The Conscious Awareness Process: A Comprehensive Fourier Transform Theory on Self and Consciousness

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Update 091312019

1. Introduction

a. Definitions

b. The physical world doesn't exist without subjective measurement. Basics of quantum measurement.

Here I attempt to "fill in the blanks" to provide a comprehensive model of "the self" which is drawn from fundamental physics. This model of the self is a natural outgrowth of the field of information processing. It is based upon current work by the same author in which the field of quantum mechanics is also understood through the lens of information processing.

Taken at its simplest face value, for the purposes of this paper, quantum mechanics tells us that definite physical phenomena are the result of a measurement interaction with a so-called observer. In the absence of such an observer, physical phenomena are not well-defined. This is the well-documented "quantum measurement problem."

2. The self is the primary reality

a. **Postulate 1**: A process we can call "selfhood" or "self" is the primary foundation of experiential reality and physical reality.

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The idea that the self is the fundamental building block of reality has been explored throughout many traditions, both in faith and in philosophy. The conviction that there is such a thing as the self is notoriously difficult to document. It is generally accepted that the self is something that we, as selves, know to exist. The "hard problem" in philosophy points out this difficulty in naming "what it is like to be something." (More on Kant, Chalmers)

b. Sense of self (Definition 1)
   i. William James, self is felt: What we feel, we identify with.
   ii. Graphic: (sense of self) <- identification -> (feeling about physical circumstances)
   iii. Definition: Self is a process of identification with felt experiences.

In his landmark publication (James 1890) William James argued that the sense of selfhood is felt.

“For this central part of the Self is felt. (The Self is) … no mere *ens rationis*, cognized only in an intellectual way, and no mere summation of memories or mere sound of a word in our ears. It is something with which we also have direct sensible acquaintance...”

Further, this sense of self derives from identifying with the feelings that the environmental surroundings stimulate.

“In its widest possible sense, however, a man's Self is the sum total of all that he CAN call his, not only his body and his psychic powers, but his clothes and his house, his wife and children, his ancestors and friends, his reputation and works, his lands and horses, and yacht and bank-account. All these things give him the same emotions. If they wax and prosper, he feels triumphant; if they dwindle and die away, he feels cast down, - not necessarily in the same degree for each thing, but in much the same way for all.”

We identify with what we feel, because felt experience defines the self.

Thus far, our definition of self is:

Self is a process of identification with mental images and felt experiences, and the physical objects these correspond to.

c. The personal self and the transpersonal self
    i. The personal sense of self is determined by the identifications of the processes above. These are filters which color future sensory experiences with associations to past felt experiences.
    ii. Without these filters, one perceives the physical surroundings directly. The transpersonal self. Knowing.
        1. The true nature of things is evident. This is the state of enlightenment, but also of momentary insight that we all have at times. “Seeing into someone else’s world”

For completeness, a distinction seems necessary between the personal self, or ego, and the transpersonal self. In the following sections, a model is proposed in which our sensory organs provide input data for our nervous system, which data is stored for later access. This data in electrical form interfaces with an emotional system based upon chemical hormones. Together these form a responsive system I’ll call the mental-emotional system which can be seen as a *filter*.

Given an impulse from the environment, in the form of sensory input, the psycho-emotional system has an impulse response composed of mental images and emotional urges. Like the impulse response defines the action of a filter in response to an arbitrary signal, the “impulse response” of the mental-emotional system defines the personality of the personal self. The impulse response can be seen as the result of a set of filters, and so the personal self is how we feel, act, and think in the presence of these filters.

The transpersonal self, by contrast, is defined here as how we feel, act, and think in the absence of these filters. For reference, it is imagined that this is the state of a baby entering the world, and also of everyday people at moments of penetrating insight. It is the feeling of “Seeing into someone else’s world.” Accomplishing this state is difficult to the extent that it is difficult to train our mental-emotional system (soon to be described in more detail) to have a “flat” impulse response. Such a flat impulse response does not imply lack of emotions or thoughts, but rather an *appropriate* response to the stimulus in question. In other words, in the state of the transpersonal self, nothing is added by the filter. (Does this apply to a baby?)

> What is knowing? Knowing is better defined by what it is not. The normal state of consciousness is a series of perceptions of the world, where each perception is accompanied by a narrative coming from the psychological filter system of the emotional memory part of the brain. This narrative gives meaning to each

perception, in relation to ourselves. These filter stories accompany every perception. This is what we call living in a dream. Layers upon layers of contextualized and culturally created meaning.

So, what is knowing? When you have a perception that is absent of these stories and filters, you are immediately aware of that fact. You are immediately aware that you are perceiving reality as it actually is. The experience can be overwhelming, because our stories are so complete and all-encompassing. We have been building them since we were babies. For example, any sense of direct knowing implies that the layer of self-critique or self-hatred is absent. This layer, I imagine, is present in every person and conscious entity. When it is removed, and one sees themselves existing in a vast and beautiful and awe-inspiring and terrible universe, one has a deep sense of relief that is hard to explain. We wear our negative self-filter so tightly to us that when it is taken off it is a deep relief such as we can't possibly fathom. Direct knowing is what happens when the filters are not there. Plant medicine does this. In this state, the truth about things is obvious. You can see it directly. If you have no presuppositions, then when you see an object falling to the ground under gravity, you immediately perceive the law of gravity as Newton or Einstein did. You don't have the equations right away, but you have the clear insight just as they did. Much as in a dream. Just as Newton or Einstein probably took their inspiration from states of direct knowing like this, maybe even from dreams, if we stay in this state long enough we do perceive even the equations.

3. The holographic brain

a. The physics of thought

i. How a hologram works

A holographic image is a wave interference pattern which can store information about spatial distributions of signals in terms of a frequency spectrum and relative phases. Essential to the storage of this information is accurate representation of the relative phases of the frequency components, since these determine the spatial distribution of the signal in space and time. To accomplish accurate capture and storage of this phase information, a hologram relies on coherent light from a laser, wherein the phase of each photon is in a known state relative to its neighbors. The signal is comprised of coherent light bounced off of an object, so its phases correspond to the delays picked up by striking the object at various locations on its surface. This phase information contains complete information about the shape of the surface of the object. However, in practice one encodes this information on film by mixing it with a reference beam of coherent light from the same laser. The combination of the two amplitudes leads to an intensity distribution of the light which can expose a sheet of film.

Some of the mathematical terms in eqn. XX are not useful for the hologram, but some of them carry the very phase information we are trying to encode related to the shape of the surface of the object. The film therefore develops into an interference pattern which captures unique information about the shape of the surface of the object. This information is what is called in (Nelson-Isaacs 2019) the k-phase map. A hologram is a photograph of the k-phase map. When the original reference beam is shone on the developed film, the waveform resulting from the film pattern and the reference beam is identical to the waveform that originally came off the surface of the object. The light that travels to the eyes is therefore of the identical shape as if the original object was present, providing the illusion of a 3D object in space.

ii. The mind's eye

The model of the relation between the human brain and the perception of conscious experience presented here is based on some observations of the information processing properties of neural structures, the known processes of

memory creation and retrieval, and the image forming properties of holograms. These will be suggested but not proven.

Observations of the signal processing properties of neural structures

1. *A neural network with equal inputs and outputs performs a Fourier transform.* A Fourier transform results from a complete intermixing of a signal weighted by phase differences. This can be implemented in a neural network as well, and it seems likely that it is even the inherent behavior of a biological neural network.
2. *A branching tree network that reduces the branches (i.e. from leaves of the tree down to the trunk) will necessarily lose high frequency spatial signals in the data and serve as a low pass filter, with the output in frequency representation.*
3. *A branching tree network that increases the branches (i.e. from the trunk of the tree up to the leaves) will retain its low frequency spatial signals and generate a coherent pulse at the leaves, with the output in frequency representation.* Like the stimulated emission of light in a laser, when a single neuron branches into many, the many branches will share a common phase due to the common source.

