Opinion And Perspectives

Cognitive Operations in the First Person Perspective. Part 2: Implementing Cognitive Operations.

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Abstract

Part I of this paper (Baer, 2011) 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. 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.

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

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1 - Introduction

Part I of this paper (Baer, 2011) 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. To help the reader segue into part II the main results from the analysis of conscious operations conducted in part I are summarized in Figure 1. Shown is the basic two cycle activity executed by the 1st Person when reaching the conclusion that a real object is observed.

The inner cycle processes an immediate observable, represented as the icon of an apple and

denoted by Δa in the text, through the Write, W(), and eXplanatory, X(), functions into a change symbol **ΔA**, which is part of the theory believed and used by the 1st person to represent the cause of the observed stimulation.

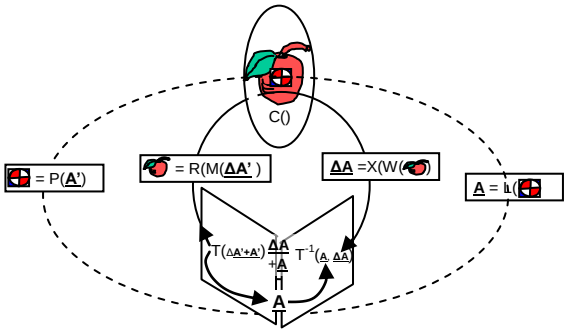

Fig. 1 The Change and Thing Changed Dual Cycle

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This is combined in the inverse time propagator $T^{-1}()$ with the symbol of a permanent entity being changed A to produce the prerequisite state of physical reality (A+ ΔA) that caused the observed sensation. The prerequisite state is then processed by the forward time operator T() into a next expected change, ΔA', which is Measured M() and Read_out R() from the symbolic theory to produce the expected observable sensation in the form of the apple icon again.

Since we did not include the creation of physical reality beliefs in this basic activity but only considered the operation of a mature belief set the modified permanent entity A' is retained inside the symbol system for use in the next execution cycle.

Likewise the symbols represent generic symbols of a theory. We were not concerned with the accuracy of the theory but if the observable Δa generated by the theory matches the observable generated from the external sensors (not shown in Figure 1) as judged by some accuracy criteria then something is right about A and its meaning is Projected, P(), into the observable as a visualization of the permanent reality underlying the sensation. We chose the icon of a charge-mass center (denoted as "a" in the text) as a visualization of the permanent thing that is changing in order to be compatible with our current belief classic physics that contends an object apple is really a form of mass and charge. Once the sensation in the optic channel is merged with the sensation in the visualization channel the belief that a real apple is present has been achieved and operations required reaching this conclusion identified.

It should be noted that though an apple was used as an example the terms a,Δa,A,ΔA are generic and apply to any permanent-change, sensation-explanation pair. In fact combination of such basic dual cycles will often interchange roles. In this example the material apple is permanent and its surface changes are identified with optical sensation. In quantum theory the same dual cycle architecture can be used when space is the permanent entity and material is atributed to a change in space. Since we can only experience the cause of our sensations symbolically we must be satisfied with experiencing a visualization of whatever plays the role of that cause in our model of reality. Most classically trained individuals, including physicists, ignore the cognitive relationship between the observable sensations and the symbols used to explain them. For them a changing charge-mass structure releasing photons is the direct cause of the real apple they see in front of them.

In addition we need to emphasize the dual role played by the symbols A and ΔA. As presented, these symbols represent the cause of our observable sensations. However they are also objects in the 1st Person Laboratory. As objects they signal the 1st person to perform certain operations demanded by the theory. For true believers they are simply externalized components of the automatic brain functions that are executed automatically.

He performs the called for operations as though he were an automaton composed of independent physical components. Like the operator in Searle's Chinese room, we may watch the operations our hands execute as though watching a third person following instructions without the slightest clue of the real meaning of such operations. It is only when we apply the Projection operator and generate visualizations of them that we can experience their meaning as non symbolic observables.

Thus the architecture of the basic activity cycles is already implemented in ourselves as operators of our theory in the 1st person in the laboratory. However in order to achieve further detailed knowledge of how such implementations are built with independent material we have two choices. We can reverse engineer the most likely location of such activities in our biological brain or we can forward engineer the construction of an implementation from inanimate material.

Though both approaches are valid the next sections of this paper deals with the latter approach and attempts to automate the cognitive operations identified by constructing a robot in our 1st Person Laboratory that will do the job for us.

2- Operations with Symbols of Physical Reality

Thus far we have only dealt with the epistemological questions addressing the operations by which the 1st Person establishes and modifies sensations that display beneficial interpretations of external influences. The metaphysical underpinnings of classic physics assumes such operations are trivial because classic physicists assume the real world is in fact the way western man has been taught to see it. No matter how such external influences are interpreted and displayed, at some point these displays reflect what appears to be an independent behavior that must be accounted for. Operations with symbols of physical reality perform this function and will be addressed in this section.

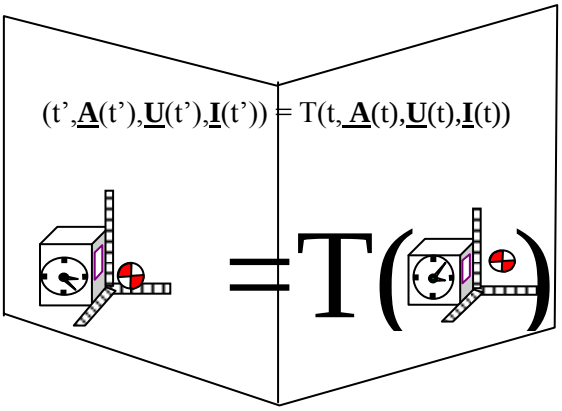

Fig. 2 Symbols of Physical Reality

Figure 2 shows only the symbol of the physical realty part of the cognitive cycle. A chevron looking diagram represents physical space inside two sides of a time interval. The bottom of figure 2 contains two states of a classic three-dimensional model introduced in figure 11 (Part 1), while the top contains an abstract mathematical description of the same operation. The top level mathematical description of this operation has been introduced in table 1 (Part 1). A real apple, given the abbreviated symbol (**A**), is used as a test object that represents any system of interest. The T() function is used to represent the interactions between the real apple and the real environment which includes both the body of the 1st Person observer(**I**) and the rest of the universe(**U**). The wall clock shown on the outside of the 1st Person Laboratory shows the time, t and t', at two states of the universe connected by the Time function during the interval, $\Delta t = t'-t$.

