural to seek the cause of these appearances. Unfortunately drawing the cause of sensations outside of the 1st Person experience defined by Figures 2 through 4 does not make sense. Why? The description of sensations, currently shown in these figures, is easily mapped into one's 1st Person experience and hence their meaning is clear however, any description outside of those sensations cannot be mapped into direct experience and remains beyond our ability to grasp.

The only way to "*see*" behind observable appearances is symbolically. Consequently symbolic answers must be restricted to those that can be performed within the confines of the drawing showing the 1st Person experience and this can be done by depicting a symbol within a symbol as shown in Figure 5.

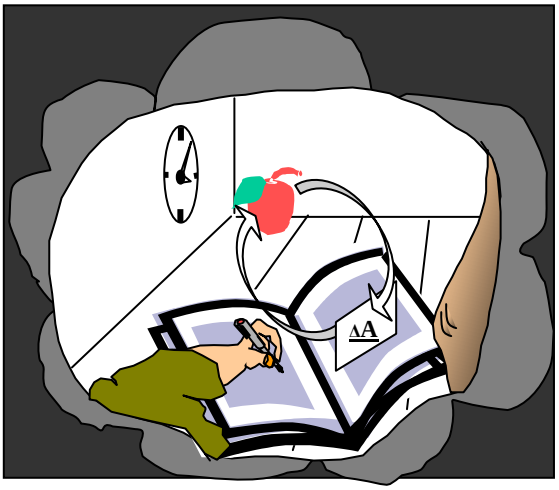


Fig. 5 - Symbolic Transcendence within the 1st person Laboratory

Here we have added an open book and a pen under the control of the 1st Person's fingers. The outline of the book divides the optical display into two distinct channels.

The regions outside the pages contain everyday objects while the region inside the pages contains symbols. The outline of the book represents the symbol boundary between the two regions.

A symbolic model of the physical explanation for what causes sensations to appear is shown on the right hand page. As mentioned earlier we are not concerned with the details of such a model at this time and only note that **ΔA** describes a change, in what we will identify as a real apple, that generates the 1st Person's optic experience.

The cognitive cycle includes a sensation, a parallelogram containing the cause of that sensation – "*das-Ding-an-Sich*" - and two connecting process arrows.

By adding a symbol within a symbol we have a mechanism for exploring the interaction between observables and any explanatory model within the 1st Person context. Furthermore, the instructions to the 1st Person implied by figure 5 no longer asks for a transcendental operation but merely an understanding of the figures and drawings located in a book in front of one's nose. But there is hitch. Reading and writing is nothing out of the ordinary.

Clearly understanding what one reads or writes is another matter. In Figure 5, the "🍎" stands for the red round apple sensation in front of the observer's nose.

The incoming process arrow stands for the explanatory path of influence from the sensation through the 1st Person and out his pen. The **ΔA** is an entity inside the observer's model used to explain the apple sensation. When a physical reality model is expressed in English terminology a more descriptive version of **ΔA** might be the words "reflecting surface from a real apple". The outgoing arrow stands for the path of influence from this symbolic entity through the 1st person to the "🍎" sensation.

The symbols like **ΔA** shown in the model of the cause - by which is meant the physical reality one believes in- cannot be mapped into direct experience and still remains beyond the 1st Person's ability to grasp objectively. This is because the words "*reality*", "*cause*", "*das-Ding-an-Sich*", and other terms used in this paper and throughout the literature do not make sense. They have no referential meaning.

They do not point to anything we can experience directly. A meaningless symbol is just another object, a pattern of ink on a page. Searle's Chinese Room (Searle, 1980) and machines trying to pass the Turing Test (2011) shows us examples of mechanisms that generate the form of symbols without any connection to their meaning. Since symbols, used to build models of physical reality, cannot be translated into sensory meaning, their significance must be sought elsewhere.

Such symbols may look like ordinary words, but they are actually operators that interact with each other to produce symbols-of-observables that do make sense. Their significance is therefore to be found in their function within the symbol system not in any sensory meaning they point to.

We have been careful to describe a cycle of influence involving only optical sensations. The observer executing this cycle is only aware of a red blob. He is not yet aware of the tactile object to which this blob belongs. We will now expand the operations inside the 1st person perspective to examine what is required for the 1st Person to come to the conclusion that he is seeing a real apple.

4 - The Basic Symbolic Operations

In the last section we introduced a picture of a book into the 1st Person perspective in order to identify a space within which objects are identified as symbols. It is easy to cross the boundary between symbols and objects thus introducing the possibility of confusion between the two categories of sensations.

To avoid such confusion we will draw symbolic objects and their operations within the symbol space provided by recognizable pages and carefully identify the operations connecting the two.

In Figure 6 a model of physical reality is connected to a 1st Person sensation by a set of processes required to believe that a real red apple exists in the space in front of his nose.

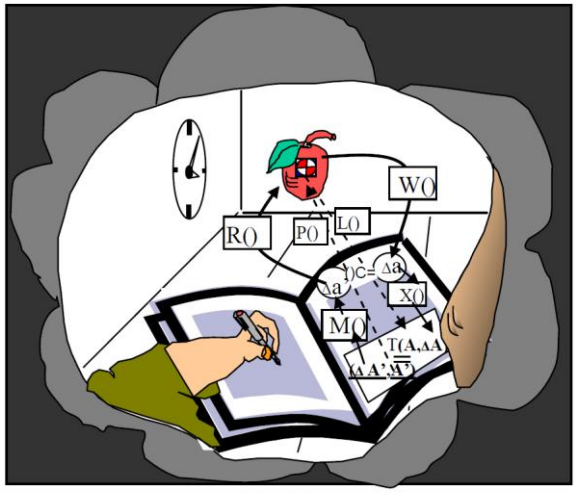


Fig. 6 - Basic Symbolic Operations

These basic symbolic operations will be discussed in this section. The operation arrows are labeled with function boxes which are defined in Table 1 below.