Mathematical tools

- Signal processing happens through the use of convolution of a signal with a filter. This is equivalent to multiplying the signals in frequency space. This is used for moving and mixing signals throughout the body.
- Cross-correlation is a similar operation to convolution which returns a strong signal when a pattern is matched in the frequency representation. This is used to determine the amount by which a given neural structure activates when interacting with a signal.

The basic model is as follows:

1. Sensory information enters the brain and is transformed into the frequency representation.
2. The signal representing the preexisting neural structure of the brain is multiplied by the sensory information, in frequency representation.
    a. Through cross-correlation these signals are compared for a match.
    b. Brain structure is affected by the incoming pattern via neuroplasticity (neurons that fire together wire together).
3. As the signal composed of the sensory input mixed with the patterns from the brain approaches the spinal cord, the spatial data gets low pass filtered by the step-down process of condensing branches.
4. The signal travels down from the top of the spinal column, branching and creating a coherent pulse representing low frequency spatial signals.
5. In the “solar plexus brain” and the “gut brain”, the signal is multiplied in frequency representation by the existing signals in those networks. Through cross-correlation of these signals, any matching patterns trigger more intense activation.
6. The signal from the spinal cord travels out to the tactile neurons spread throughout the skin, muscles, etc. The signal picks up pleasure/pain data from the tactile neurons, as the signal passing through is convolved with the structure of the tactile neural net.
7. Once reaching the outer branches of the tree, the signal is regenerated from the neural cells and “reflects” back toward the spinal cord. Again the signal has its spatial resolution impacted by a low pass filter through the step-down process.
8. This signal passes up through the spinal cord carrying low spatial frequency data, corresponding to the overall broad patterns that have survived the various filtering processes. This signal is amplified into a coherent pulse as it steps-up and travels into the leaves of the tree in the brain.

9. This amplified coherent signal interacts with the brain and serves as a reference signal. Through cross-correlation, certain patterns existing in the neural structure of the brain become more strongly activated, based on how well they match the signal coming from the spinal cord. Given that this signal contains only low spatial frequency information, this may represent the emotions, which carry a broad influence but lack high spatial resolution.
10. The signal from the spinal cord (i.e. the emotion) activates (through cross-correlation) a given low spatial frequency pattern in the brain structure. This activation in the brain is not limited to the low spatial frequency portion of the signal—the activated pattern also has higher spatial frequency components, i.e. detailed visual images. These patterns arise as electrical signals distributed throughout the neural structure of the brain, potentially giving rise to a holographic image in that region that can be associated with the experience of a "mind's eye."

Let us work out a detailed example. Our subject is a recently newborn baby.

1. Sensory data $s_1(x,y)$ flows into the baby's nervous system, say through the eyes. This signal is complex, consisting of phase and magnitude of electrical signals in two dimensions. For example, we shall consider s_1 to be a visual image of a parent's face smiling at the child.
2. The brain $b(x,y)$ is a vast but arbitrarily interconnected web of neurons. The signal $s_1(x,y)$ is converted into its frequency representation, $\sim s_1(k_x,k_y)$ through the Fourier transforming properties of this neural network. Since the neural network is new (for a newborn baby), $\sim b(k_x,k_y)$ encodes no patterns. The filtering process is therefore trivial,
    a. $\sim r_b(k_x,k_y) = \sim b(k_x,k_y) \sim s_1(k_x,k_y)$
3. The signal travels down into the spinal cord and is stepped down through the low pass filter,
    a. $\sim r_b'(k_x,k_y) = \text{LPF} \sim b(k_x,k_y) \sim s_1(k_x,k_y)$
4. The signal mixes with the brain centers in the solar plexus and the gut
    a. $\sim r_c(k_x,k_y) = \sim c_{sp}(k_x,k_y) \sim c_g(k_x,k_y) \text{ LPF} \sim b(k_x,k_y) \sim s_1(k_x,k_y)$
5. and spreads into the outer branches of the nervous system,
    a. $\sim r_c'(k_x,k_y) = \sim t \sim c_g(k_x,k_y) \sim c_{sp}(k_x,k_y) \text{ LPF} \sim b(k_x,k_y) \sim s_1(k_x,k_y)$
6. The signal "reflects" off the leaves of the tree and heads back toward the spinal column, interacting with the gut brain and solar plexus brain again, possibly triggering an enhanced signal due to matching between these neural networks and the new signal t. This process also results in an addition low pass filter.
    a. $\sim r_c'(k_x,k_y) = \text{LPF} \sim c_{sp}(k_x,k_y) \sim c_g(k_x,k_y) \sim t \sim c_g(k_x,k_y) \sim c_{sp}(k_x,k_y) \text{ LPF} \sim b(k_x,k_y) \sim s_1(k_x,k_y)$
7. This signal travels up the spinal cord and interacts with the brain again, which has evolved through neuroplasticity based on the previous interaction, to b':
    a. $\sim \text{final signal} = \sim b'(k_x,k_y) \text{ LPF} \sim c_{sp}(k_x,k_y) \sim c_g(k_x,k_y) \sim t \sim c_g(k_x,k_y) \sim c_{sp}(k_x,k_y) \text{ LPF} \sim b(k_x,k_y) \sim s_1(k_x,k_y)$

It is evident that the more patterns are successfully matched in these processes, by the signals listed above having frequency distributions in common, the stronger the final signal will be. This enhances the formation of memories, as well as triggers the retrieval of memories.

It also generates electrical fields represented by r_b and "~final signal" which may be able to account for the mental image the baby experiences of the memories stored in the nervous system.

This model accounts for emotions as signals which capture the low spatial frequency data of the system, therefore capturing large scale tendencies and giving rise to an ability for large-scale coordinated action, and lack of resolution.

The model accounts for memory formation and retrieval as patterns in frequency representation which can be associated with each other and unlocked by feelings or new sensory stimuli, and which have many known

properties of memories, such as non-local distribution across the brain, resilience to localized damage, and the seriality of thought.

This model is clearly simplistic and misses many complications. Furthermore, so far there are many aspects which are reasonable but not proven to be viable. It is intended as a first order approximation to identify the fundamental holographic nature of the brain and the mental pictures associated with consciousness.

iii. Information gathering and storage

The brain is known to rewire in response to its own electrical activity, a phenomenon known as neural plasticity. A holographic pattern thus hypothetically results from the spinal cord pulses interfering with sensory data every 3 to 6 seconds, and these provide the mental image of the mind's eye in this interval. Rewiring occurs at these moments, since this is when a coherent pattern is established in the brain neural network, and thus memories are formed at these intervals. There is hypothesized an emotional response to these same stimuli, which will be discussed shortly.

Memories here are defined as the periodic storage of these interference patterns in the wiring pattern of the brain. This wiring pattern changes, to some extent, with each holographic image formed at 3-5 second intervals. Therefore, memories are stored in their frequency representation within the structure of the neuronal connections in the brain. This structure has all the characteristics of data in frequency space: robustness to data loss, decentralized storage, and sensitivity to change detection, to name a few.

iv. Information retrieval

In this scenario, memory retrieval in the brain uses the same process used with filters designed to recognize images, such as in machine reading of text. A given memory is a pattern stored in frequency representation in the brain's neural network as an interference pattern between a sensory stimulus and a reference beam, and within the frequency representation many such signals can coexist in the same medium without mutually disrupting each other. Let's say one applies both a reference pulse from the spine and a new set of impulses from the sensory organs. To the extent that this new phase information matches a prewired neural pattern in the brain, the mental picture in the mind's eye will light up more brightly. In other words, images stored in frequency space in the brain are locks, and new input images act as a key. The brain will activate more strongly if there is a strong match. This is what we experience as retrieval of memories. It is a process triggered by a particular impulse from the environment.

b. The physiology of thought

i. The Specious Present
ii. Why is thought serial? We must move from one thought to the next in series, relying on familiar triggers to bring us back to an idea repeatedly.