Expanding details within both T() and **A** depends upon the theory of physics we wish to employ. In classic particle physics **A**, the thing itself, would stand for coordinate and momentum vectors and T() would contain the time derivatives calculated from the Hamiltonian of the system. In quantum physics the thing itself is described by the Schrödinger wave function, ψ(), while T() is a unitary operator which formally is built by imaginary exponentiation of the same Hamiltonian converted to an operator.

Since we want to stay theory neutral we will not delve further into implementation details but instead point out general characteristics that are performed by any 1st Person wishing to account for the apparent independence of his personal experiences.

Let us remember that the content of the physical reality node is intended to represent the real world outside. The immediate cause of sensations is due to an interaction between the 1st Person and the outside, which sends a change through a cognitive cycle. This causes the apple observable to appear. We are now dealing with the mechanism that causes the apple to make its appearance at two different locations in the rest of the universe. It should be noted that the time (t) in lower case letters is a symbol-of-observables and represents what the observer experiences when reading the clock. This time is actually a subset measure of the state of the Universe and therefore redundant to the information already contained in **U**.

Hence the T() function actually describes an interaction between three parts of the physical Whole. Furthermore the interaction with **I** has already been taking into account in the Measure and eXplain operations and is assumed to be negligibly small. This does not mean the **I** stands still, but only that his propagation in time is separate from the interaction that makes the apple move between two

positions while **I** is not looking. A simplified mathematical expression that only describes the interaction between the Apple and the rest of the Universe is shown in the bottom section of Figure 3.

The top diagram portion of figure 3 shows the interactions in graphic form. Measurement and eXplain operations connecting the symbols-of-observables with the model of external physical reality are implemented through the model of the 1st Person, **I**, as discussed in section 4.2 (part 1). Here the explicit role of the self model symbolically reverses the contribution of **I** in the eXplain process and adds it back in through the Measurement process. **I**'s role in converting between symbols-of-observables and symbols-of-reality is indicated. **I**'s symbolic sensor arrays protrude into the chevron outline of the reality model. Only three divisions corresponding to the three parts of the **W**hole are indicated in these arrays and their upper and lower icons represent two process states of the same, not spatially separated, detectors. The external world interacts with the observing self through these arrays. Executing the operations indicated by the change arrows connects the two sides of **I**'s time interval. The reader may want to conceive of the entire spaghetti of operations as packaged in the

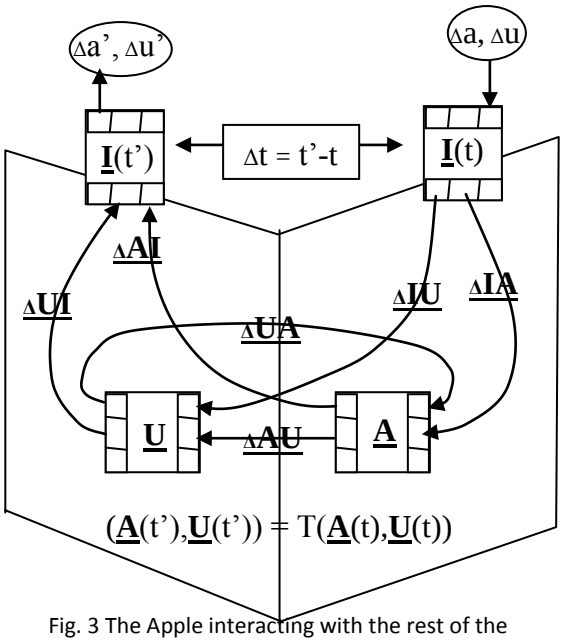

Fig. 3 The Apple interacting with the rest of the Universe

time interval geographically located inside the 1st Person's skull. That way the figure can be recognized as a kind of exploded view of the operations connecting two states of the brain.

To see how these operations work lets assume the 1st Person's knowledge of himself and the external world is stable and **I**,**A** and **U** are accurately known. In this case the expected and actual sensations are exactly identical, (Δa', Δu')=>(Δa, Δu), and the entire system is in a dynamically stable single state that holds the cognitive memory of a single time instant with no surprises. Eventually the 1st Person is surprised to experience a new report, "$\Delta a^{\dagger}$", from the external camera display indicating an unexpected change has happened. In addition he also sees a change in the wall clock which measured the state of the Universe and reported it on the dials as a new "$\Delta u^{\dagger}$".

Normally this is given the special designation as the time with symbol "t", but we are using "Δu" to emphasize the fact that time is the observable sensation reported by a clock used to measure the state of the universe.

Upon receiving the unexpected "$\Delta u^{\dagger}$" and "$\Delta a^{\dagger}$" the model of the physical self **I** is updated and a change, **ΔIA** is sent to the model of the Apple, which is thereby set to the state it must have been in prior to releasing the photon, i.e. making the change, that caused **I**'s sensation.

However, the Apple was illuminated by the sun and therefore a **ΔAU** signal is sent to update the model of the Universe. In addition **I** also sends a time signal **ΔIU** to the Universe model. The Universe model is thus updated both in time and by the change that was required to illuminate the Apple to the state it must have been in prior to the release of signals that caused the 1st Person's experience. This sequence describes the update operation resulting from an incoming apple and clock sensation.

To close the cognitive cycle, the model of the Universe now releases a photon, **ΔUA,** which bounces off the Apple and sends a signal, **ΔAI**, to the model of the 1st Person's retina. The Universe also sends **I** a clock increment signal **ΔUI** to the second

channel in the 1st Persons retina. The 1st Person model generates expected sensations which, if the model is accurate, will match the incoming sensations "$\Delta a^{\dagger}$" and "$\Delta u^{\dagger}$", which closes the loop in a stationary cognitive cycle. The entire model is now in a state compatible with the fact that the 1st Person is seeing an apple at time "t".