Table 1: Symbolic Operation Notation Definitions

 = icon of an optic modality display observable; filled color blobs

 = icon of an expected touch space display observable; outline only

 , Δa = icon and symbol of a fused optic and expected touch observable

 , a = icon and symbol of the reality believed to change when seeing "Δa"

Δa', a' = symbol of a sensation and what changed after T() is applied

A = Apple: example name or description of the real entity that is believed to exist behind the sensation; Names the physically real "Ding-an-Sich" behind appearances; a symbol-of-reality

ΔA = The change in Apple that is the physical cause of the sensation "Δa"

A',**ΔA'** = Apple and its change: after T() is applied

W() = Write_in: Takes a sensation and writes its name into a symbol system.

R() = Read_out: Takes a name from the symbol system and generates its sensation.
P() = Project: Takes a symbol of reality and projects its meaning sensation into the sensation it is intended to explain thus establishing the illusion of reality.
L() = Learn: Takes a sensation believed to be real and attaches it to the symbol of the Ding-an-Sich it stands for.
X() = eXplain: Transforms the description of a sensation into a symbol
M() = Measure: Transforms the a symbol of reality into a symbol of the sensation it produces
C() = Comparison of
T(t,) = Time transform: Transforms symbols-of-reality from one state to another within the model of physical reality (**ΔA'**, **A'**, t')=T(**ΔA**, **A**,t)
t = Time, name of the state of the rest of the Universe observable (**U**)
name of what clocks measure
U = The rest of the Universe not including the 1st Person **I** or the system of interest **A**

Included are four operations that cross the symbol boundary and four operations that transform symbols into each other.

The Time transform T() aggregates a myriad of symbolic manipulations operations that constitute the theory believed or utilized by the 1st Person operating his model. Here we show it acting upon an Apple at one time to produce Apple' at another time. In the text we use lower case first letters to designate symbols referring to sensations and upper case first letters to refer to what we believe it actually is. Hence the sensation called apple is caused by a change in an object called Apple. Bold underlined first letters are also used for emphasis and as abbreviations to fit the labels into diagrams and mathematical equations.

The operations shown in figure 6 describe the basic activities required to externalize the thought process of a cognitive being conscious of seeing an **A**pple. The architecture is that of two parallel cognitive action cycles between observable sensations and the model of their physical causes. The solid line cycle moves the changes experienced while the broken line cycle deals with the entities believed to be changing. One node of both cycles is the falling apple in front of the 1st Person's nose. The second node contains the model of the apple's physical causes.

These are ultimately the changes, **ΔA** , in physical entities, **A**, normally hidden behind the observables. The second node, which usually refers to the inner workings of the 1st Person's brain, has been externalized as a symbol structure on the page. This was done to allow the observation of both nodes of a cognitive cycle and emphasizes the transition between observables and symbols necessary for understanding what otherwise cannot be seen. It must be emphasized that drawing process arrows between the displays of sensory experiences only defines the observable end points. Observables do not perform the processing. The actual processing paths go through the operation boxes implemented in the 1st Person's Brain and symbols come out through his pen.

The processes boxes name large complex activities without any attempt to provide further details of the theory inside each processing box or how its functions are implemented. We are attempting to remain physical theory neutral in order to analyze the metaphysics that provides the framework for any theory in which conscious phenomena are possible. The actual processing is implemented by internal activities executed by real components of his physical node. Thus the processes W() through T() listed in table 1 defined instructions the 1st Person must carry out to be conscious of a real object.

We assume the 1st Person's Brain is able to perform the operations identified because he or she, the reader, is a cognitive being. Such performance is proven by self demonstration and no further proof is required.

In the subsections below we will discuss each actual operation in more detail. This will set the stage for automation of the framework which will allow us to see how the hidden physical nodes can be built with independent physical entities and lead to the construction of cognitive loops

that can be combined to form external cognitive beings.

4.1- Read_out and Write_in Operations

A closed cognitive cycle modeled in Figure 5 represents an isolated cognitive being that does not interact with the rest of the universe. A typical 1st Person is not isolated but accommodates and controls external influences by adjusting the dynamic state of its cycle. The R() and W() functions added in Figure 6 provide the necessary interaction. Arrows that connect the observable apple with its name "*apple*", or simply "*a*" for short are heuristic artifacts that only connect the end points. The actual process sequence cannot be traced through the 1st Person experience since they exit and reenter the observable space through time lines that are perpendicular to the observed display.

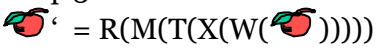
Though we cannot observe the complete process sequence directly, it is easily performed by any 1st Person who has learned to read and write. Exactly how this is done remains a mystery until we see how cognitive cycle is automated.

Using the current physical sciences to explain how the 1st Person accomplishes the Write-in function is bound to fail.

Classic physics tells us that Photons leave the surface of the Apple, are absorbed by the Retina, and processed by the Brain which produces the flow of neural Pulses that control the Pen motion over the Paper leaving an Ink record that is observable as a stable sensation.