The "specious present" is the name given to the special slice of time that we consider "now." Our sense of the present is distinct from the past and the future, neither of which can be directly experienced. The question of how long the specious present lasts for has been long studied, going back at least to James, Wundt, and others. James defines the specious present by what is *felt*. "...it is what we feel when we become aware of its (the present's) presence." James identifies the "nucleus" of self-awareness to be composed of the dozen-or-so seconds that have just past (1890:611), although his estimation has been considered more lenient than other such as Wundt, who have identified this duration as 3.6-6 seconds.

The specious present is the time interval within which we can have a single coherent thought. In writing this passage, an idea occurred to me that I wanted to retain, but it was necessary to complete writing the sentence at hand so as not to lose it. By the end of the current sentence, the new idea had been lost to my awareness, and I had no power to recall it. This is the manner in which the specious present works. We become aware of our surroundings afresh in each moment at intervals on the order of 3 to 6 seconds, and our previous contents of awareness are inaccessible to us. I timed the duration necessary to rewrite the passage at 11 seconds, providing an upper limit for the length of time ideas are retained in the specious present.

Within the framework presented here, the specious present naturally occurs as the length of time it takes the brain to perform a Fourier transform, as the spine illuminates it with a reference pulse of coherent electromagnetic signals from the spine. As the signals travels up the spine and passes into the brain, the holographic mind's eye is established in the brain's neural network, which process requires physiological changes in each neural cell due to the firing time of each cell. This pulse of electromagnetic energy passes through the neural net like blood being pumped into a complex capillary system, and the holographic mind's eye fades into form, providing an impression which is part of the process of experiencing a sense of self.

The process involved in creating this conscious experience of the mind's eye is the process of converting the frequency space representation of the contents of memory into a spatial representation. This process requires a finite amount of time, and gives rise to the experience of the specious present.

The above process is discrete, giving rise to one conscious experience. One must wait for the next pulse to have another conscious experience. *Between these, although sensory data input continues, one is not directly aware of it.* As I sit here, a train passes noisily in the vicinity. I realize that although that data enters my brain continuously, I only become aware of the details of that stimulus every 3 to 6 seconds or so, consistent with the timeframe of the specious present. When I realize the sound is there, I also *remember* in my mind's eye that the sound has been continuous over the past 3 to 6 seconds, even though I was not myself directly aware of its exist throughout that time period. The sound of the nearby train did not cease while my conscious mind was not noticing it. Once my mind notices its environment once again, I am conscious that the sound of the train had been there all along.

James says that the Self is felt. He also associates, I think, the Self with the Specious Present. Hence, the Specious Present is defined by what is felt. "...it is what we feel when we become aware of its presence."

It is also apparent to one who follows their own thoughts that these happen sequentially, one thought leading into the next. The contents of the previous thought are not accessible to one in the present experience of the specious present. In order to have a coherent chain of thoughts, one relies on the context of the situation—the ongoing sensory input—to provide consistency. Thus, it is easy to be distracted by the environment, as it is providing the main source of clues for the direction of coherent thought. If we lose a thought, we cannot simply recall it; rather, we must attempt to lead ourselves through a similar train of thoughts which originally led to the previous thought. In this way, with one thought leading to another, a given thought can recur as part of a chain.

The above description is consistent with the lock and key description of memory stored in frequency space representation. Both the environment and the current holographic image in the mind's eye present a source of input stimulus which acts as a key to unlock a matching pattern in the frequency space representation of one's stored memories. This matching pattern is activated as the next thought, leading to another key and unlocking another matching memory. A sequence of holographic images appear in the mind's eye, each triggered by the previous, giving rise to the experience of train of thought.

c. The physics of emotional reactions

The emotional system is a process for generating physical motivation. The chemicals which lead to motive power--oxytocin, adrenaline, seratonin—are released into a network quite similar to that of the neurons. They result in a felt sense of physical urgency in the body, inspiring muscles to engage. In a sense they seem to play a similar role to the mind's eye for the neural network of the brain. Not sure about this though.

4. Selfhood is a process

a. The sense of self

i. The sense of self is a combination of a holographic mind's eye and the identifications of felt experience

The definition of self above is a process of identification with mental images and felt experiences and the objects these correspond to. We have discussed the mental images produced by the mind's eye. These are holographic images within the neural structure of the brain which are spatial representations of current sensory stimulus or faithful reconstructions of past sensory stimulus. These holographic images interface with the endocrine system to control the hormones in the body that occur in response to the holographic mental images. The sense of self is thus a feeling associated with a mental picture in the mind's eye.

The mental images are driven on the 3 to 6 second cycle of pulses from the spine, so the sense of self is updated on this timeframe when a new mental image and emotional response arise. As James says, one identifies oneself with one's experiences. Thus, the sense of self is a dynamic process which exists only in the specious present, when one has a feeling associated with a mental stimulus.

b. The sense of self is not hierarchical

i. "Your loyalty to your liver is only insofar as it keeps you alive."
ii. A process is made of subprocesses, but the nature of the process does not reflect the nature of the subprocesses.
iii. A self is not an aggregate on many voices, it is one voice.

The self defined here is a process of stimulation from sensory organs appearing holographically every 3 to 6 seconds in the neural circuits of the brain, combined with an emotional response in the form of hormones in the bloodstream which provide a sense of physical agency.

Selfhood is a process. As such it is not hierarchical. One does not, in this model, consider that the cells, molecules or atoms have some thing called conscious awareness. *Matter is, by definition, inanimate, for "animation" is a process, not a thing.* There is no secret substance waiting to be discovered which animates either human beings nor electrons.

The process of selfhood can have many subprocesses which demonstrate intelligence, and can itself be a subprocess for a larger process of intelligent nature. The key is that these layers of intelligence are separate from each other, each arising from the process of selfhood arising at that level. Cells in the liver are involved in processes that may have an identity and may be considered a sense of self, but this self does not contribute to the sense of self of the human being. Similarly, a crowd of human beings may have an identity. A set of values may emerge for the crowd which motivate its actions. While the quality of the values that this crowd identifies with may depend on the quality of the individual selves involved in the crowd, the existence of a sense of self for the crowd is not made of the individual selves. It is a unique process which emerges from the interactions of the individual selves. The

nature of the process of being human does not reflect the nature of the subprocess of being a liver or of being a skin cell.

This is illustrated by considering a human being's sense of ownership of its constituent parts. A human being is only loyal to the cells or organs that make it up so far as those entities benefit its sense of selfhood. The human does not consider the liver as an essential part of itself, nor cells from the skin. Cells for the skin are continuously being lost with no impact on the sense of self of the human, and a liver may be replaced with a new liver without any impact on the sense of self of the human. This is consistent with the proposal that the self is a process, one which requires a certain set of machinery to exist but is not itself the machinery. The machinery can be replaced so long as its function allows for the process to be sustained.

Another way to see that the conscious awareness process which exists for the self is not inherited from the smaller subprocesses is that a self is not an aggregate of many voices, it is one voice. If I were a compilation of the conscious awareness of my liver, my skin sells, and each other subprocess, I would expect my sense of self to inherit qualities from each of those subsystems. To my awareness, there is no evidence of this in our exploration of psychology. Rather, it seems evident from first person experience that I am a singular entity with a singular voice. That voice may be influenced by many distinct subprograms, such as my reaction to eating pickled herring or my inexplicable preference for even numbers, but these are simply patterns stored in the frequency domain in the brain which are triggered under certain stimuli. The process of interaction between the holographic images in the brain and the physical-emotional system of hormones and muscles is a single process, giving rise to one stream of consciousness which refreshes approximately every 3 to 6 seconds.

c. Patterns/programs of belief

i. Beliefs are associations between stimuli and self
ii. When sensory stimulus is received, holographic mental images and resulting emotional responses appear.
iii. Personality: A single self may have numerous patterns of emotional response.

It is worth examining the concept of "belief," because what we believe factors in strongly to our behavioral choices. In the model presented here, beliefs emerge naturally as programs of identification. When an experience happens, we identify with the feeling we have from the experience, and thereby with the objects of the experience as well. This correlates to a pattern of stimuli stored as frequency information in the brain's neural structure.