If nothing else were to happen, the 1st Person would stay in this state of forever seeing an apple at time "t". He would constantly refresh his experience much like the continuous sound of "tick-tock" described in part I section 4.1.2 until surprised by the next external change.

Reacting to surprises is not very useful. The model must also predict by allowing model of the Universe as well as the Apple to interchange signals **ΔUA** and **ΔAU** which are not seen by the 1st Person. In classic physics these signals might be identified with gravitational forces or specific electro-magnetic influences that do not involve the 1st Person. These are the interactions described by the relationships "(**A**(t'),**U**(t')) = T(**A**(t),**U**(t))" which set both the Apple and Universe to new states.

If accurate, the model of the Universe would reach a state from which it sends a new photon in its **ΔUA** change to the Apple which in turn reflects the photon sending a **ΔAI** signal to **I**. This updates the expected sensation to be received from the camera display. **I** also receives a signal from the Universe model that updates the expected clock display. The 1st Person then expects a new sensation at a new time. If it matches his next external sensations, he will happily be in a new state of seeing an apple in a new location at new time t'.

The lesson to be learned is that a process of interactions between entities can describe the architecture of entities and changes required for cognitive experiences without reference to the details of the physics inside those entities.

In specific the dynamics of observables occurring between measurements is due to unseen interactions between the System of interest and the rest of the Universe. For those familiar with quantum theory these unobserved interactions are the origin of uncertainty enshrined in Heisenberg's principle.

3- Automation of a Symbol System

So far we have asked the 1st Person to read, write, and manipulate symbols without considering how such activities might be accomplished. The 1st Person perspective only allows us to see sensations being transferred from one sensory channel to another but does not tell us how or why the transfer happens. If we build rules to describe these transfers and relationships, we would end up in the classic physics trap, i.e. the physics describing the apparent interaction between observables. In this section we dig deeper into the mechanism behind this manipulation of observables.

The general externalization method for such investigations was introduced when we replaced the 1st Person's eye and retina with a camera and display shown looking out the window in figure 4. We can see how the manipulation of observables proceeds by looking at an externalized system that does the job for us. The easiest procedure is simply to ask a 2nd person to execute instructions written in a symbolic model. This is easy because, except for some specific training, most individuals possess both the mechanical and cognitive capabilities required to execute the requested instructions. Unfortunately, since the "*easy problem*" of consciousness has not been solved, we lack the ability to trace the process through the 2nd person's brain. This leaves us with an incomplete description of the mechanical process.

Since the "*hard problem*" has even less of a solution, asking a 2nd person also leaves us completely ignorant in regards to how the sensations are experienced. One way to address the "*easy problem*" is by constructing a computer that automates the symbol manipulation task. Though a practical implementation of a computer is a silicon based machine that differs considerably from the biological carbon structure of a typical 2nd person calculator there are fundamental similarities that will allow us to transfer the functions and architecture from one calculator to another.

Whether carbon or silicon, a computer functions by translating meaning into symbols, then harnessing the physical properties of such symbols to interact with the physical properties of other symbols in order to produce new physical symbols that can be translated back into meaning.

The manipulation of these physical entities by other physical entities is usually divorced from the meaning that might be attached to them. Hence the essential step in building a computer is to implement a symbolic process in physical entities that manipulate themselves without our intervention.

Lets assume we have built a Physical Reality Model Calculator that allows us to enter the symbol of observables on one side, performs the (Δa', Δu')= M(T(X(Δa, Δu))) operations, and produces the symbolic result, then we will have automated this section of a cognitive cycle. Such a calculator might look like the box connected to the input camera display with a second camera as shown in figure 4. The architecture of the automated portion of the cognitive cycle implemented inside the 1st Person Laboratory is shown as red lines in the open book. At the edge of the right page, an icon of the camera detector plane is shown. This sends signals through the Write_in() function which produces the symbols-of-observables, a and u, which are sent to the calculator. The calculator is outfitted with an internal camera to read the display screen. Inside the calculator, the observable apple is converted to a symbol-of-reality, which flows through T(), is incremented to **A'**, is processed by the measurement function M() into the expected observable, Δa', and finally flows back to the external camera display. Here the 1st Person is asked to compare the two signals. If the expected and new observable matches, the difference signal is zero. In this case the calculator contains the best explanation of the cause as the meaning of **A'** and the 1st Person can close the cognitive cycle by projecting its meaning i.e. knowledge of a real Apple, into his reality space. If not, the reality model is modified until a minimum difference is calculated. In actual practice, failure to find a model that minimizes the difference between calculated and actual measurement results often leads to a denial of the sensations or introduces miracle components in the physical reality

