Article

The Language Expansion Required to Make Progress in Science

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Abstract

Positivists introduced the differentiation between theoretical and observational language statements to emphasize the difference between what we observe and how we explain those observations. This differentiation is inadequate to describe the processing phases one executes in order to know the world. The collapse of multiple meanings into identical symbols has obscured the subjective reality we actually experience within an objective framework. It is the fusion of observation and theory that produces the objects we see. Once fused, we think objects are fundamental and forget our own role in making them appear. The multiple-meaning collapse of words we use to describe reality has prevented science from properly integrating mind and body in an event-oriented world view that grasps both aspects of the reality in which we exist. Expanding our language to allow independent identification of mental versus physical phenomena is the prerequisite for allowing scientific theory to advance our understanding of the total reality in which we live.

Keywords: Language expansion, progress, science, positivist, observation, differentiation, mental, physical, phenomena.

1. Limitation of Objective Language

The English language as taught in school and used in general discourse is specifically designed to describe an objective worldview. This view assumes that moving material things and their influence fields are all there is "out there" and will continue to be "out there" whether we live or die. Both classic physics and quantum physics have been developed to describe and control the world we experience by eliminating the subjective observer and attempting to explain all phenomena from the properties of objects or probability packets, both of which are thought to exist independently of our involvement. The logical inconsistencies of these theories to properly explain what we actually see have been cited by many authors. The hard problem of consciousness (Chalmers 1997), the explanatory gap (Levine 1983), and the elimination of the observer from physics (Stapp 1993) are only a few of the many logical critiques that point to the assumptions built into our mainstream theories that patch over logical difficulties, which would be called miracles in any other discipline.

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To show how our language enforces such irrational assumptions, consider an individual resting on a balmy beach looking up at the night sky. If asked what he sees, he or she might say, "I see a moon embedded in a beautiful firmament of stars." When asked, "Where do they happen?" He or she might answer that the moon is many thousands of miles, and the stars, many light years away. What such an individual actually experiences are blobs and dots of light that happen in his here and now. The blobs and dots of sensation are referred to as qualia, and such words are categorized as observational language. The fact that such sensations are immediately called moon and stars clearly shows that the words we use to identify our world are theoretical (Carnap 2000). We generally characterize the actual sensations we experience in terms of the objective theory we have been taught and then go on to believe that our theories express the truth.

Our example is not a contrived demonstration but rather a description of what we almost always do. We hear a tinkling sound and say, "I hear a bell." The bell is an object causing the sound not what we hear. In general, when we experience a sensation of our native language we immediately construct its meaning, while the same meaning expressed in a foreign language is heard as the sound. I've often heard physicists claim they are looking into an atom when they are looking at the display screen of their measuring apparatus, or an astrophysicist looking at dots on a photographic plate and claiming he is looking at some phenomena millions of light years away. We speak and communicate almost entirely in the objective terms of the theory and world-view we have been taught and believe we are describing reality. This immediate jump from sensation to explanation happens so fast that we fail to notice the incredible amount of processing the goes on behind the scenes to allow us to use our consensus reality terminology in useful ways.

Unfortunately, whether lounging on a beach at night or looking at experimental data from a measurement apparatus, we fail to acknowledge our role in creating what we see because it happens so fast and because we only have terms to describe the past and future end points of the epistemological process that actually generates what we experience. The limitation of our language obscures what we do when we see or experience, and we believe things just happen. Most readers will say, "These words, here in front of me now, happen because they are there." How they came to be here-and-now as tangible objective little objects in front of us is forgotten because we do not have the language structure to accommodate the processes actually happening.

2. The Proposed Language Category of Expansion

Contemporary English language contains word categories like noun, verb, article, etc. Following Wittgenstein's language empowerment concept, each of these word categories are used to implement our own language-based model of reality that is being executed by members of the language user group. A configuration of nouns -- man, earth, moon. sun. stars, and whatever dark material imbedding it all -- is shown as a cartoon circle in Figure 1. It is a graphic representation of the 'Now' instant given an objective user's world view. In addition to the classic 'body' of a 'man' holding an 'apple' on the 'earth' surrounded by a 'space' filled with 'stars', the figure contains the image of his mental 1st-person experience in a thought bubble. Here, his field of view contains an '**a**rm' holding an '**a**pple' with the tip of his '**n**ose' as seen from his left eye.