For instance, if I take an emotional risk to ask somebody on a romantic date, and they turn me down, I will identify myself to some extent with the emotional experience that results. More influential even than the veracity of this information is the fact that I have identified with it. I call it me. It is a patterns in my neural structure in the frequency domain, and when a similar situation arises in the future that brings with it a similar emotional risk, that pattern will be unlocked and I will have a holographic image in my brain along with a felt experience which mirrors the previous experience.

The key is that we identified with an experience and our physiology is built to bring back that experience under similar stimuli regardless of its veracity in the current situation.

Belief is the tendency to assign truth to the experiences we identify with.

There are thus two possibilities when dealing with personal beliefs. One is to accept their veracity by choosing to act in alignment with the feelings triggered by the current stimuli. The other is to question their veracity by striving to gain information about what is really true in the current situation, and then choosing actions accordingly. There are many methods for doing this, for instance in the field of psychology.

Hoffman, et al have pursued inquiry into the relative viability of veracity versus "fitness" in the well being of an organism. It will be discussed in the section on "meaningful history selection" that beliefs influence choices which influence the likelihood of related physical circumstances, in which case *circumstances follow belief*. Hence, fitness is actually determined by belief, i.e. what we believe guides our actions and circumstances unfold with respect to those actions, making our actions fit with the world we ultimately experience.

The approach here differs from Hoffman's in that their model makes the assumption of an objective world out there which is influenced only causally by the actions of what they call the conscious agent, whereas here it is suggested that the world that is experienced by a conscious agent is one which reflects the choices made. Hence, in Hoffman's model, truth and fitness may be completely unrelated, whereas in the model of meaningful history selection one's identifying beliefs lead to actions which bias history toward a world in which those actions are indeed fit. Similar to Hoffman, fitness plays the dominating role, and truth only matters when a conscious agent makes a concerted effort to bring belief and truth into alignment.

5. Interactions: the building blocks of physical reality (some of this can be moved around to other sections)

- *a. Relationality*
  - i. To obtain definite physical results out of a multi-block universe, one requires that all interactions are mutual and relative
  - ii. Retroactive event determination
- *b. Holistic spacetime trajectories*
  - i. The block universe describes the entire existence of any object over time.
  - ii. The contents of physical reality are the interactions between objects in x- and k-space.
  - iii. The possible interactions that could occur are governed by the laws of physics and evolve via signal processing techniques.
- *c. The physics of "Experience"*
  - i. Experience is a definite interaction. Quantized.
  - ii. In the absence of an observer having an experience, there is a plurality of realities
  - iii. All experiences are interactions. Only interactions are physically meaningful. Thus, all experiences give rise to physically meaningful events

Relationality

Consciousness has been claimed to be a process of the "self" identifying with its experiences of the physical world. In order to more carefully define what is meant by "experience," we need to establish the "relational" nature of the physical world, as is done in Nelson-Isaacs (2019) and elsewhere (Mermin, Rovelli). In Nelson-Isaacs (2019) this is done through a generalization to the theory of quantum mechanics. One considers all physical systems as signals or information in an abstract version of space and time. Through the established tools of signal processing, one arrives at the conclusion that "Only interactions are real."

This statement has a long history with quantum mechanics.(Rovelli 1996, Mermin ?) Relational quantum mechanics highlights the notion that any physical measurement is an interaction between two entities; it is a private game of chess, not a football game in a stadium full of cheering fans. Each interaction defines a set of truths relative to the entities involved in the measurement, and nothing more. Other observers, when arriving on the scene and interacting with either of the players, would encounter the chess game from either one or the other players' perspective. For instance, witness "A" would observe the same board as the white player, and witness A

and the white player now have interacted. Their views are correlated. Also, because the white player has previously interacted with the black player (because they are observing the same chess board in common), witness A is now also correlated to the black player. There will be no arguments between any of the three people as to the actual state of the pieces on the board.

Should another person, witness "B", come on the scene, the process will be the same, as witness B interacts with either witness A, the white player or the black player. Within each interaction, all the laws of physics apply. But we are expressly forbidden in talking about "the objective state of the world." The world is always defined from a perspective. This implies that any item outside of one's perspective is described not as a single reality that is unknown, but as a collection of possibilities.

There is a "relationality" controversy within the field of quantum mechanics between theories in which the collapse from possibility to actuality is an objective process (if it happens for one, it happens for all) versus a subjective process (it happens from a given point of view). Here I take the relational view, within which the study of conscious experience is a study of interaction events.

Holistic spacetime paths

A holistic system is one whose properties depend on the entire entity, rather than being composed piecemeal from its parts. The importance of holism in physics can be illustrated by a simple experiment, the pinhole camera. One shines light from a scene through a small hole in an opaque material, and obtains an image of the scene on the far side, without using a lens. One therefore shows that each tiny pinhole of physical space contains the entire scene. No matter where one places the pinhole, all of the surroundings are captured. The hole can be made arbitrarily small, and it still contains the totality of information. One can loosely say: each part of a system contains a complete description of all of the system. In this section, we will formulate the related idea that the entire path of travel (the spacetime behavior) of an object is defined as a whole, much like the pinhole camera image is defined as a whole.

In Nelson-Isaacs (2019), physical objects are represented as a spread of information over an abstract notion of space and time. Imagine a map similar to the surface of the ocean, with peaks and valleys. This map encodes information about the motion of objects.[1] Importantly, this is a map not just in space but also in time. Motion is not a simple path *through* this map. Rather, the map is essentially a hologram of the actual path of motion of the object. Although the map *encodes* the way the object changes over time, the map cannot itself change *in time*, because it is a map over the time dimension. In other words, although the map doesn't change in time, from its overall shape one can infer how the system changes with time.

A hologram is a generalized version of a photograph. It contains a 3 dimensional picture on a flat piece of film, and if part of the hologram is covered or cut off, a blurry version of the entire picture can still be seen in the remaining film. The holographic picture is made from the whole film *all-at-once*, and each portion of the film contains the whole picture. A hologram works because it is not defined in physical space (or time), but in "frequency space."

Just like a holographic image is created by the hologram as-a-whole, not piece-by-piece, the spacetime behavior of an object is defined as-a-whole, or holistically. In other words, the beginning of the chess game and the end of the chess game are both defined at once, and the path from beginning to end is called a *history*. There are many possible histories, just as there can be many possible holograms, but each history exists as a whole.

This obviously has implications for our understanding of the past, present and future, which will be only lightly addressed here.

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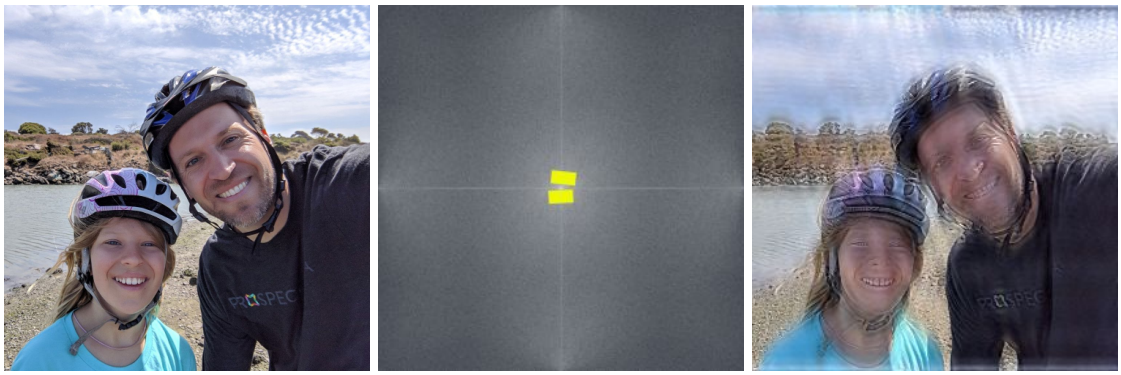
[1] This is a generalization of the wavefunction defined in standard quantum mechanics, but with important modifcations.