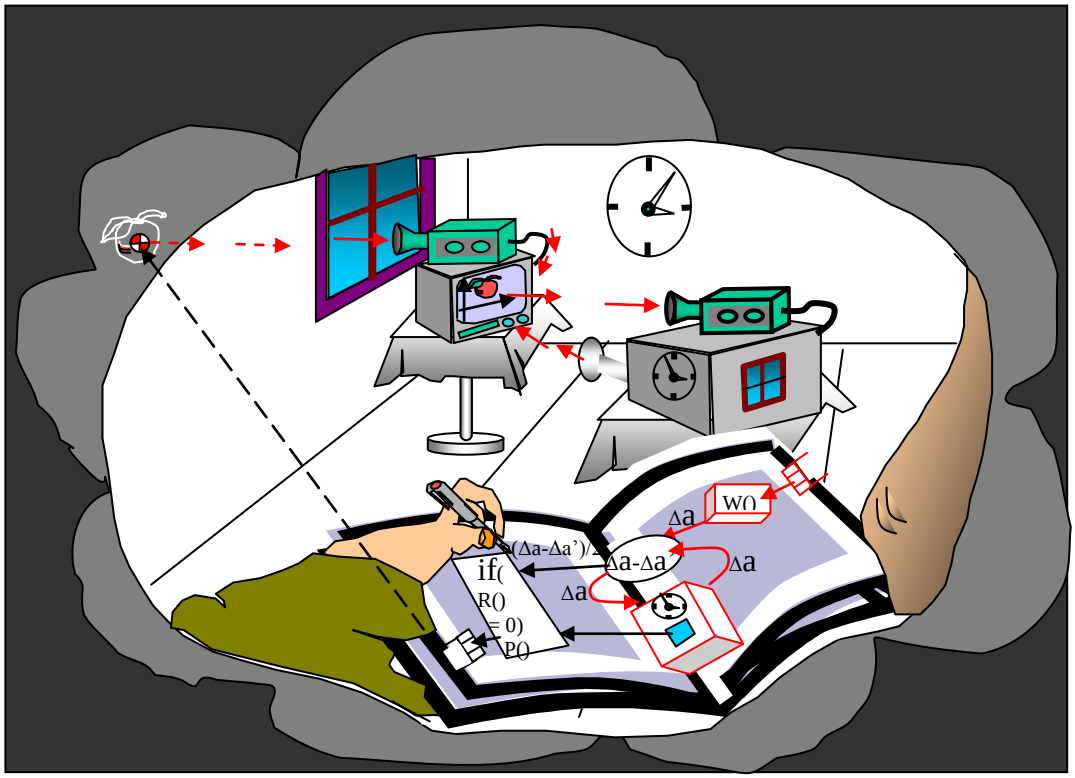

Fig. 4 - Automating the physical Reality Model

models. It is precisely the miracle inside the brain that produces conscious sensations in classic western culture that we are attempting to demystified in this paper.

Now let us look further inside such a computer to see what such an implementation can teach us.

3.1- Inside the Physical Reality Model Calculator

Figure 5 shows what the 1st Person would see when looking into the calculator. Inside the physical reality symbols **A**,**U**,**C** are manipulated.

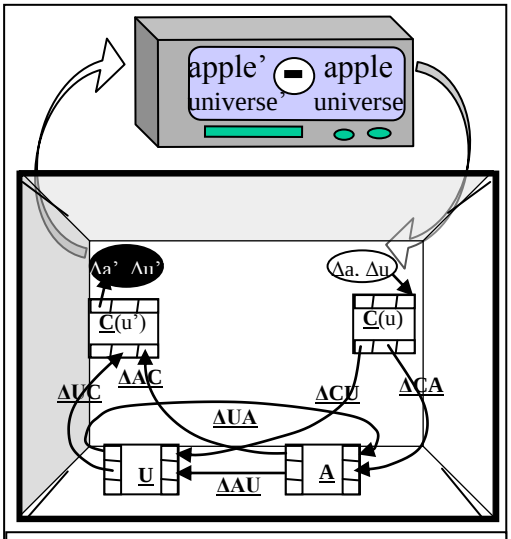

Fig. 5 - Looking at the back of the Physical Reality Model Calculator

The computer symbol **C** has been substituted for **I** since a piece of equipment now performs the functions of the 1st Person's self model in figure 3. The eXplanation process now implemented through **C** requires the reversal of the measurement implemented by the camera, digitizer, and display hardware shown in figure 4. This process not only reverses the optical acquisition and recognition process, but identifies the source of the change as **A** and adds the change, **ΔCA** , to it. The implementation of the symbol **A** will interact with the implementation of its environment, **U**, exactly as the real apple is expected to do. Furthermore such interaction should be implemented by physical forces inherent in the implementation of the symbols. In fact the combination of **C**, **A**pple and the rest of the **U**niverse should be an accurate self propelled model of the **W**hole physical universe believed by the builder of the computer.

Nothing has been done except that the cognitive processing cycle has been automated. The 1st Person no longer needs to Read_in an observable apple, eXplain it in his brain, and Write the result out through his fingers and pen onto the symbolic reality space as the symbol **A**, because this job has now being performed for us by the calculator.

The 1st Person can now look at what is going on in a cognitive cycle from two points of view. By looking at the **A** in the calculator we, the 1st Person, can see a physical flow of change through his observations. This is an external 3d person view of the cognitive operations. When we look at "apple" on the screen we are looking at a copy of the flow through the computer. This is the 1st person view point.

It is not that these two views were not available when we, the 1st Person, was asked to operate the cognitive cycle but now we can systematically examine the operations performed by harnessed independent forces. Because the physical forces operating on the independent computer entities are fundamentally identical to those that operate in the 1st Person's brain and the architectures shown in figure 3 and 5 are identical, a study of these externalized computer functions should show us how our own cognitive operations are implemented.

3.1.1 – Seeing Inside the Calculator

Before extracting physiological analogies from the automation exercise we must remember that here too the 1st Person only sees the result of his own measurements. To convert from what one sees to what is actually there the 1st Person's, not the automated computer's eXplain operation is required. **I**'s eXplain operation eliminates the contribution of the 1st Person and produces a symbol of the thing itself which looks like **A**, in our example. **A** itself is an observable symbol but is also a real object. If we apply **I**'s eXplain operator to the observable **A**, we would get X(**A**) i.e. the symbol-of-reality

for the sensation seen when looking into the computer. Similarly if we apply the eXplain operator to the T() function symbol we would get a X(**T()**) as a the real entity behind **T()**. The same goes for X(**A'**). In other words the symbolic operation **A**(t')= T(t',t,**A**(t)) is completely converted to

Eq. 8 **X(A**(t'))= X(T(t',t,X(**A**(t)))).

To say that we are "looking into" the calculator when in fact we are providing another set of design boxes may be misleading. To be clear, the reader should imagine looking inside an actual silicone based calculator. If he did, he would not see an **A.** He would see readings from voltmeters flowing past leads on electronic gates and latches. The specific voltage patterns that model an Appple has been given the name **A** in figure 5. This means that when we look inside we can see the voltage patterns transformed into new voltage patterns as the computer executes the model. Changes in these voltage patterns are described by the classic physics equation,

Eq. 9 **A**(t')= T(t',t,**A**(t)).