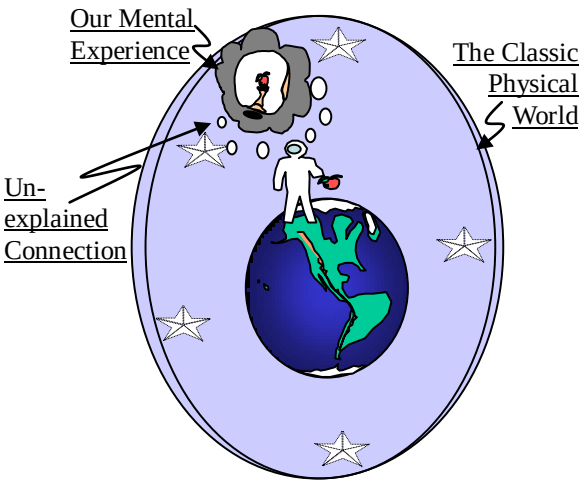

Fig. 1. Man standing on the Earth holding an apple

The reader will notice the words naming mental sensations in Figure 1 are written with boldface first letters. The noun category expansion was first introduced as a suggestion for expanding the German language (Mitterauer 2013) and later used in the development of Conscious Action Theory (Baer 2020), which is an action formulation of physics that integrates the mind and body in a single comprehensive framework. The noun codes suggested in these theories identify four categories of entities that happen in the thought processes resulting in our everyday view of the objective world around us. These codes are listed in Table 1.

Table 1. Definition of noun codes appearing in Thought Processing Phases

Example	Definition	Description
Apple, **M**an, **S**tar	Capital bold first letter	names the memory model entity which stores the explanation of the 1st-person sensation; processed into a memory recall sensation.
apple, **m**an, **s**tar	Lower case bold first	names an immediate observable letter sensation or qualia; processed from external sensor interactions
apple, man, star	Lower case	names the visualization of the meaning of the memory model entity; projected onto sensations producing objects seen in our every-day experience.
Apple, Man, Star	Capital first letter	Names the real entity out there beyond our sensation and explanation; names the Kantian unknowable thing onto itself.

The meaning of the lower case codes were reverse from their original introduction in order to match existing English language conventions as closely as possible. Normal English uses lowercase letters to reference general categories or concepts of things seen or felt, but not specific actual examples. Hence such references are intrinsically mental. Capital **bold** letters are often use in mathematical physics as a dyadic or tensor to model real things. Hence these refer to actual reality model components and theory parameters. Lower-case **bold** letters have no grammatical equivalent but are necessary to separate the sensation one experiences from its projected explanation. As demonstrated in the last section, the interpretation of a sensation, such as a **s**ound, into its explanation, such as a bell ringing, happens so quickly that we normally simply experience the resulting fusion of external and internal experiences. Separating the fused external and internal conscious experiences is necessary in order to become aware of the mental processing executed through the model of reality in our everyday lives.

Using these codes, we are now able to expand sentences like, "I see an apple." into, "I have an **a**pple sensation that is remembered in an '**A**pple' whose meaning is the 'apple' object I project to identify its really out there." These three forms describe processing stages internal to the observer. The ultimate cause of these experiences is that some real external Apple causes the Observer to process and display his or her sensor interactions into a conscious **a**pple experience. Un-bolded capital letters are used to name the real thing in conformance with the capitalization rule for names in English. When something is given a name, there is an implied reality associated with the thing named. The expansion of pronouns provides some interesting examples. The 'I' is normally capitalized, which in this code expresses the fact that whatever else may be true at least 'I' am real. When You, dear Reader, are also real and My interaction produces in You these **w**ords, which You remember as '**W**ords', and their reality as objects will be expressed as the 'words' you see. The suggested use of these codes when imbedded in a paper written in English is to enclose the symbols in single quotes when applicability of code meanings is to be emphasized. Otherwise, normal English interpretations suffice for non-bold first letters and bold letters always identify memory and sensation entities.