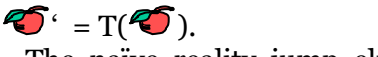
Unfortunately the story told by classic physics is not one of sensations but rather a description in terms of an adopted reality model. The classic physical terms - Photons, Apple, Brain, etc. - used in the classic physical description of a Write-in function above were deliberately written in capital letters to signify that these are symbols-of-reality not symbols-of-observables. By applying classic physics two subtle, unnoticed, naïve reality jumps have been made. The actual sensation is automatically translated into a symbol-of-reality. Then the classic physical processing path is applied. Then the resulting symbol-of-reality is translated back into a sensation. In mathematical notation the entire cognitive cycle could be written using nested process functions as shown below,

Eq. 3a



while the truncated naïve reality version is,

Eq. 3b

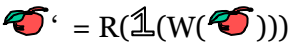


The naïve reality jump eliminates the distinction between sensations and real entities and reduces the X(W()) and R(M()) sequences to identity operations that do nothing. It therefore attempts to explain everything, including the Write_in function, as a special case inside a theory of physical reality, T(), performed only on physically real entities.

Rather than trivialize and ignore the processing paths between sensations and the physical model that explains them, lets see if we can isolate these operations in order to understand what they do.

Mathematically this is done by setting all internal operations listed in equation 3a to the identity operator (). The identity operator multiplies all input by unity to produce an identical output product. Equation 3a thus simplifies to equation 4 shown below and Figure 6 reduces to Figure 7.

Eq. 4



If the primed and unprimed sensations are identical this sequence of operations is simply a memory cycle and reproduces the experience observed by 1st Person each time it executes. The observable endpoints connected by the W() and R() functions are the apple sensation and the motion of the pen used to write on the page. The prime only indicates the symbol has been moved from the write to the read side of the time instant and no further change is imposed by the identity function.

The process arrows in Figure 7 show a connection between two observable end points.

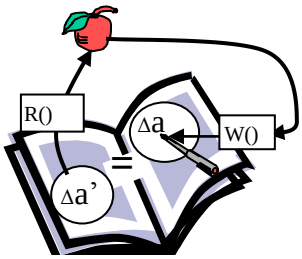


Fig.7 - Isolating the R() W() Functions

According to cognitive action cycle theory the actual processing path executes around the cycle through the 1st Person.

Unfortunately, what can be shown on a static page is only a spatial projection of a time cycle. The influence of the apple sensation disappears from the 1st Person's observables and reappears as its description on the page. If, the 1st Person is conscious of what he is seeing before writing two cycles are involved. This is shown by expanding the spatial projection of the Write_in function and tracing the observable influence through the digitizing retina. This retina is represented as the detector array on the right side of Figure 8.

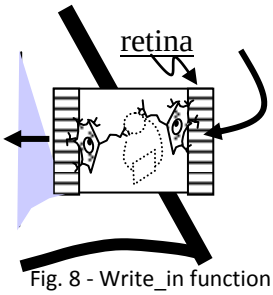


Fig. 8 - Write_in function crossing the symbol boundary

The conscious awareness of the sensation that is being named Δa by the 1st Person is indicated by the dashed circle in the cognitive cycle. The influence would disappear in neural activity which crosses the symbol boundary through the hidden physical node of the cognitive cycle and reemerge as neural activity that stimulates the muscles to move the pen tip. An expanded diagram of the W() function is shown in Figure 8. Here straight line input and output arrays are shown receiving and transmitting stimulation while neuron icons are connected through a cognitive cycle, shown as dotted lines, that crosses the explanatory gap.

4.1.1 – The Externalized Explanatory Gap Process

Why would a process executed by the 1st Person that transforms an everyday sensation into a symbolic description of that sensation cross the explanatory gap?

Recall that a geographic explanatory gap arises because the Neural Correlates of Consciousness (NCC) (Metzinger, 2000) usually projected inside one's head are located at a different position from the sensations they are supposed to produce.

An appearance explanatory gap arises because the look of the NCC does not match the look of what is actually seen.

Science, based either on classic or quantum physics, offers no mechanism for bridging these gaps. This implies that an unidentified connection exists between these two observable locations and an unidentified transformation exists between the two appearances in them. The exact nature of these connections is the main mystery of consciousness. What is not mysterious is that whatever this connection is, a cognitive being can make it. If a cognitive being is asked to write a description of something he sees he will produce a symbol. If later he is shown such a symbol he will be able to pick out its optical signature assuming the symbol is sufficiently accurate. The symbol on the page is merely an externalization of neural functions. By externalizing these functions the gap has not been eliminated. However, both the geographic and appearance gap has now been transferred to the obvious distance and difference between the symbol on a page and the observable sensation in front of one's nose. Hence the 1st Person can do something that crosses the explanatory gap during the process of writing or reading a symbol. Consequently by studying what we do during reading and writing we should be able to isolate the operations that cross the explanatory gap and gain insight into its mystery. This is our goal in the next section.

4.1.2 – Examples of Simple Cognitive Cycles

The use of optical observables and optical symbols introduces difficulties.

Optical sensations are hard to describe verbally and optical sensations are only generated by the 1st Person in hallucinations, dreams, or works of art.

Evidence exists that feedback in the retina primes the optical input channel (Joselevitch, 2008) and therefore the act of reading a description of an apple on a page produce a neural filter pattern for image recognition. Such a pattern may be experienced as delicate but negative stimulation.

However, a strong optical sensation detached from external stimulation only appears in dreams and hallucinations and is not readily part of the 1st Persons everyday experience.

Consequently the cognitive cycle through optical channels is not easily demonstrated in humans.