This equation symbolically represents the real universe acting upon the real apple. On one hand these patterns are symbols representing whatever the programmer assigned to them. In this case we assume the programmer assigned a real Apple as their meaning. So the movement of what we called **A** represents the real Apple, but the work is not being done by voltage patterns. Voltage patterns are what we see when looking at the display output of voltmeters. The work is being done by electrons and atoms which are the eXplanations of the voltage patterns in current scientific modeling and are designated by X(**A**). But the real entity inside my computer that executes these symbolic manipulations is given by,

Eq. 10 X(**A**(t'))= X(T(t',t,X(**A**(t)))).

If a biological calculator is used, the "looking inside" would mean seeing voltages across ion channels in neuron cell walls take the place of **A**. In neither case do we see what is actually there.

Even though we cannot see the physical reality inside the calculator box directly, when we have built it correctly, we know that we have captured something that looks like **A** is really X(**A**) and acts like the cause of the 1st Person observable apple. The criteria for correctness of the model is when Δa'-Δa and Δu'-Δu are both zero. In figure 5 this criteria is shown on the upper display screen as apple' minus apple equals zero and universe' minus universe equals zero.

3.2 - Closing the Cognitive Cycle

Whether the model of the cause of our sensations is automated with a silicon or carbon based 2nd person computer we have not yet seen how the cognitive cycle is closed. We have designed receivers and transmitters into the front of the reality model box so that it could send the expected apple description back onto the comparator screen. However, this only automates a closed cycle within the *model* of the cognitive process. We night assume the computer or 2nd person "sees" the apple as a 1st person experience because of this feedback loop. Such an assumption is often made of robotic systems that mimic human behavior and pass the Turing Test, but behavioral similarity is not the proof that a 3d Person view of the complete cognitive processes would provide.

If we are to observe a closed cognitive cycle then we must engineer a connection not only from the real Apple outside the walls of the 1st Person Laboratory but back to it. However there is no apparent transmitter from our setup to the real apple beyond the walls.

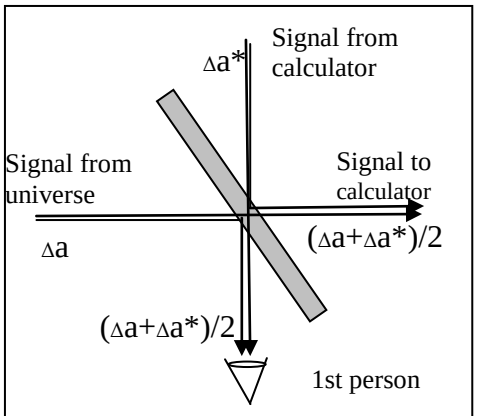

Fig. 6 - Comparison Mechanism using ½ silver mirror

To address this problem we must understand exactly how the cognitive cycle is closed through the 1st Person and try to automate this last branch from what we can learn. Remember the implementation shown in Figure 4 contains a physical reality model computer box that uses the description of an error between the expected and measured apple and produces a description of the next expected apple sensation. The expected and measured observable apple is compared at the external camera image display plane. At the display, a signal merging mechanism was assumed that enabled the 1st Person to perform the comparison. Such a merging mechanism could be automated by a half silvered mirror shown in figure 6. If a new signal, Δa*, from the model is exactly equal but opposite to the signal, Δa, then the both the output seen by the 1st Person and the output seen by the calculator are null.

Eq. 11 if(Δa = -Δa*) then 0 = (Δa+Δa*)/2

To consistently produce a null output the calculator must have an accurate model that is properly updated and synchronized. The synchronization mechanism requires the use of time sensations from the universe as discussed previously. These were generally designated with the letter "u" but are summarized by the reading of the wall clock "t" which is used to update the clock on the calculator box. If, for example, the clock does not increment between calculation cycles then all the paths transmitting changes that involve the **U**niverse, i.e. **ΔUC**= **ΔUA**= **ΔAU**= **ΔCU**, are zero and the only paths containing changes are between the Calculator and the Apple. In this case the eXplanitory function produces the state of the Apple before the measurement,

Eq. 12 **A**(t-Δt) <= **A**(t) + **ΔUA**(t) <= **A**(t) + **C**(t, Δa) <= X(t, Δa).

While the Measurement function implemented in the reverse self model of the calculator produces the same Apple and the expected observable output Δa(t) again,

Eq. 13 {t, Δa(t)} = **C**(t,**ΔAC**(t)) - **A**(t) = **ΔAC**(t)- **A**(t)<=M(t, **A**(t-Δt)).

In this case, the calculator simply produces the same expected result, which is compared with the same measured input to maintain a stationary sensation of the apple until the universe increments its time state. Since time is measured by changes, there is no absolute measure of the length of time intervals between changes.

Once synchronized and updated, the output of the comparator is null which means that the state of **A** is as accurate as the model allows. Then the 1st Person can look into the calculator, see the **A**.

Remember **A** is the observable of the real X(**A**), which is the captured reality that was automatically involved in the Measurement, eXplain, and Time increment operations, but **A** also is a symbol that can be translated into meaning by the 1st Person. By looking into the calculator the 1st Person symbolically knows what and where the real Apple is located. As documented in part I he can experience that knowledge by placing a calculated icon of a gravito-electric object into his expected touch and chosen reality sensations of the Apple outside the walls of the 1st Person Laboratory. This final Read-out() operation makes the Apple real for the 1st Person and closes the cognitive cycle.

3.3 – Automating the Material Projection Function

We have learned that the cognitive cycle partially automated in the setup shown in Figure 6 is closed by the 1st Person when he produces the meaning of the model **A** seen through the window of the Physical Reality Model Calculator. If we want to automate this last operation we would invent a third hardware box that is outfitted with a camera to look through the small window to see the **A** model for us.

This third box would then also be required to express the meaning of what it sees by projecting a gravito-electric reality icon into the real apple location outside the 1st Person Laboratory. As discussed in section 3.2 it is highly unlikely that any conventional computer could be built that would perform this operation unless it could learn the meaning of its own symbols. The meaning of symbols manipulated inside a computer is assigned by the programmer from the outside. A computer that would grow and program itself from sensory experience gained through its history is conceivable but the characteristics of such a machine essentially describe a cognitive being.