Of special significance is the use of capital names such as 'Apple' or 'Reality' as Kantian things-onto-themselves. Such symbols refer to intrinsically unknowable items because we cannot get out of ourselves to directly experience the cause of our sensations. These symbols are referred to as operational symbols in Conscious Action Theory or "use symbols" by Wittgenstein (Johnston 2007). The meaning of such symbols is not referential. That is, there is no demonstrable experience one can point to that is its meaning. Therefore 'Apple' does not mean there is an apple object out there. We do not and cannot know what 'Apple' actually is. Instead the meaning of such symbols can be found in their *use* within the symbol system one's thought process operates. Such use is directly tied to the physical properties of the object endowed with symbolic significance. The word 'Reality' is not the composite '**R**eality' that names model symbols each observer maintains in memory, nor is it the 'reality' one visualizes as one's worldview, or the '**r**eality' of one's life sensations. Instead it refers to that directly unknowable entity beyond one's sensors, which can only be seen when that actual 'Reality' interacts with one's actual 'Sensors' to produce observable **s**ensations. Mathematically a symbolic interaction function (Interaction(Reality, Sensor) = **s**ensation) must have been executed to produce observable results and only observable measurement results can be compared with one's memory model output.

The following C-code computer statement expresses the scientific method using the noun expansion codes introduced in this section.

Eq. 1
```
While (sensation =Interaction(Reality, Sensor)) - (sensation = interaction(Reality, Sensor) == 0{
        Then ( Reality = Store (Reality); exit;// Reality in your model is correct
        Else ( Reality = Correct(Reality); continue; // Reality is not correct and must be updated
}
```

It states that when our model of reality using its current '**R**eality' and '**S**ensor' information calculates an expected sensation that exactly equals the result of the real 'Reality' interaction with our real 'Sensors', then we have an accurate model of the real 'Reality'.

Once the expanded noun types are explicitly introduced into our language, the fact that we calculate the perceptive world we experience, in which we then believe to be living, becomes expressible in a direct and unambiguous manner. Once expressible in our language, specialized theory codes can further be defined to develop the mathematical structure of a process or event-oriented physics. In such a physics, the operations executed by the 'Observer', creating his perceived world view and then developing a theory that explains it, are all included.

3. Summary of Event-Oriented Physics

Development of a process or event-oriented physics is an ongoing project that has been taking place since the emergence the Copenhagen School of quantum theory suggested, but stopped short of, including the Observer in its formalism. DeBroglie and David Bohm (1993) proposed the pilot wave interpretation of Schrödinger's wave function. Such waves have a suggestive similarity to thoughts. Rovelli (1997) proposed a process physics interpretation that emphasizes the dynamic interval between states rather then the state sequence itself. Tegmark (2014) has moved physics away from its Aristotelian roots and returned our attention back to Plato. Almost at an engineering level, Giuseppi Vitiello (2001) used quantum field theory to physically model the brain as an open system. The physical requirement to double all degrees of freedom was forced on Vitiello in order to accommodate the Brain's internal model of the world. This step implied that some physical correlates between the Brain material and what 'It' experiences must be physically built into physics so that it can accommodate the mental characteristics of the Observer. Taken together, the groundwork for an Observer inclusive physics has been done. To summarize and present the main principles for this new development, we will follow the graphic flow diagram approach pioneered in Conscious Action Theory (CAT). This uses action as a flowing material of change in a sequence of flow diagrams that describe a new worldview in which the use of four first letter noun codes find their natural application (Baer 2020).

Since the classic model of reality shown in Figure 1 represented the Universe, we have evolved our concept of time. After Einstein's special relativity and Hubble's expanding universe discovery, our model of reality is more accurately represented by a spatial sequence of all Now frames shown in one instance in Figure 2.