Because the entire "path" of an object through time and space is defined at once, it cannot represent something *actual*, for our experience of actual things is that they are specific to a single time and place. Rather, the path describes the *possible locations of interaction*. Only when we define an observer and interact them with an object is the object actually in a specific location on its trajectory. Stated differently, the physical path of an object through space and time is not an actual path but rather a set of possible locations where the object could be found if measured.

Light in free space, for instance, is constrained to be measured at points along a straight line as if it had travelled at the speed of light. Whenever we measure it, it appears to have traveled continuously to the location at which we measure it. Yet it is not valid to say the light travelled in between interactions. The light only exists in definite form when detected at some point along its "path."

A spacetime path can be thought of as a piece of recorded music which is decomposed into its spectrum. Frequency space describes the spectrum of frequency components of the entire audio piece *as a whole*. One cannot isolate certain *moments* of the song when looking at frequency space; any changes made to frequency space show up across all of space and time. If we introduce a new set of frequencies in frequency space, and then examine the effect on the corresponding sound in time, we find the new frequencies have effect over the entire piece of music.

Similarly, if we convert a photograph into frequency space and remove a very small portion of the information, we can have a big impact on the entire photograph, see figure.



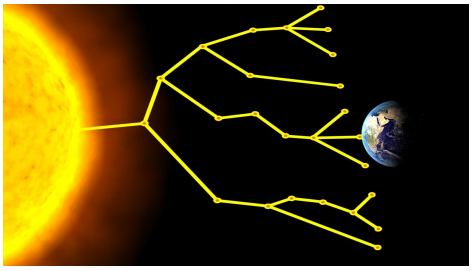
(Figure Caption: The frequency space representation of the photo of my daughter and I has a mask placed over two small regions, resulting in a major distortion across all of the photograph.)

Similarly, for an object in spacetime, each potential path is defined as-a-whole, and is just one of many possible paths. Out of the many possible paths, an interaction makes real one of the possible paths, from the point of view of the participants in the interaction. Only the interaction events themselves are real. These possible paths can be thought of as branches on a tree. Every branch of the tree contains the entire physical universe in a unique configuration, a unique set of circumstances.

Retroactive event determination

These all-at-once paths of travel lead to the description of relationality above: we can only know when and where the particle interacts from *our own frame of reference*. We are disallowed from claiming to know where the particle "actually" exists, even if we infer that "it must have been at a prior location in order to get here." For instance, a single particle of light (photon) travelling from the Sun to Earth may hypothetically branch many times along its 8-minute journey into possible new directions, yet none of these branches correspond to an *actual* location. When the photon is observed by us on Earth after 8 minutes have gone by, then an actual location is specified.

Furthermore, that interaction allows us to *infer* where the photon was, say, 4 minutes prior: it was halfway between us and the Sun. *But was it?* Without an interaction, no labels of "where" and "when" can be applied.



Just a millisecond *before* the measurement, the photon's recent history[2] could only be described as a collection of possible branches or histories, yet just a millisecond *after* the measurement on Earth the photon's history can be pinned down to a specific path between Sun and Earth. This is a process called *retroactive event determination*: the light's actual history becomes determined *after-the-fact* from the perspective of the person who experienced its endpoint on Earth.

Objects go from mere possibilities along a path to an actual measured entity only through interactions. *Information about location exists only for measurement interactions, not for objects themselves.* Further, location information exists only relative to those involved in the interaction. This is what was described earlier as relationality: all measurement results are defined with respect to a specific observing system; they are subjective. The observer is itself a system that is interacting with the environment, and these interactions can also be labeled with "where" and "when" they take place. The observer does not have objective reality any moreso than the photon. Only through their interactions with the environment do real events exist.

Consciousness meets physics

It is here that we are faced with the significant connection between consciousness and relationality. I just claimed that only interactions are real, so that there is no actual description of reality in between interactions. Yet there appears to be one fundamental exception to this: any conscious creature will assure you that they are real *all the time*. How does a conscious observers suggestion that reality exists all the time for them align with reality as defined only through interaction?

We can examine this dilemma through a related question, "What constitutes an observation?" Can a dust particle between here and the Sun be considered an interaction? The answer according to the relational model is that any interaction is a "relative observation" between the interacting entities. However, there is a fundamental difference between discussing interactions between two third-parties in some abstract sense, and discussing interactions made between *me* and a third-party. When *I myself* am involved in a measurement interaction, *I* always get a specific or definite result.

This is how we identify a conscious experience from a general interaction: a conscious experience always leads to a single result, not a collection of possibilities. Notice that it is always described from a perspective, *mine*. Here, the use of the pronoun "I" or "mine" is essential, because the pronoun always refers back to the self. From my perspective, I always obtain a single result from measurement, and hence I have the experience of a real world. Because of the use of the pronoun "I" and "mine", this statement applies equally to any conscious being.

By contrast, any interactions that *I* am not part of have a different nature: they are plural. There are many possibilities for how any given interaction can go, so long as *I* do not have information about it.

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[2] From the Earth observer's point of view ...

The concept of *me* as the primary observer emerges out of the relational models of quantum mechanics. In this model, the description according to me is not interchangeable with a description according to you. Describing a physical interaction from a first person perspective is fundamentally different from using a third person perspective, even though it is hard to make this distinction within verbal language. Something fundamentally different emerges when we introduce the *self* or first person entity into the picture. The physical description goes from a superposition of many possibilities to a single well-defined outcome. *This well-defined outcome leads us to the definition of experience.*

"Experience" is "a definite interaction"

Experience is at the heart of physics, and it is also at the heart of conscious awareness. One cannot describe physics in the absence of the experiences in which physical things happen. Physics is built on the back of *experiments*, which are rigorously controlled *experiences*. At the same time, in this paper, as laid out in the definitions above, having conscious awareness is equated with having experiences. It is taken as self-evident that as conscious beings we have precisely one perspective on the physical cosmos. For instance, we have two eyes which provide data for only one stream of thought. These conscious experiences therefore have the important characteristic that they are *singular*. We are located in one place and time, and we experience one set of circumstances of the physical world.

If we insist that our experiences are real (in fact, "experience" or "experiment" is how we define "real"), and from the previous arguments we conclude that only interactions are real, then our experiences must be interactions. But in physics, interactions can lead to many possible outcomes, whereas experience is always singular. Thus we need the following definition.

> *Experience is a definite interaction.*

According to this definition, all experiences result from interactions, but not all interactions are experiences.

What types of interactions are not experiences? Let's examine the case of two billiard balls colliding? W**hen we describe an interaction of two balls from a third-person perspective, it results in a plurality of possible outcomes.** When a third person perspective is used to describe an interaction, we cannot consider the interaction between the balls as an "experience." We can say, however, that the *third person* has the experience of the balls colliding. In the third person case, the collision itself is an interaction but not an experience, while the third person does have an *experience of* the collision.

Is there a sense in which the ball "experiences" the collision? From the ball's perspective, the collision with the other ball is indeed an experience if it results in a single possible outcome. But it only results in a single outcome from the perspective of the ball. Does the ball have "a perspective"? If physical reality is relational, then one can only experience one's own perspective. It makes no sense to compare these perspectives according to some "objective" set of facts. So the question of whether the ball has an experience is ill-defined, but so is the question of whether *you* have an experience. All that can be claimed is that *I* have an experience, by the very definition of the term.

A better question is whether the billiard ball has a *self*. The self is defined as "a process of identification with mental images and felt experiences, and the physical objects these correspond to." Without a brain or limbic system, the process of identification with experiences cannot occur, so the billiard ball cannot develop a process of selfhood. The utility of the term "experience" is thus questionable when describing a ball. It is useless to question whether billiard balls have experiences, because the experiences they would have cannot become a part of the process of selfhood. They have no physical machinery with which the necessary identification with experience can happen.

So it would be strange, but not wrong, to say that there is a perspective from which a billiard ball experiences a definite interaction. Certainly the first ball obeys the laws of physics as it strikes the second ball, but without a process of selfhood, we inevitably return to the question of how it is experienced from a third person point of view, by *me*.