Including such a third box would make the computer like a 2nd Person. Building a 2nd Person is currently not feasible without capturing a life cycle that is already closed. Again we are confronted with something that we can do but do not know exactly how.

The third box, being a physically independent entity would, according to the action cycle theory we are developing, facilitate the conscious of something that is contained in the natural cycle it closes.

That natural cycle involves not only the small pieces of data we might have programmed into it but the flow of electric power and the history of the gravito-electric parts that make up its structure.

The electric power flow comes from the sun and is dissipated into heat that flows out into the blackness of space. This is the cycle that natural inanimate objects belong to. The cognitive experience associated with this flow is hardly of concern to the computer builder. Programmers do not care what the computer feels, any more than we care what the man in the Chinese room feels. Builders and programmers capture cycle bundles with whatever forces are required to make them perform the

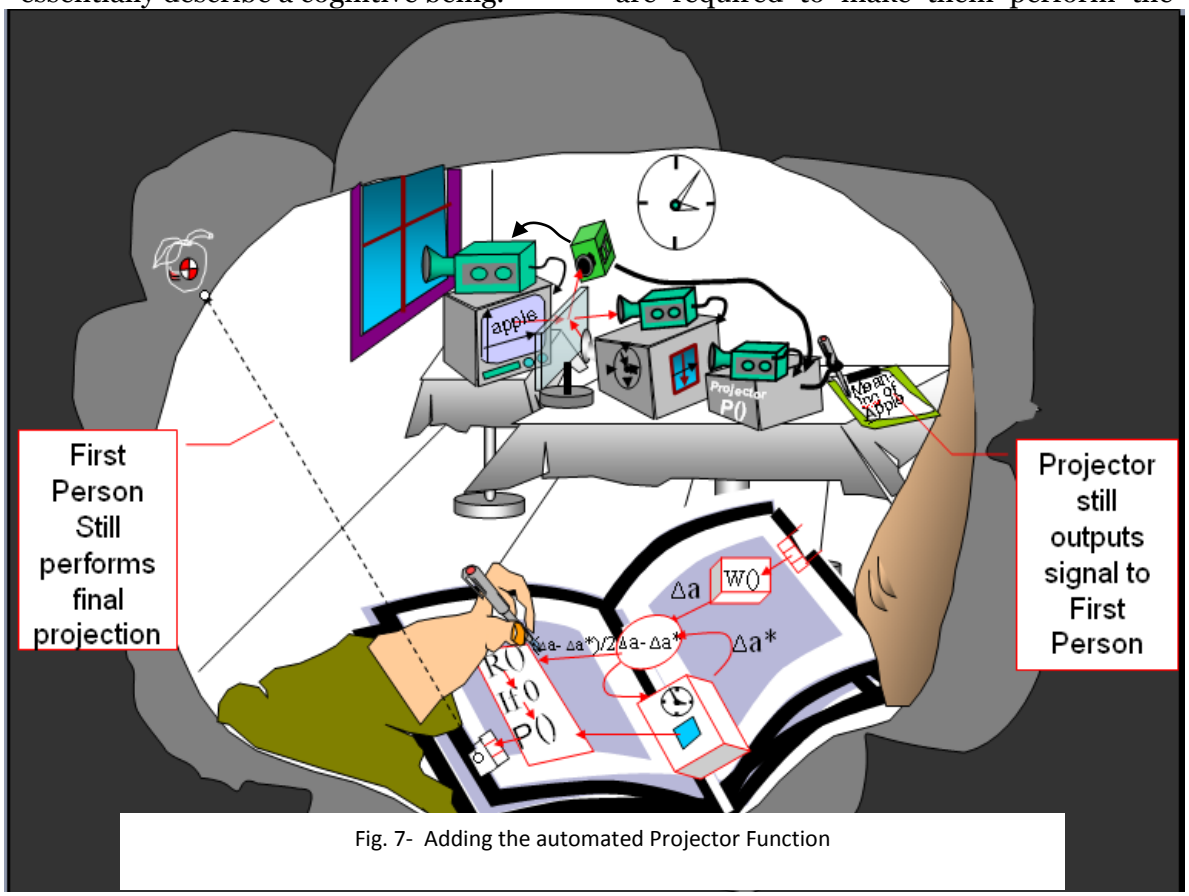

Fig. 7- Adding the automated Projector Function

symbol manipulation they desire now and do not consider the possibility that their neglect of the computers feelings will extract retribution in some other part of our own cycle.

Figure 7 shows the added equipment in our setup required to automate both the comparison and the readout of the **A**pple symbol discussed above. The half silvered mirror is located between the camera display and the reality model calculator. A new projector outfitted with a camera to look into the back window of the calculator reads **A** and publishes a meaning of **A** signal by controlling the motion of a pen.

This meaning was originally assigned by the programmer who built the reality model calculator. The projector box could be implemented by a kind of automated programming and diagnostic tool that transforms specifications into code.

Unfortunately the design of the experiment in figure 7 still calls for the 1st Person to look at the output signal "Meaning of **A**pple" and perform the actual projection that leads to the appearance of the reality icon. This is analogous to a 1st Person providing a program specification in which the actual meanings have been coded into a program specification language and the programmer then performs a symbol to symbol transform. Thus the output is written in terms of the specification language, which still does not equate to the meaning assigned by the 1st Person when the specifications were written. Someone still needs to provide the meaning to the words "Meaning of **A**pple".

In order to eliminate the 1st Person's role in closing the cognitive cycle, the message output by the projector box must be meaningful not to **I** but rather bypass **I** and connect directly to the external entity that focused the change on the real apple where it was when the photon left it. That entity is the meaning of **U**niverse in which the meaning of **S**un is a part and thus we must find an output signal that may look like a symbol such as "Meaning of **A**pple" but is built of material which interacts with the **U**niverse to close the cycle. To identify such a signal and describe the final closure of the explanatory gap, it will be necessary to modify the metaphysics upon which both classic and quantum theory is built.