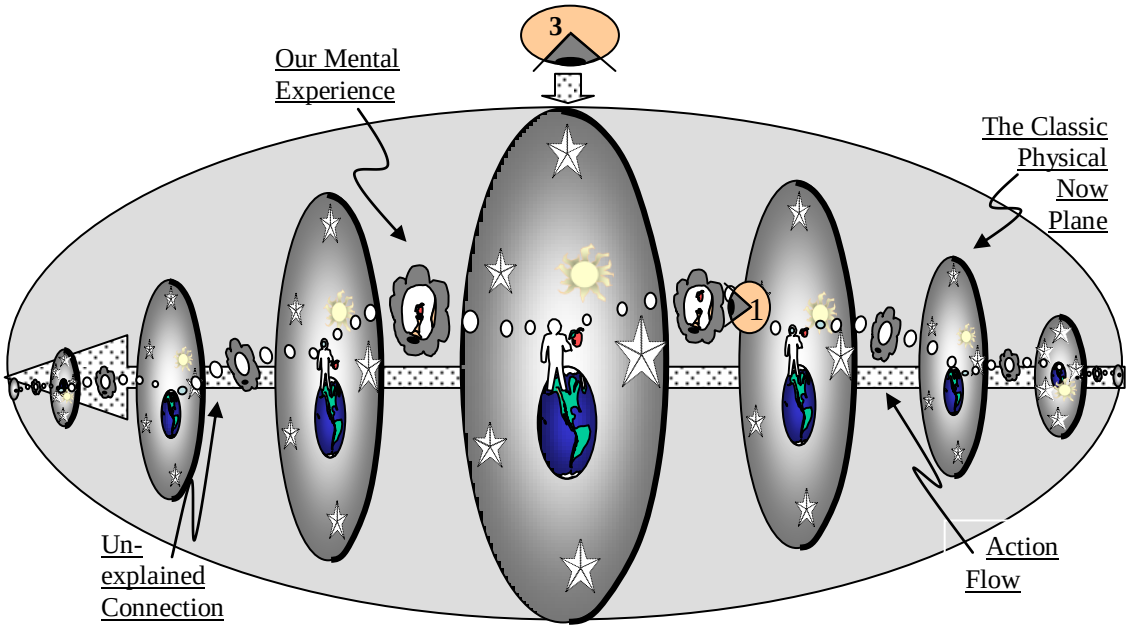

Fig. 2. The Block Universe Model showing mental phases between classic physical Now states

Called a block universe, the frames start as points, grow to the current Now instant and are projected, on aesthetic grounds, to shrink back to a point. The display is like a cosmic calendar. Advanced theories cited in the last paragraph have formalized the process or the happening between states rather than the object in a state. These theories recognize that what happens between Now states of objects is equally if not more important than what happens at a Now.

Furthermore, and most important, is the fact that however rapidly successive measurements are made or how densely Now plane frames are stacked together, the classic assumption -- that objects seen in the Now plane measurement displays move from one time plane to another as the objects seen in those instantaneous measurements --is wrong. What happens between Now plane states are processes or events. Though most physicists attempt to define these events on purely physical grounds, CAT replaces the classic assumption by assuming that what happens between physical states are either mental events in themselves or at least immediate physical correlates of mental events.

The argument for the validity of this assumption starts at the cyclic connection between the 1st-person experience and the physical body having those experiences in Figure 1. Though dualistic debates have often identified the mental experience as an epiphenomenon, and, notwithstanding Libet's Free Will experiments, simple observation cannot deny that we react to what we consciously see and hear. Whether or not such action flow through the sensor brain activator sequence is true epiphenomena or closely correlated with physical phenomena not identified with classic material is irrelevant. Some action flows through our perceptive system and if 1) we are looking at material objects in our everyday mental display from the outside, and if 2) no one has any idea of how we are conscious of the things we see (Pinker 1997), then it is reasonable to

propose *that something* happens inside material from which 'We' are made as it changes through time and that *that something* generates our subjective feelings and observations. Our 1st-person experience and its mystery is explained by assuming that we become aware of the inside of our own material while our view of other things and people is a physical accommodation inside our own material to interactions with those other 'Things' and 'People'.

The use of the CAT-noun code allows a clear description of this concept. When 'You', the real system reading these words, sees is an '**a**pple' or parts of your own '**b**ody' such as your '**a**rm', You are experiencing qualia sensations. They are produced through data- processing sensor-action records from the external to the internal phase of material. In order to be remembered, changes are made in the material of your **M**emory, whose meaning is projected as the 'head' of the 'man' shown in each Now state in Figure 2. The real model components are named **A**pple and **A**rm and produce an internal memory output of the '**a**pple and **a**rm' sensation they are designed to remember. These sensations are projected from interactions indicated by the **E**yeball model icon facing the past field of view in Figure 2. The flow of activity from the future-right to the past-left is indicated by the dot filled arrow. The rate of action flow through each material point '$\underline{\mathbf{X}}$' is called energy [$\mathbf{E}(\underline{\mathbf{X}})=d\mathbf{A}(\underline{\mathbf{X}})/d\mathbf{T}$]. The intensity of action flow through each material point owned by 'You' correlates to your 1st-person qualia experience. The new material, here to fore not identified in classic physics in which the epiphenomena consciousness may be thought to happen is the inside of the old classic mass and charge we project as 'material' into the objects around us.