The sensory channel for which humans are equipped with an obvious stimulation generator is the auditory channel. Hence we can use a sound and its optic representation as the two nodes of a cognitive cycle. As an exercise assume we take the role of the 1st Person and ask ourselves to write a description of a sound and read what we have written. We can see words being written and can play them back by making the sound they represent. To eliminate representational complexity we can use onomatopoeia.

For example, when we write the words tick-tock, we can read them back by making a sound that does not represent anything but the sound.

Making a symbol involves reading a meaning from one channel and writing into another one that holds the sensation of the symbol. Similarly, retrieving the meaning of a symbol involves reading from the symbolic channel and writing back into the 1st Person sensation channel from which the original sensation came. The pathway from an observable sound to the symbol and back to observable sound implements two sequential cognitive cycles and each execution produces two sensations of which we are conscious as shown in Figure 9.

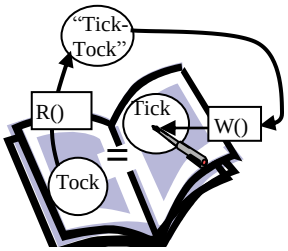


Fig. 9 - Isolating the Gap Functions

We do not need to observe both nodes to be conscious of a "*tick-tock*" sound.

Asking the 1st Person to write a symbol and read it back was only introduced in order to externalize the physically real cause node. In doing so the 1st Person becomes conscious of both the sensation of the symbol and the sensation of what it stands for. If we short circuit the path through our hands and ask the 1st Person to repeat what he hears, a shorter cycle is performed. We hear the sound over and over, and as long as we do we are conscious of "*tick-tock*".

The words "*I am conscious of seeing an apple*" implies the execution of a loop that transforms an optical image into the symbol apple and back into an optical sensation. The words "*I am conscious of hearing tick-tock*" describes a similar loop that transforms the sound "*tick-tock*" into a symbol and back again.

To produce this conscious effect we have carried out the loop and transformed a sound into a motion of our vocal cords that in turn produced the sound.

Repeating a phrase or, for example, a telephone number over and over is a common way to hold a pattern of information in memory, although one usually does not consider such an operation as involving a memory. Memory is typically referred to neural activity inside the brain. By externalizing this activity we can see that it consists of a loop between an observable and what is normally an unobservable stimulation of a physical sensation generator.

In case of the single loop, the unobserved sensation generator is the vocal cords. If a symbol node is inserted, a second unobserved sensation generator is sequenced into the cycle to produce the nerve impulses that move the hand. These unobserved sensation generators are the physical cause nodes of a cognitive cycle and can never be observed directly because they are hidden behind the sensations they generate. What that unobservable sensation generator does can, however, be made visible if we look at it with a second modality, or a second channel in the same modality, such as indicated by the dashed line cycle in Figure 6. In our present example of the hand and vocal cords, one type of second modality is provided by the motor feedback sensations. In the case of the hand we can also see its motion in the optical field and we can store a motion as words. In either case the motion, or if we want to store it, the record of the motion is experienced in the optic modality as a symbol of the sound. These second modality experiences are symbolic of the sensation. Symbols are containers of meaning. They contain the sensation they are processing through the cycle. In the optic modality they are seen externally as containers through which those sensations flow. To extract the audio content from these symbol they must be interpreted through an R() function to produce the sensations that constitutes their meaning.

Hence Tic-Toc is both the input for an instruction designed to produce a sound and a symbol that means the sound.

This simple auditory copy cycle shows the essence of the conscious process is an internal self stimulating activity. The activity produces a sensation in one node of the cycle and is caused by a physical activity at its opposite node. The physical node is hidden behind observable sensations but can be made visible by using a second modality. In that second modality the physical node is observable as a symbol of the sensation it contains.

4.2- Explanation and Measurement operations

The eXplanatory "X()" and Measurement "M()" functions transform symbolic descriptions of observables to symbolic descriptions of their causes and back again. Although we use the terms "*cause*" and "*explanation*" to describe the content of the body node, in practical terms, these symbols represent a change in the "*Ding-an-Sich*" of physical reality.

What one believes to be real, actual, or independent of one's perception of them depends upon one's belief structure. In classic physics space, charge, and mass are often considered the fundamental components of reality. In quantum theory the same role is taken by deBroglie waves named by the symbol of the Schrödinger Wave Function "ψ()". In Cognitive Action Cycle Theory the independent role is taken by the entire cycle of activity rather than any part of it.

Figure 10 shows a symbolic cognitive cycle with the eXplanatory and measurement operations branches. We have reduced the time step function "T()" to unity and closed the cycle by equating the two observable descriptors (Δa'=Δa) to highlight only the functions of interest in this section. It is important to emphasize that this drawing shows a mimicked cognitive cycle while the cycles shown in figures 5 to 7 represent real cognition operations. The difference is that actual cognition requires a transform between 1st Person observables and symbols-of-reality to cross a symbol boundary while in Figure 9 all parts are at the same symbolic level.