Would a physical world exist in the absence of observers with brains and limbic systems? Following in the steps of Neils Bohr, we can ask "What does it mean, "to exist"? The universe is a collection of possibilities. That is what exists. But real experiences only occur when a perspective is taken upon that collection of possibilities. In this sense, "the objective multiverse" is distinct from "the realness of the world we experience." In the world we experience, experience itself defines what is real.

A slightly different way to pose the dilemma is this. When a tree falls in a forest and nobody is around to hear it, what we mean is that an interaction between the tree and the ground is occurring from a third-person perspective. Since "nobody is around to hear it," no first-person observation is being made, and a *multiplicity of possible outcomes* result from the interaction. The tree is in a superposition of "fallen" and "not fallen". If a person arrives on the scene, a first-person description is made of the scene from the outside, and only one singular outcome results: the tree has fallen, or maybe it hasn't. Either way, something definite has occurred. The first-person perspective by the tree itself would be described as an "experience *by* the tree." The third-person description by the human would be described as "an experience *of* the tree." The question "If a tree falls and nobody is around to hear it…" points to the third-person description *in the absence of a third person*. Therefore, an *interaction* may have occurred (between tree and ground), but there is no *experience* of that yet (because we are asking about the *person's* perspective and the person has not yet arrived).

Quantized experience

Conscious experience is related to *definite interactions*, and interactions are discrete events. The path of a billiard ball, for instance, involves continuous motion punctuated by specific interactions with other balls which change its direction. Experience is therefore, in this sense, quantized. It comes in discrete chunks corresponding to each interaction of the observer with the environment.

However, one would consider conscious experience to be continuous, in the sense that if one sits down to watch a clock, one will see its second hand continuously spin around in a circle. Is it possible for experience to *appear* continuous if it is quantized? The explanation is simple but subtle within the integral transform framework in Nelson-Isaacs (2019).

To understand this, think of what we usually mean by an object being "still." This means the object is sitting in one place and not moving. In relativity it is known that one can switch reference frames and find that an object that is still from one reference will be moving in another reference frame. But there is more. In the theory proposed here, "still" is more correctly described as "moving without interactions." The key element of the holistic trajectories described earlier is that any point along the trajectory is equally true, without preference to a special "now" moment. This type of motion along a trajectory happens "for free" along the path. In other words, the trajectory defined as-a-whole cannot tell us where the particle is, it can only tell us the entire range of possible places. "Still" therefore means "moving along a single trajectory."

Imagine a world where everything is moving along its own single trajectory. A billiard ball rolls on a table. A baseball flies through the air. We perceive continuous motion because each object continues to evolve its spacetime location continuously according to the trajectory it is currently on, even though we only measure it at specific intervals. Say we see the ball leave the cue, then a moment later we see the ball hit another ball. The rolling of the ball is described by continuous motion because it involves motion along a single trajectory or path. But from the perspective of physics, nothing is happening. Each observation of the ball is essentially a snapshot of it. In

between snapshots, it is only the potentia that keeps evolving, not the actual location of the ball. The "actual location" of the ball is only updated at the discrete moments at which we choose to look. These are the discrete experiences.

One can say that the "time of experience" is quantized. Time only advances when an experience is had. But imagining quantized time is counter-intuitive in the following way. When imagining time as discrete, one usually thinks of a still snapshot of a bunch of objects shown frozen in space. A series of quantized moments would be like the frames on a 35mm filmstrip, each containing a different still-life scene.

That is incorrect. A "discrete moment in time" is not a photograph of objects frozen in time, but a collection of objects moving freely and minding their own business. "Frozen" spacetime really corresponds to motion with no interactions. This motion is continuous, so we perceive a continuous world. If we turn our eyes away, the ball still follows the path dictated by its holistic path. There is a notion of time which continues in the absence of an observer. This is the time by which the ball computes its proper motion along the path. But this is a time which measures *potentia*, not reality. For that we need the "experiential time", which is quantized.

Whereas in the absence of interaction, the ball continues unperturbed along its predefined path, *changes* to this motion are discrete. These changes result from definite interactions, or what we have called experiences. Experiences *are* these discrete interactions at which time advances. This is perfectly compatible with the continuous "experience" of space and time itself that we perceive every day, so long as we take the relational perspective discussed here, in which interactions are the only physical reality. Mermin says "Correlations have physical reality. Correlata do not."(Cite Mermin)

At the Exploratorium science museum in San Francisco, California, they have a fun exhibit for kids that we'll call an "impression board." It is a dark room with a wall made of white phosphorescent material. There is a timer which counts down repeatedly from 30, and when it hits zero a bright flash of light illuminates the room. Participants get set into statuesque poses, and when the light flashes it creates a silhouette on the phosphorescent wall behind them. The silhouette is strong at first, but gradually fades from view until the next bright flash captures the next scene, 30 seconds later.

This can help one visualize how the physical world evolves through interactions. Just as the impression board is very sharp after a flash occurs, any *interaction* that an object has with its environment leads to a distinct updating of the surrounding world, or a "flash." But just as the impression board gradually fades, an object's picture of the environment grows fuzzy as every potentia in the environment evolves over time, until the next interaction. *Experiences* are a subset of these interactions, those which take definite form from a particular point of view.

6. Shaping the self through interactions

a. Interactions are about mutual shape conformation

i. Physical example: water and shore
ii. Example from quantum measurement: selecting eigenstates during measurement
iii. Example from signal processing: Band pass filter, Windowed Sinc function

The concept of "identification" has been utilized in the definition of the self. Next we will examine the idea of identification more closely, with a rigorous definition rooted in physics.

Consider the shoreline of an ocean. Imagine a water wave approaching the shore, in more or less a straight line. The wave's initial shape is a result of the forces present in the wide expanse of the open ocean where there are no obstacles to bend it. But after the wave interacts with the shoreline, the wave takes on the form of the shore. The specific shape of the rocky coastline forms an *impulse response* as described above, and the interaction between the incoming water wave and the coastline is known as a convolution integral, to be described in more detail in a

moment. The waves that have bounced off the shore are essentially drawings of the shape of the shore. We could say the incoming wave "identifies" with the shape of the coastline.

The process of identification is mutual. The shore also takes on the form of the wave through the process of erosion. Any portion of the shore that doesn't match the initial shape of the incoming wave takes the greatest force in the process of deflecting the water, resulting in erosion of the shoreline to match the water waves. The impact is different on water and rock because each material is so different. Nonetheless, this is a process in which the shape of the water waves and the shape of the shoreline gradually "identify" with each other.

Identification in quantum measurement

For those familiar with it, these same ideas can be seen in the formalism of quantum mechanics. Quantum mechanics finds the essential result that when a measuring tool interacts with a quantum system like a photon of light, if the photon starts out in a combination or "superposition" of all the potentially allowable properties allowed by the measuring device, by the end of the measurement process the photon displays only one of these properties.

We can think of this in terms of shape. The shape of an apple describes how the apple is extended in space, typically described in terms of particular values for length, width and height. A quantum object like a photon is described in an abstract version of space called Hilbert space. It's "shape" in this space is defined particular values for its basic elements, known as eigenvectors. It is well-known that any shape can be "decomposed" into more basic shapes using methodologies related to the Fourier transform. One can describe the shape of an apple using different basic shapes, for instance either the basic sine waves or what are known as the spherical harmonics. In either case one can come up with a good approximation of the apple's shape.

Similarly, any complete set of eigenvectors can be used to describe a quantum system, by giving each eigenvector its own value. Together, these weighted eigenvectors describe the various possibilities for the photon. We can think of this as its "shape."