So far, we have only described the flow of action within a model of reality. All the symbols in it actually refer to the meaning of model **M**aterial inside your real Head in which the process flow described by Figure 2 actually occurs. This is not the '**h**ead' you might see in a mirror, but the physical mechanism producing that sensation. The process flowing right to left in the model intersects the central Here and Now, which represents the world view 'You' are imagining at this instance. What 'You' are actually seeing are the graphic meanings of the instrumentalist Capital-Bold first-letter symbols. These meanings are named 'apple and arm' in our example. They are projected from a perpendicular 3rd-person perspective shown by the Eyeball icon above the central Here and Now. The actual direction runs along the timeline directly from the page to your eye. In practice this is the direction in which 'You', by controlling the image of a pen, could update this externalized model. In actuality, the real '**M**odel' in your 'Head' is updated directly by the flow of action through your 'Eyes'.

Using the 3rd-person view the Reader looks down on a system of processing **E**lements. However, because these are real things-onto-themselves they are only seen through detector cells 'Dc' –see Figure 3- of our internal memory measurement apparatus and therefore displayed as each element's meaning. The situation is analogous to a graphics computer engineer who develops a program that processes the output of a camera retina into a model of the world stored in memory. To make sure his model has been updated correctly he uses the model data and programs a perspective view display that is compared with the camera output. The comparison program statements were shown in Equation 1. These update the model until a minimum difference is reached. If he 'looks' into the machine he would see a whirl of wires carrying voltages that have no discernable resemblance to the scene he has captured in his model, but which they can reproduce. The engineer's situation is similar to the neurophysiologist who looks into the whirl

of neuron wiring in the brain and finds Levine's explanatory gap between the wiring pattern and what a human actually sees (Levine 1982). It's a gap because we have not been able to follow the signals through the inside of the objective material we believe our **b**rain is made of. In the computer case, the whirl can be traced to program statements that include sub-routines named in our noun code as **E**arth(), **M**an(), **A**pple(), etc. Looking down on this code, or the whirl it produced, the engineer imagines the meaning of these processing elements and writes his imagination into the drawings or further descriptions in a program specification manual. The content of the specification manual would be written in symbol types 'earth, man, apple', etc. By analogy, Figure 2 is like a drawing in the specification manual of a human, which shows the meaning of computational elements executed in the human's 'Head' as the Now plane sequence while the sensations he actual experiences are referred to as **e**arth, **m**an, and **a**pple and happen between the Now states.

A summary of how these four noun types are connected in an abstract flow diagram is shown in Figure 3. The big round circle connects the qualia sensation type '**a**' with its memory storage component type **'A'.** This acts like a memory refresh cycle through a self-display pattern-recognition program. Display sensations are transformed to model elements by an actuator function [**A** = Ac(**a**)]. The model elements are measured through detector cells [**a** = Dc(**A**)] to reproduce the observable display. Repeated execution of this cycle holds a sensation in immediate awareness but does not provide the feeling that a real object is being observed. The second oval cycle between '**A**' and 'a' is the model meaning cycle that generates the theoretical meaning sensation 'a' from the sensation calculating model element '**A**'.

In the upper oval we have also drawn connecting thought bubbles that in Figure 1 connected the mind and body. There we identified this connection as a mystery that must happen but we did not know how it could happen. Figure 3 makes it clear that attempting to find a physical causal connection between the 'a' and '**a**' observables is fruitless. It is as fruitless as trying to find the physical causal connection between two actors seen on a television screen. Physically the actors are produced by parallel electron hits on screen phosphors that are not causally connected. The real connection happened between the real actors in front of the camera in a distant studio and would involve a backward time connection, as explains entangled stated in quantum theory. Here we show the common past happenings are real memory model **C**omponents executing in the real Brain, which connect sensations of type '**a**' with explanations of type 'a'. These two **1st**- and 3rd-person observables are merged to produce the feeling of real objects out there in our mental display of the world in front of us.