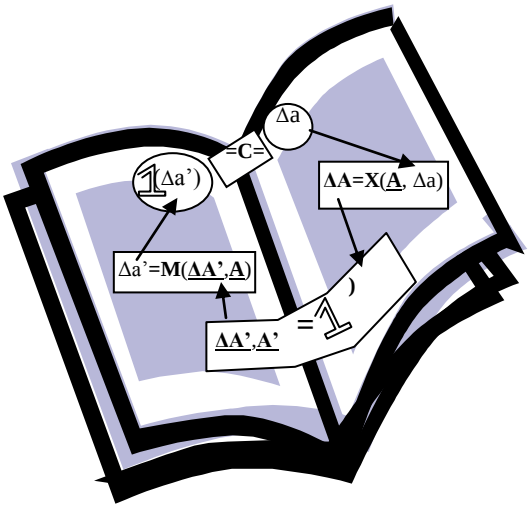


Fig. 10 - eXplain and Measurement Functions

For example the explanatory branch cast into mathematical notation,

Eq. 5 - $\underline{\mathbf{\Delta A}} = X(\Delta a)$

is not equal to

$\underline{\mathbf{\Delta A}} = X(W(\text{🍎}))$,

since the critical W() operation that crosses the explanatory gap is missing.

Another critical difference is that we have closed the cycle with a unity operation between the symbols-of-observables "$\mathbb{1}(\Delta a') = \Delta a$" to close the top mental node. If a computer were asked to carry out these instructions one would not actually be able to perform this operation since the function is on the left side of the equation and requires a step in the negative time direction. The difference is that an equal sign in a computer program instruction implies that a set of input variables on the right side of an equation is to be placed into an output on the left side of the equation. The equation that represents the cycle,

Eq. 6 - $\Delta a = M(X(\Delta a))$,

is not a computer instruction and cannot be executed. It is instead a mathematical statement of condition in which the input and output "Δa" are in fact identical in time not just time sequential instantiations of the same variable.

Mathematical equations are conditions and therefore reversible between input and output. The condition expressed by equation 6 and Figure 10 is one of stability and equilibrium between two variables "Δa" and $\underline{\mathbf{\Delta A}}$ given a constant real entity $\underline{\mathbf{A}}$ which accepts and releases the change.

The condition of stability is satisfied only when an Apple exists in the model that can reversibly accommodate the change.

If no such entity exists in the model the sensation cannot be explained and no memory of it can be made. What do these functions do?

The eXplain and Measure functions transform symbols-of-observables, i.e. mental sensations, into symbols of models of actual physical causes of those sensations. In order to understand the meaning of such functions and the cognitive cycle they build it is necessary to map the entire cycle from the book into the 1st Person Laboratory experience. As always, we must be careful not to confuse a sensation with its symbol. The (🍎) shown in Figures 5 to 7 represent actual observables not symbols of them. In order to get a symbol-of-observables into the 1st Person Laboratory we can automate the Write-in function using a pattern recognition camera shown in Figure 11.

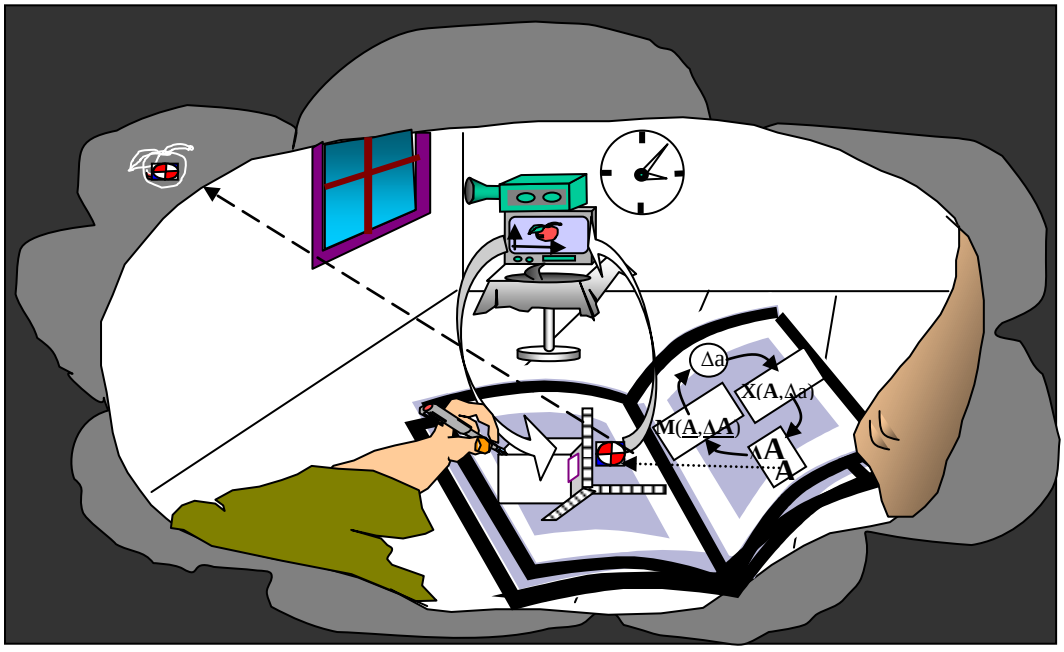


Fig. 11 - Mapping a Symbolic Cycle into a 1st person experience

The image on the screen here plays the role of the "Δa" in the book.

For the second node in the cycle a symbol of a model of reality can be written directly into a book that documents the theory of reality utilized by the operator.

The cycle can therefore be directly mapped into the 1st Person scientist's laboratory as shown in Figure 11. Here a camera is pointed outside the walls of the 1st Person Laboratory. The instrument takes a picture and displays an observable image on the display screen seen on the table. If the walls represent an externalized skull of the 1st Person, this screen image takes the role of the consciously observed sensation display seen by the 1st Person.

The scientist calculates the meaning of this observable in terms of the symbols of a theory he believes describes the world outside the walls and writes the result into the left page of his book. Although we try to be theory neutral, we are using classic physical view here as an example.