This modification consists of recognizing cognitive cycles themselves as the fundamental events from which reality is built and requires a breakthrough in physics so that it logically incorporates the existence of sensations.

3.3.1 – Defining the Breakthrough

If the physical reality model computer is built correctly, the **A**pple it implements acts exactly like the meaning of **A**pple we presume to exist outside the 1st Person Laboratory. For there to be such an accurate and correctly built computer implies that the Universe would have produced an exact model of itself. It may seem strange to talk about the Universe building the model, but remember that we are part of the Universe and though we, the 1st Person or any other entity may claim to be independently responsible for some activity, we are all part of an interacting whole. The role any one part plays may seem significant but that significance must be viewed within the context of all the parts that jointly participate in its evolution. We did not specify how the hardware shown in figures 4 and 7 was built, only that it would operated independently by harnessing its own physical forces and would occupy a small volume inside the 1st Person perspective. If the building process were observed within the 1st Person Laboratory it may very well look like an army of people each contributing a small part of the Physical Reality Model Calculator.

Who or what organized all these individual actions was not specified in any detail but was simply lumped into the process called **U**niverse. The end of the building process finds the **U**niverse containing a model of itself and since a model of itself is a symbol of itself, it could represent one node in its own cognitive cycle.

If we could show that there actually is a cognitive cycle between these two nodes, - i.e. the real universe in the outside box of the 1st Person Laboratory and the model in the inside box – then a signal from the inner box could in principle flow around

the cycle an regenerate the photon that illuminated the real apple in the first place.

3.3.2 - The Universal Cognitive Cycle

Our next investigation is based upon the assumption that some component of the Universe is interested in knowing what it is all about. How such a component will motivate the evolution of the Universe is described in more detailed by Baer (2010b). If the Universe wanted to know itself it would have to convert its observables into an observable symbol of itself and then read it back. Our contention is that this describes two sequential cognitive cycles and is precisely what the Universe does. To prove it we would have to identify the flow of observables through the 1st Person experience and into their explanations and back again. This is precisely what we intend to do.

To make this idea more palatable, let us first consider the symmetry between the Universe outside the 1st Person Laboratory processing room and its computer model inside the room. In one case the 1st Person looks through a window in the walls of the room from the inside out into a volume filled with observables he believes are evidence of real material objects. In the other case he looks through a window in the walls of a box from the outside into a volume filled with observables he believes are evidence of real material objects. The 1st Person is surrounded by an outer box and in turn surrounds an inner box. His experiences are wedged between the inner wall of the outer box and the outer wall of the inner box. The far side of the inner box is an infinitesimal cube surrounding the center. The far side of the outer box is a cosmic sized cube surrounded by a border beyond which lies infinity. The two boxes are related by a scale transformation,

$$\text{Eq. 8} \quad \underline{\mathbf{R}} = Ss \cdot \underline{\mathbf{r}},$$

where the $\underline{\mathbf{r}}$ is measured in units of distance from the center of the inner box to model features, $\underline{\mathbf{R}}$ is measured to the real features outside, and Ss is the scale factor. This transformation provides a scale model connection between the outer universe and its model inside the inner box. A planar graphic representation of the geometric relationship between the outer box and inner box is shown in figure 8. Here the white outside box with the real Universe, Apple, and I represents the Physical Whole in state, t_0. The physical Whole surrounds an observable node region which in turn surrounds a model of the Whole in state, t_1. The dashed line in the middle of the observable node represents the comparison plane through which observables flow. Rather than be reflected back and compared, the processing line goes from the real apple at time, t, and goes through the observable to the real apple model at time, t_1, and continues through a small second observables node which in turn surrounds a third physical Whole in time state, t_2.

The processing lines are flat projections against a shrinking and fading ...body-mind-body-mind... sequence that flows straight into the diagram.

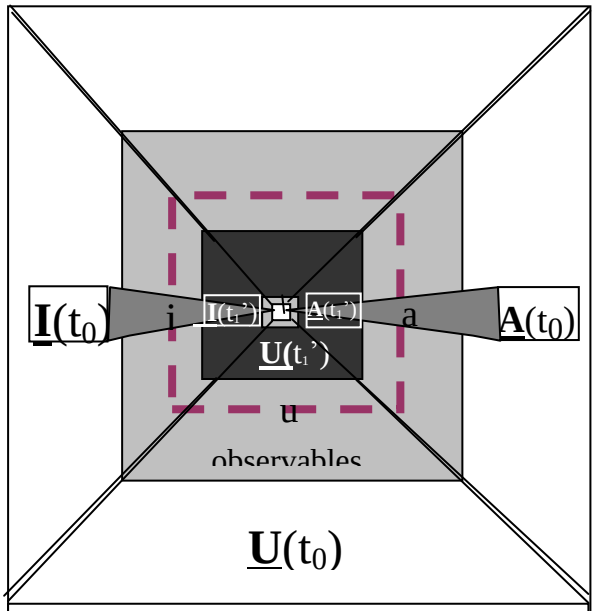

Fig. 8- Physical and mental nodes in a nested time sequence

The interaction between the inner and outer box is a cycle. To close the cycle through the large-small direction, it is only necessary for the state t_N to equal the initial state, t after N cycles. The number of steps in the cycle determines the number of individual descriptions of the Whole one sees before the cycle repeats. If N equals 1 then all sensations, w_1, show up at once and are eXplained by the physical Whole in a perpetual stationary state. If N

equals 2 then only w_1 followed by w_2 is experienced and the system will appear to oscillate between two observable states. If N equals the number of cycles in the Universe the cycle repeats with the age of the universe.

If the small inner white box is equal to the outer white box in figure 8, then it would portray the exact two phase cycle in which $t=t_2$. The model of the universe inside the universal observer's conscious experience would already contain a model of the model which loops around to become the outside containing his experience again. The universal observer would see the universe emerging out of the small box which would appear to be constantly growing. The suggestion that the Universe might be closed through a large-small axis is highly speculative and to date little investigation of such a possibility has been pursued. However the suggestion is consistent with aspects of cosmological wormhole theories. For example, that the Universe appears to be growing is well known as Hubble's expansion phenomena. That a forward motion toward a point would produce appearances that accelerate from that point outward is also well known. By moving toward a point in time the universal observer might see space expanding. This expansion has been equivocated with gravity in the Einstein's General Relativity Theory or more directly with spatial acceleration models (Cahill, 2006). Here, we have identified the same phenomena as an appearance caused by the motion of a universal observer around a cognitive cycle.