In an interaction between two things, say a photon and a measuring tool, one thing decides upon the basic shapes used to describe the other. In the example with the waves hitting a shoreline, the shape of the shoreline decides which basic shapes make up the outgoing waves after they hit the shoreline. Similarly, we usually think of a measuring tool deciding the basic shapes by which we can describe the photon after the two interact. The shape of the photon is described in the eigenvectors determined by the measuring device. For instance, the "shape" of a tool that measures the polarization of light will generally be described by two possibilities, such as vertical or horizontal polarization. Here is the key idea: by writing the photon in terms of vertical and horizontal polarization, the photon becomes identified with the measuring tool. By the end of the measurement process, one and only one of these possible eigenvectors actually occurs, and the final state of the photon is therefore constrained by the "shape" of the measuring tool.

The entire formalism of quantum measurement is therefore a process by which two systems identify with each other through the process of interaction. The photon "takes on" properties of the measuring tool. This process can be understood through the field of signal processing, by which a photograph or piece of music is modified by a filter.

BAND PASS/WINDOWED SINC

System A (the "measuring device") is described by an *impulse response* which describes how it responds to the simplest possible disturbance. If we want to analyze another signal, B, using signal A, the two signals are mixed via a *convolution integral*. The convolution process is essentially a comparison of shapes. The mathematical process of convolution has been also known as Faltung, or "folding" in German, emphasizing the essence of conforming one

shape with another. The result is that signal B is written in terms of the shapes that would naturally be used to describe system A.

An important example of a filter is a low pass filter. This filter is like a step in a staircase. It has the value 1 for all the low frequencies, and the value 0 for all frequencies above a certain threshold. The shape thus described is in the frequency representation. In the spatial representation, the corresponding shape is called a sinc function, which is a sinusoidal wave that decays is either direction from the center. (See figure) This is the signal that we must convolve with an arbitrary second signal to filter out the low frequencies from the high ones.

When these signals interact, the resulting signal has properties of both. It has the shape of signal B, the one that we want to analyze, but it also has the properties of signal A, namely that all the low frequencies are removed. We could say here that signal B has become identified with signal A, and vice versa. Signal processing is therefore the process of two signals mutually identifying with one another. Furthermore, in (Nelson-Isaacs 2020) it is proposed that quantum mechanics is a theory of signal processing, where all physical entities can be represented as signals. In this way, the fundamental physical description of reality is a process of mutual identification between interacting signals.

b. Interaction also alters the shape of the environment

i. Defining the shape of the environment: its eigenstates
ii. **Identification Postulate**: Felt experience of an object is equivalent to the object
    1. Not only does the self's identification with felt experiences, as James says, define the self, so also does this identification define the experiences.
    2. Felt experience of an observer changes the shape of the environment via mutual shape conformation
iii. Felt experience is a holistic property, not derived from the sum of its constituent parts. It may be suddenly true as if it were always true.

Let's try to connect the dots between identification of signals in the simple examples given above, and the definition of self as "a process of identification with mental images and felt experiences, and the physical objects these correspond to."

It has been presented here that mental images are literally holograms inside the neural net of the brain. It is easy to see how this can be understood as a "signal" in the traditional sense, for it is an array of data points. We have also seen that the traditional process of quantum measurement can be written in terms of the signal processing language. (Nelson 2020)

Can this same approach apply to macroscopic systems? Can this approach apply to the entire environment?

It is well understood that quantum mechanics is a linear theory. In principle this means there is no limit to our ability to combine microscopic systems which we know obey quantum mechanics in order to obtain larger objects which should also obey quantum mechanics. In practice the theory of Decoherence has been developed to explain why we apparently don't see these quantum behaviors at a macroscopic level.

It has been argued in (Nelson 2020) that the process of a system taking definite form in a quantum measurement is a relational process, meaning that the change that occurs is only relative to another entity. From a wider perspective, no definite state has been chosen, and a conspiracy of ever-widening correlations ensues.

In the microscopic model, the eigenstates are the allowable results of a measurement, and are defined in a specific and rigorous manner. The eigenstates of a macroscopic system, on the other hand, are hard to identify, and I will

not be able to do so here conclusively. They are defined in the same manner: the eigenstates of a macroscopic interaction are the various possible ways that interaction can result.

It needs to be understood that macroscopic quantum mechanics, like the hologram in the brain or the timeless trajectories described earlier, applies to macroscopic objects as a whole. We do not apply quantum mechanics to each of the individual particles, each with their own measurement operators, and then add up the effects. It is well known that such an approach is doomed to failure. Rather, the interaction between two macroscopic objects is a single measurement, and described by a single measurement operator (which we will not be able here to mathematically define) and which has a set of possible macroscopic outcomes.

You may ask, how can there be many possible outcomes for such an interaction when the laws of macroscopic physics are deterministic? It needs to be remembered that because this process is relational, objects around us in the "environment" have evolved into a plethora of different possible states. So we are interacting with an environment whose macroscopic states are undetermined from prior such measurement interactions that we were not part of. These lead to unpredictable available outcomes at the macroscopic level.

Finally, to connect to the previous discussion, it is these sets of available outcomes that define a sense of the "shape" of the environment. These are the branches of the tree of possibilities.

We now define the second postulate.

Identification Postulate: Felt experience of an object is equivalent to the object

Here it is being said that not only does the self's identification with felt experiences define the self, as per W. James, so also does this identification define the experiences. In other words, the felt experience of an observer changes the shape of the environment by defining what the allowable possible states are and selecting between them.

To restate a key point from above, only from a subjective point of view can an interaction be equated to an *experience*. In this section we go further to say that experience defined this way is a process of mutual identification between a conscious observer and its environment: the conscious observer takes on the shape of the environment, and the environment "takes the shape of" the conscious observer. This leads to the phenomenon of synchronicity, in which the circumstances in the environment reflect the inner qualities of the conscious observer.

I will try to be explicit here. Picture yourself walking into a crowded room at a party. Maybe you immediately feel insecure and watched, or maybe you feel welcomed and appreciated. Either way, your subjective experience of the room is formed from specific interactions you have with some elements in the room: you take on a qualitative (emotional) state in relation to what you perceive.

Your subjective experience of the room is analogous to the interaction of the photon and the measuring tool described earlier, or the convolution of the two signals. In that case, we said that the final state of the photon is equivalent to one of the states defined by the measuring tool. Here, we suggest that when you walk into a crowded room, the qualitative state of the room (the "photon") can only be interpreted through one of the qualitative states pre-defined by your own experience of it. The qualitative nature of the circumstances in the room are "equivalent to" your interior experience, because the macroscopic possibilities available from your interaction are determined by your experience of it. This, in turn, results from the mental images and emotional responses you have when you walk in the room.

I encourage you, the reader, to *feel* the way in which this is the case. While we generally assume that our feeling when we walk into a room is irrelevant, except for instance to the extent that someone in the room can pick up facial cues, instead picture that the whole room has a quality which reflects your feeling. This quality of your feeling is not only associated with you, it is associated with *the room*, as you experience it. Again, relationality is central.

The quality you associate with the room is associated with the room as it exists from your perspective, and this is the reality of the room. There is no other "room" that exists independently of your perceptions of it.

One might complain that some physical mechanism must exist for a conscious entity to be able to objectively influence the room. However, one is forbidden from talking about the objective quality of the room, without defining a perspective. The room only has physical reality in its relationship to other entities. We must define the room relative to you, and the room takes on a quality, relative to you, that you bring to the relationship. There is no physical mechanism such as a force guiding this process. Rather, the process of mutual identification between the shape of the observer (you) and the shape of the environment plays the key role.

To take the example further, if you notice people in the room looking at you and you feel insecure, there is a qualitative sense in which the room becomes threatening. This decomposes the states of the environment according to those which match this experience and those which do not. Through a process called meaningful history selection, to be described shortly, an outcome in which an embarrassing event occurs will become more likely. You might decide to open a bottle of wine, and the bottle spout breaks in your hand and spills wine and pieces of glass. You now feel embarrassed. An apparently random bad luck experience such as this may in fact be a qualitative experience which accurately reflects the qualitative experience that you felt walking into the room. *Physical circumstances* are preferentially selected in order to make a certain *qualitative experience* occur.