The result of his calculation is shown in Figure 11 as a center of mass (CM) icon representing the real object, **A**, believed to be outside of the laboratory. It is a change in this object that caused the image on his display. The left page also shows a drawing of a three axis coordinate array attached to the outside of the laboratory box. These axis format the model of the real space spanned by these real arrays and allows position coordinates to be assigned. When the scientist, in this case the 1st Person draws the apple (CM) in the book, he is recording the result of his calculation. This calculation is what is meant by the eXplain function symbol. Similarly when the scientist looks at his notepad containing a drawing of an apple (CM) relative to the drawing of his sensor calibration arrays and takes this as input for a calculation that produces the location of the observable measurement result, he is performing the Measurement function. Curved arrows connecting the endpoints of these calculations represent the actual operations involved.

To find out more about what how these functions are executed, they can be observed from the outside either by watching the 1st Person's hands perform the manipulation, asking a 2nd person to do them, or automating the job with a mechanical device. Upon watching the calculations performed by the 1st Person scientist when implementing the eXplain function we would see that he starts with the output of an external measuring instrument and calculates the reverse process such an instrument must have executed in order to generate the observable image. He then calculates the reverse photon path in his physical model and records the result as a CM symbol at the calculated source of the photons.

Similarly when starting with a symbol of the real entity in his model, the Measurement calculation reproduces what the actual measuring instrument does when producing the displayed result. This implies that the contribution of the measuring instrument during the process of sensing a real entity and building a display is included in the Measure function while a similar contribution is eliminated by the eXplain function.

4.2.1 – The 1st Person Reference Frame

That the contribution of the measurement instrument is added and subtracted by the Measure and eXplain functions is a very general property characterizing these operations. Since the real entity referred to in the model is intended to represent an independent reality it should not be surprising that the influence of the measuring instrument must be taken out when calculating such entities from its reports. To emphasize the importance of this insight and provide a more explicit example of what these functions look like we will provide an example.

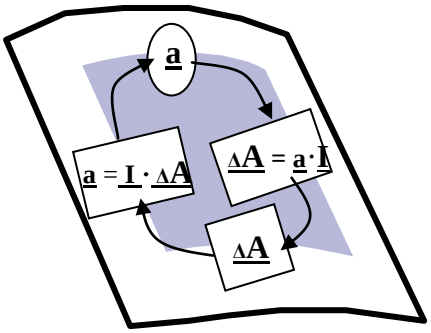


Fig. 12 - Cognitive cycle in vector notation

The left page in Figure 11 shows a both a model of the real apple and also a model of the real coordinate axis and processing room in which the measurement signals are processed into the display observed by the 1st Person. From the outside, the processing room and coordinate arrays can be identified with an extended 1st Person's physical body. Let's let vector symbol **I** represent this body. Let the coordinate axis be represented by the vectors **Ix**,**Iy**,**Iz**.

Then to the extent this body is composed of the coordinate axis, **I** am equal to **Ix**+**Iy**+**Iz**. If the symbol for the change in the real Apple is abbreviated as the vector symbol **ΔA** the then the Measurement operation will result in three observable components ax = **Ix**· **ΔA** , ay = **Iy**·**ΔA**, az = **Iz**·**ΔA**, while the eXplanation operation without identifying what has changed is implemented by the formula **ΔA** = ax·**Ix**+ ay·**Iy**+ az·**Iz**. If we now define the observable vector as an array **a** = (ax,ay,az) then the cognitive cycle shown on the right page in Figure 11 can be conveniently rewritten in vector notation as shown in Figure 12.

The significance of this discovery is enormous. Not only have we provided an explicit example of the Measurement and eXplain functions we have also shown how the model of one's self is involved when performing cognitive operations.

The actual coordinate frame with which the 1st Person knows the world defines the display space within which observables appear and the model of such a coordinate frame processes its data to produce the cognitive experience.

Those familiar with quantum theory will recognize that we used special Cartesian coordinate frame as our example but a multi-dimensional Hilbert Space frame is actually appropriate to handle the many sensations beyond space-time experiences.

The detector arrays with which one knows the world span the Hilbert space in which deBroglie waves are defined. The architecture of quantum theory maps into the cognitive action cycle, however, its vector and matrix arrays are clearly a linear approximation to the more general cognitive action cycle theory we need in order to describe the operations of cognitive beings.

4.3- Reality Projection Operation

The function of the reality projection operation is to define observable sensations that are taken for reality by the 1st Person so he/she can feel comfortable that decisions based upon the information displayed will be accurate and beneficial. Figure 11 shows the projection along a dashed line from the center of mass-charge ( ) reality symbol in the model to the expected touch sensation outside the processing room where the 1st Person feels the real apple is located. This line is mentally traced by the 1st Person in what he believes is the real space in front of his nose. The symbolic equivalent of this line goes from the center of mass reality symbol to an unseen symbol of the book inside the drawing of the processing room.

Both these lines are straight lines however, as we have seen often before, they only connect the end points. The detailed processing path can be traced from the expected touch sensation outside the processing room through the detector arrays in the camera to the display screen, and finally through the 1st Person eXplain calculation that results in a center of mass placement inside his model.

Two general characteristics of the reality projection operation need to be discussed. First, the specific apple projection is one example of a global mapping between the model in the symbol space provided by the book and the observable world the 1st Person believes he lives in. Second when the detailed processing path crosses the detector boundary a connection is made between the observables and the sensations he believes are realities. These connections are painstakingly discovered by experiment and learning during the 1st Person's development stages and thereafter automatically establish in the reverse symbol generation operation, L(), that codifies his reality belief without awareness that it is happening.