If the Whole Universe is divided into **I**,**A**, and **U** as shown in figure 8, the closure of each of the parts is through the same ...body-mind-body-mind... sequence that flows straight into the diagram. This means that if the cognitive cycle for the Whole closes through a time line (Moldoveanu, 2007) that goes around the small-large loop and we collect a bundle of cycles that we give the name Apple, You, or I, then these bundles of cycles also close with a loop through the small-large axis.

The Greeks believed man could be visualized as sitting backward on a donkey (Walker, 2000a). He would move forward with the donkey but could only see the world he had just passed flowing backwards through him. Here the same feeling is evoked only the stream of sensations disappear into a shrinking model which contains a further nested shrinking model that which eventually comes around to the Universe surrounding his immediate now. Classic physics assumes real particles simply move from one state to another along infinitely divisible lines of time. Quantum physics acknowledges finite but mysterious jumps in the states. Neither recognizes that time is the name of a state and the process of moving from one state to another passes through a mental phase of an activity cycle we have identified as the process of consciousness in this paper.

7- Future Work

The framework for an integrated theory of cognitive beings has been presented in abstract terms. The letters a,i,u and Δa,Δi,Δu name the observables experienced by a being whose permanent physical reality is designated by vector symbols **A**,**I**,**U** and the physical changes propagating within such permanent structures designated by **ΔA**,**ΔI**,**ΔU**.

Expanding the detailed characteristics of these symbols and their associated visualizations is the next logical stem in the development of the theory of cognitive beings from the framework presented. By identifying **A** with an atom and **ΔA** with a transition generating a photon one can begin to grasp how quantum theory describes systems in dynamic equilibrium, i.e. fermions, that transition from state to state through absorption and emission of signals i.e. bosons.

One possible picture of the Neural Correlates of Consciousness that emerges from such a framework involves the model of physical reality based upon a force that holds mass and charge together with an interpretation of the quantum wave function as a mass-charge separation distance in a field of space cells (Baer, 2010c). Such a force would balance and thereby accommodate the gravito-electric influences from the all the other models of

physical reality in the loops that compose the Universe. If mass-charge separation is the physical phenomena associated with consciousness in the brain the degrees of freedom required to define such a system would double since now there are two characteristics for each particle (Vitiello, 2001). The double model of the brain then leads to aggregated water structures which in turn control the behavior of nano-tubules in dendrites (Hagan, 2002). The astroglial system is thought to produce calcium waves homeomorphic to feelings of pain and pleasure (Pereira, 2011). Long range correlations between neuron cultures is being investigated (Pizzi, 2009) and if verified can lead to correlated effects in Ion Channel Proteins (Bernroider, 2005) that control the rate of neural pulse observed classically in brain function.

The picture spanning the levels from low level mass-charge separation fields to neural pulse control is speculative. A great deal of development both theoretical and experimental is necessary to bind the hierarchy from quantum fields to higher neurophysiologic observables together.

8- Implications and Conclusions

We have developed an explanation of consciousness by carefully mapping the cognitive operations executed by the 1st Person to an external mechanism. At a high level of aggregation this mapping answers the question, "What does a material object actually do to be conscious of the things around itself?"

Our investigation showed we must look very carefully at the operations performed by a cognitive 1st Person when interacting with any symbol system that is believed to represent physical reality. We were primarily concerned with the construction of physical world beliefs involving the remote sensing displays of the optical field, auditory display, and touch as well as the internal knowledge display of the expected touch and memory sensations.

Experiences in these display spaces are immediately and obviously available. They are called qualia by modern psychologists, and were dubbed "*observables*" by the physicist Werner Heisenberg, and are identified as the "what it feels like to be the physical model of the Universe" that holds our beliefs (Nagel, 1974).

Our methodology utilized the 1st Person graphic display of a laboratory within which operations and experiments were conducted. The laboratory was treated as a metaphor for the inside of our brain. We, the 1st person scientist in the laboratory, took the role of a homunculus inside the brain. We imposed upon ourselves the restriction that whatever operations we were to investigate, we could not get out of the 1st Person perspective in the laboratory. Thus only experiences within the view of the 1st Person Laboratory would be directly available to us.

Within this environment four experiments were analyzed to determine the operations required to become conscious of a real object. They were a falling apple inside the laboratory; a falling apple outside the laboratory seen through a camera; the addition of an automated explanation mechanism of the camera image substituted for the 1st Person; and finally the experiment designed to substitute the complete cognitive contribution of the 1st Person homunculus.

By automating the homunculus and systematically transferring the job it performs to externalized process boxes we can define what happens inside the brain with an outside view of its processes. This external perspective into the workings of the brain has shown us that changes flowing inside processing paths interact with each other to produce changes that emerge from the ends of these paths as everyday 1st Person experiences flowing through us. At the same time these paths can be symbolically interpreted as real structures that make up the universe. Thus the past and future we envision and believe ourselves to live in is the meaning of real existing processing elements that direct the flow of changes so as to produce what we experienced today. In that visualization, the ultimate explanatory node of the cognitive cycle is the origin of the universe, and the processing paths from the origin to the here and now observables are implemented by the independent physical characteristics of the entities that generate our visualization.

This allows us to conclude that the world that you see, the sound that you hear, the touch that you feel and everything you experience is a display phase of a larger activity that we have identified as the cognitive cycle that is You. You are a physical entity and You are built to accommodate the influences from the rest of the universe in your model of that Universe. What you experience is "*what it feels like*" to be that model.

You live in a universe of interacting cognitive cycles. This reality integrates the physical explanation with our mental experiences and represents a new vision of reality within which consciousness is the process happening.

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