What about other "Selves" that are also present in the room? Doesn't their felt experience identify with the room as well, and bring about physical circumstances to match their experience? Yes, but in the relational model, one cannot compare two differing perspectives. One cannot discuss the room as an objective entity being impacted by the different selves. Reality itself *is* the experience that a self has with its environment, and the environment does not exist in an objective sense independent of an observer.

This is captured in the identification postulate, "felt experience of an object is equivalent to the object." One could also say, "the experience of an object is not distinguished from the physical object itself." One cannot separate the description of the environment relative to a subjective observer from the felt experience of the environment by the subjective observer. In the quantum measurement process, this is like saying the measurement doesn't *lead to* the measurement result; the measurement and the measurement result are one thing. *The process of experience gives rise to the possible states of the environment.*

The environment *is identified with* the process of self. One cannot exist without the other, for a property does not exist in definite form without an *experience* of that property.[3]

c. Self-identification and filters

i. Shaping of the holographic brain through sensory stimulus and emotion leads to identification of self with certain qualities
ii. Fourier Filters: Input stimuli is processed according to these identified qualities or associations ("feelings, beliefs"). Lock and key.
iii. Actions are motivated by the impression made on the self based upon the filters existing in the self by which the stimuli is processed

The picture painted here is now summarized.

Events in the physical environment enter as sensory stimuli into the brain of the observer. These signals interact with a reference beam of neural pulses from the spine to create a holographic representation of the sensory stimuli

[3] Cite experiments on Bell's theorem

within the neuronal structure of the brain. The neural activity triggers the release of hormones throughout the body which provide a capacity for agency through motivating the body.

Self is a process of identification with these mental images and felt experiences, and the physical objects these correspond to. Through this exchange, the environment also reshapes itself. The quality of experience associated with the observer defines the array of physical events available to occur for the observer, the extension of eigenstates from traditional quantum mechanics.

Through repeated cycles of experience, one's "personality" develops. The personality is composed of patterns of behavior stored in the nervous system (in frequency representation) that are unlocked or triggered by physical circumstances. These patterns are a combination of images in the mind's eye and physical senses in the body resulting from chemical signals (i.e. emotions). Our personality is a collection of mental and emotional responses that arise from stimuli in daily experiences, and these seem complicated because those patterns of response are stored in a form that is not accessible to us except when triggered (the frequency representation).

In storing these mental and emotional patterns in the nervous system, one associates themselves with these patterns. This is what is meant by the definition of self, "Self is a process of identification with mental images and felt experiences…", because the mental and emotional patterns we process actually become patterns stored in our nervous system. These become part of our response system known as the personality.

7. Attention, Meaningful History Selection, and Accuracy of Perception

a. Attention

i. The qualities are emotional in nature, and they interact with and give form to the physical circumstances.
ii. It is not the object knife that carries the quality of the knife but the perception of the knife by an observer.
iii. The qualities of things come from our attention
iv. By experiencing the thing a certain way, this defines what it is.

Based on the proposal so far, experiences are interaction events which are viewed from a first person perspective, and create an identification between the observer and the environment. The observer develops mental and emotional patterns in response to the experience, and the environment is mutually affected by those mental and emotional patterns in terms of the possible configurations that are likely to occur. This whole picture is described as a "quality of experience."

Next we note that the quality of our experience is not only informed by the present experiences. This process happens within a context of two other important factors: our attention, and our past experience.

Our past experiences are very influential in how we experience each situation, since the sensory input we receive from the situation highlights old patterns in the frequency representation of the mind and turns them into holograms in our mind's eye. If this was the extent of the process, then it would seem at first glance that we would be doomed to repeat past experiences inexorably.

We do not repeat these patterns inexorably, but why not? Where does our choice come from. On this point, I can only sketch a few ideas.

Why do we change? And how? We do so when our current feelings and thoughts motivate us to try something different. The incoming sensory data triggers past experiences that may have nothing to do with current circumstances. If we see the emotional reaction we are having, we have the ability to choose differently. By "choose" I mean to direct our attention in a different way.

Attention is our ability to direct our physical body to control which sensory input it takes in by adjusting its sensory organs. It is also an ability to steer the mind's eye back to a previously held holographic image or feeling. Our attention is a great asset, for wherever we direct our attention, our experience of that thing necessarily defines its very qualities. If I focus on watching my child, I will have an experience. It is very probable that I will have an emotional response of some kind, which may prompt me to say or do something, the response to which from the environment is constrained by the experience I had. If my attention on her is critical of her appearance, it is quite likely that I will filter all future incoming data through that lens, and possibly contribute to the situation through a comment or action.

The evolution of the macroscopic world is highly impacted by the placement of our attention. Our attention requires the environment to exist in "eigenstates" that are defined by the qualitative experience we have of it.

In this model, our free will is our ability to direct our attention. The process of interaction between the neural hologram in the brain and the limbic system has the ability to affect physical action in the body in response to preprogrammed patterns embedded in the memory.

A key element is not fully explained: What is the ghost in the machine? The sense of I that develops and which identifies itself with its context and environment. What is it?

b. Meaningful history selection

i. conscious beings have the capacity to take previous experiences of a certain quality and change the quality of new experiences through the exertion of attention.
ii. Our attention chooses what objects in the environment to focus on as well as what inner emotions to focus on.
iii. This is a process I call meaningful history selection, and leads to the experience of meaningful coincidence or synchronicity.
iv. meaningful history selection is not physically causal. It could be said to have "causality of experience," or "causality of meaning,"
v. Our mental and emotional worlds create representations in k-space. These are indecipherable from representations of actual physical circumstances.

This brings forward a central, and controversial, proposal. Not only does our attention define how the possible branches of history of our environment are *defined*, it influences how they *unfold*. In other words, it is proposed that the quality of the subjective experience influences the amplitudes of the quantum description of the environment. This framework is to be published in (Nelson-Isaacs MHS 2020).

This process results from the subjective observer landing on a specific cognitive interpretation of their surroundings. Like an optical illusion which can appear to look different from one moment to the next as the brain chooses between the perspectives, a given set of environmental circumstances will look different depending on which emotional memories are focused on. There may be many potential triggers to choose from. For instance, if you are a student and the teacher calls on you to answer a question, you may have some experiences where this

was traumatic, but you also likely have experiences where this was a pleasant experience. The traumatic experience will likely have been accompanied by high levels of stress hormones which lead to a stronger memory pattern in the neuronal structure of the brain, so this memory is more vivid when recalled. Nonetheless, like the cubic optical illusion, many patterns coexist, and it is up to the subjective observer to pick out that which it chooses. This choice is largely automatic, except that it can be influenced by the subject's attention.

This choice of perspective or interpretation of the qualitative content of the experience not only determines the responding actions of the observer, it influences the "shape" of the environment. Physical circumstances become more likely to unfold which match this qualitative content, since this is precisely how the observer and the environment mutually identify with each other. In our example, if you, the student, choose the interpretation based upon previous traumatic memories and the accompanying stress hormones, it influences the probability of something occurring which gives a recurrence of those stress hormones, such as the teacher asking a question about the only chapter in the book you didn't read the night before.

8. Distinguishing the holographic brain from the self

a. *Self is a process of identification with thoughts and emotions.*
b. *Interior data (emotional/chemical and cognitive/holographic) is equivalent to the external circumstances/objects of perception. (Postulate)*
c. *The holographic brain is a thing, made of the mass of the nervous system and the emotional system and also the physical electromagnetic fields. Probably includes both the physical substrate for both thoughts and emotions.*

9. Problems with the approach

a. How is language cognition explained in this model?
b. How are abstract concepts represented in the holographic mind's eye model?
c. What is the nature of emotion? Is it chemical?
d. The mystery is contained in the Identification Postulate.
e. If the mind's eye is a holographic em pattern, why don't I see your mind's eye when I stand next to you? Is it because my neural circuit and inverse fourier transform is not identical to yours, so the inverse transform is gobbledygook? Or is it because the hologram doesn't exist in free space but rather in the "space" of the neurons in the brain. Therefore one person's brain is always different from another's, and the data wouldn't be coherent.