Consider first the mapping between the model on the left page of the book in Figure 11 and the three dimensional space

sensations that define the 1st Person's reality belief outside his laboratory. Useful maps, such as those guiding visitors to parks, are conventionally defined by transformation equations written into the legend of the map and augmented with a "*you are here*" sign that indicates the maps actual location on the map. In our example the processing room within which the 1st Person is located is symbolically identified as an external picture of the cube in the model. By scaling, rotating, and translating the corners of the cube can be co-llocated with the corners of the observable room. This defines the transformation equations. Using these transformation equations the remaining model content can be mapped into the expected touch space. If one firmly believes one's model, these mapping projections establish a firm feeling of reality even if the actual world outside the 1st Person observable experience can only be verified through measuring instuments.

The projection of a real apple symbol from the model into an expected touch space co-locates two sensations. The two sensations may be superimposed but they are distinctly different as shown in Figure 13.

Fig. 13 -Two Sensations

In section 2.2 we discussed the search for reality. Here we encounter an example of this search. Knowing that optical observables are internally generated measurement displays leads us to project expected touch sensations, shown as solid outlines, in order to establish the feeling of reality. Knowing that this expected touch sensation is also internally generated leads us to calculate a model and project the model symbols into the expected touch display in order to establish what we believe is a more reliable reality. It is as though the projected symbols-of-reality are another and deeper reality modality.

The space of this deeper reality display is represented by the solid black square attached to the frame of the 1st person figures in this paper.

The frame represents the deeper stake-your-life-on-it reality belief built into us. We can imagine sight displays go away, we can imagine sound displays go away. With some practice we can even imagine how the expected touch space disappears in sleep. However the truly believed reality space which contains the reality that we believe exists even when we are dead cannot be imagined away. A collection of sensations associated with the display of the five senses provides the initial feeling of reality. The collection of sensations associated with the expected touch space and the symbols-of-reality projected into that space provide a more reliable calculated reality display. It is the feeling of these symbols-of-reality projected out there that establish reality for us.

The reality projection discussed above connects end points. If we trace the actual projection path through our model, the processing path is described by symbols-of-reality until it hits the detectors. At this point the processing path crosses the symbol boundary and emerges not in symbols-of-reality but symbols-of-observables. Symbols inside this boundary represent 1st Person experiences that can be seen directly and copied into the model.

The detector boundary is the crossover point between two symbol types and these two symbol types characterize our sensations. When crossing the detector boundary, a symbol of reality on one side is connected with a symbol of observables on the other side. When this transition is projected into the real detectors in the 1st Person Laboratory, symbolic appearances representing real stimulation are translated to actual appearances in front of the 1st Person's nose.

It is as though the role of inside and outside is reversed. Outside the detector boundary, internally generated sensations of reality are experienced, while the directly observable sensations are not. On the other side observable sensations, for example an optical image, are experienced while the reality is hidden inside of it.

Outside the detector array, the real location of the stimulation is represented by symbols-of-reality. Inside the detectors, the stimulation is located by the name of the detector or implicitly located by their position in the array. A ubiquitous mapping takes place between projected model coordinates and coordinates derived from the names of the array cells being stimulated. What we actually see and what we firmly believe to be seeing are two nodes of a cognitive cycle.

4.3.1 – Inside vs. Outside Symbolic Coordinate Representations

Consider a detector from the outside. A detected event "**ΔA**" is located at position X,Y,Z,T as defined by reality model coordinates. For those still clinging to the reality illusion these variables would label what they believe is real space. From the inside a detection event "Δa" happens inside a detector event named x,y,z,t. The event is transmitted on a wire, possibly through electronic gates, latches and amplifiers and eventually displayed on the reporting side of the detector system in a pixel- voxel, if a 3d device- also addressed as x,y,z,t. Figure 14 shows the detector and digitizing system used in Figure 11 .

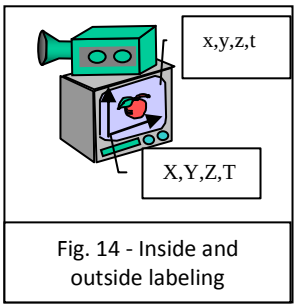


Fig. 14 - Inside and outside labeling

The screen points are actually named and manipulated by the x,y,z,t detector addresses to which they are attached but the event "a" is recognized as a real event "**ΔA**" and located relative to the X,Y,Z,T volume labels. These labels are provided by the formatting the screen array when digitizing the external coordinate axis shown as arrows. An observer looking at the display would say he is seeing a real Apple at a real X,Y,Z,T location when in fact his 1st Person observable event consists of "Δa", the symbolic representation of the event at a location x,y,z,t the name attached to the detector element in which it happened.

By crossing the detector boundary while performing a reality projection operation, the 1st Person is executing a transformation between two sets of reference frames. Such transformations are mathematically defined by a generator of the form

Eq. 7 F(X,Y,Z,T, Δ**A**;x,y,z,t, Δa),

which is a function of all the coordinates and the event content of the coordinates.

In classic physics the content of coordinates is called momentum and such transformations are called canonical or contact transformations (Morse, 1953b) when connecting two views of physically realizable events.

In summary the two major characteristics we have discovered by studying the reality projection operation is that the 1st Person produces a field of symbolic sensations from his physical reality model that act as his true reality with sufficient conviction to stake his life on their display.

We have also discovered that in changing views from what is observably presented in front of his nose to what is calculated in his model of reality he is performing a generalized version of a contact transformation that plays a central role in the Hamilton-Jacobi formulation of classic physics.

5. Conclusion

This paper introduced the concept of a 1st Person Laboratory in which we defined a set of operations required to answer the question, "*What do we do to become conscious of a real object in front of our nose?*" The question contains an implicit definition of "*consciousness*" as the ability to have a subjective experience of sensory stimulation. The defined operations represent an introspective documentation of *what* the 1st Person does but do not address the question of *how* such operations are accomplished.

In the next paper Part II addresses the how question by systematically implementing cognitive operations discovered in Part I with independent

physical objects available inside the 1st Person Laboratory. The successful conclusion of this project will document the methodology for building a cognitive robot and provide insight as to how its biological equivalent could have been constructed.

References

Atmanspacher, H. and Hans P. (2006) *Pauli's Ideas on Mind Matter in the Context of Contemporary Science*. Journal of Consciousness Studies Vol 13, No 3, p. 34

Baer, W. (2010a) *Introduction to the Physics of Consciousness*, Journal of Consciousness Studies. Vol **17**, No. 3–4, pp. 165–91

Baer, W. (2010b) *Op. cit.* See section II.b

Baer, W. (2010c) *Theoretical Discussion for Quantum Computation in Biological Systems*, SPIE Defense & Security Symposium, 5 - 9 April 2010 in Orlando, Florida, USA. Quantum Information and Computation VIII, Paper #7702-31 URL http://spiedigitallibrary.org/proceedings/resource/2/psisdg/7702/1/77020W_1

Bernroider, G. And Roy, S. (2005) *Quantum entanglement of K+ ions, multiple channel states and the role of noise in the brain* - International Society for Optical Engineering (SPIE), vol. 5841 URL http://www.quantum-mind.co.uk/bernroider-c54.html

Cahill, R.T. (2006) *A New Light-Speed Anisotropy Experiment: Absolute Motion and Gravitational Waves Detected.* Progress in Physics, Vol 4, pp 73-92

Chalmers, D.J. (1997) *Facing up to the problem of consciousness.* Journal of Consciousness Studies 4:3-46. Reprinted in (j. Shear,ed) Explaining Consciousness: *The Hard Problem*, MIT Press,. URL http://www.geocities.com/computerresearchassociated/consciousness.htm

Hagan, S., Hameroff, S. R. and Tuszynski, J. A., (2002) *Quantum computation in brain microtubules? Decoherence and biological feasibility.* Phys. Rev. E 65, 61901, 1-10.

Hofstadter, D. R., (2007) *I am a Strange Loop*, Basic Books, ISBN 0465030793

James, W. (1890), *The Principles of Psychology*, Vol. I and II, Dover 1955 (see Chapter X The Consciousness of Self)

Joselevitch, C. (2008) *Human retinal circuitry and physiology*. Psychology & Neuroscience Vol 1: 2, pp. 141 – 165

Lehar, S. (2003) *The World in Your Head*, Lawrence Erlbaum Associates, ISBN 0-8058-4176-8

Levine, J. (1983) *Materialism and Qualia: the Explanatory Gap.* Pacific Philosophical Quarterly, Vol 64 pp. 354-361

Mach, E. (1867) *Contributions to the Analysis of the Sensations* (tr. By C. M. Williams), Chicago: Open Court

Metzinger, T. (2000) *Neural Correlates of Consciousness: Empirical and Conceptual Questions*, The MIT Press, ISBN-10:0262133709.

Moldoveanu, F. (2007) *Quantum Mechanics and Closed Timelike Curve.* Quantum Biosystems Vol. 1, pp 66-73

Morse, P. M and Feshbach, H. (1953b) *Methods of Theoretical Physics*, McGraw-Hill, Part 1 p289

Nagal, T (1974) *What Is it Like to Be a Bat?*. Philosophical Review LXXXIII, 4 (Oct) pp. 435-50 URL http://organizations.utep.edu/Portals/1475/nagel_bat.pdf

Note A (2011) The Illusion identified here is similar to what eastern traditions call Maya. It is used here in the complimentary sense to identify the illusion associated with the feeling that something is physically or materially real when in fact such a feeling is based upon another sensation.

Pizzi, R., Rossetti D., Cino G., Baer W.and Vescovi A. (2009) Anomalous Findings in Cultured Neurons in Presence of Laser Pulses, Proc. 8th European SSE Meeting August 13-16, 2009, Viterbo, Italy, pp. 37-46.

Searle, J. (1980) "Minds, Brains, and Programs", published in *Behavioral and Brain Sciences* **3** (3) 417-457

Turing Test (2011) Stanford Encyclopedia of Philosophy, on line at URL http://plato.stanford.edu/entries/turing-test/

Vitiello, G. (2001) My double unveiled, John Benjamins ISBN 9027251525

Walker, E. H. (2000a) , *The physics of Consciousness* , Perseus Publishing, ISBN 0-7382-0436-6, see chapter 16 "From Epicycles to Loops"

Walker, E. H., (2000b) *Op. cit.*, p 293

Webster, N. *Instructive and entertaining lessons for youth*, General Books LLC, (2009), reprint from the original S. Babcock and Durrie & Peck, 1835, *"We turn our eyes, and in an instant **we see** innumerable objects around. We close our eyes, but the ideas of distant worlds are retained in the mind*" I have only found general references to the feeling of sensations surrounding us when we close our eyes.

Whitehead, A. N. (1978) *Process and Reality an Essay in Cosmology*, Corrected Edition by D. R. Griffin and D. W. Sherburne, The Free Press N.Y. ISBN 0-02-934580-4