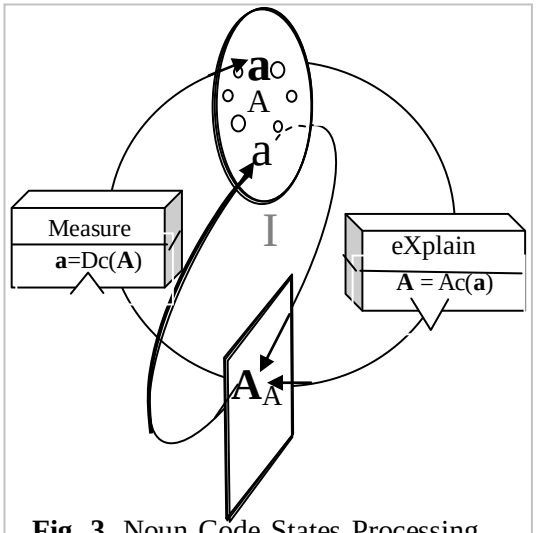

Fig. 3. Noun Code States Processing Flow Diagram (Baer 2020)

4. Expanded Noun States in Contemporary Physics

Introducing expanded noun states would only be a possibly interesting but practically useless abstract exercise unless the results can be equated with facts and operations already proven. Such identification has been documented in the Conscious Action Theory (CAT) text in which action flow structures are used to construct a macroscopic version of quantum theory. CAT reduces to contemporary quantum theory when oscillatory amplitudes of Schrödinger's 'ψ()' are small enough not to destroy the media in which things happen (Sotina 2014, Baer 2020b).

The meaning of media here is the degrees of freedom of any material system executing in dynamic equilibrium in which 1) small disturbances generate restoring forces producing oscillatory motions described by quantum theory and 2) larger disturbances produce construction and destruction events of the systems involved described by CAT. Such a system could be a flat pond of water on which a wind disturbance produces waves, a disturbed quantum experiment apparatus (Hilbert space) producing ψ() waves, a computer performing calculations, or the memory model of a mature Human producing thought. The key difference between CAT and quantum theory is that the construction, interpretation of results, and the dismantling operation of experimental apparatus, performed by the scientist who does all the experimenting, is included in CAT but excluded in quantum theory. Waves on a pond, or 'ψ()' oscillations in Hilbert space, are an adequate description until the dam holding the water in place breaks.

To give an example, consider a computer that has been constructed to run programs. Such a system provides a memory space and accumulators energized to idle in an equilibrium state. In such a system, programs that modify and transmit the voltages around the circuits must be small enough not to burn up the machinery in order to run accurately. In CAT the physical rather than the symbolic operation of a program is used as a real model of reality, then such an executing system can only model phenomena that exhibit small movements that do not destroy the circuitry. A similar situation occurs with a mature Human who operates a model of reality using real physical components of noun type '**A**'. If the thoughts, i.e. Bohm's pilot waves, destroy the Brain circuitry, the model will not run correctly, and the human may have physical convulsions or epileptic seizures. Thinking beyond what can be accommodated in his or her current model requires growth or learning. The difference between a conventional computer and a Human is that a Human can grow Brain connections, while a computer requires outside intervention to modify its hardware.

The concept that Schrödinger's 'ψ' function are real disturbances in real physical systems was published in his seminal paper (Schrödinger 1926) in which he derived a real Schrödinger's equation utilizing the classic theory of small oscillations (Goldstien 1965). The complex and well-known Schrödinger equation of quantum theory was first published by Mandelung, who attempted to describe a fluid flow interpretation of quantum theory known as the Mandelung equations (Sotina 2014). The complex Schrödinger equation stuck because oscillatory motions are more elegantly described by 'e^{i}' rather than the sines and cosines when purely real values are used. CAT utilizes the proposition that quantum theory and its macroscopic extension can be based on treating Action as an incompressible fluid; then flow diagrams become useful in presenting its concepts.

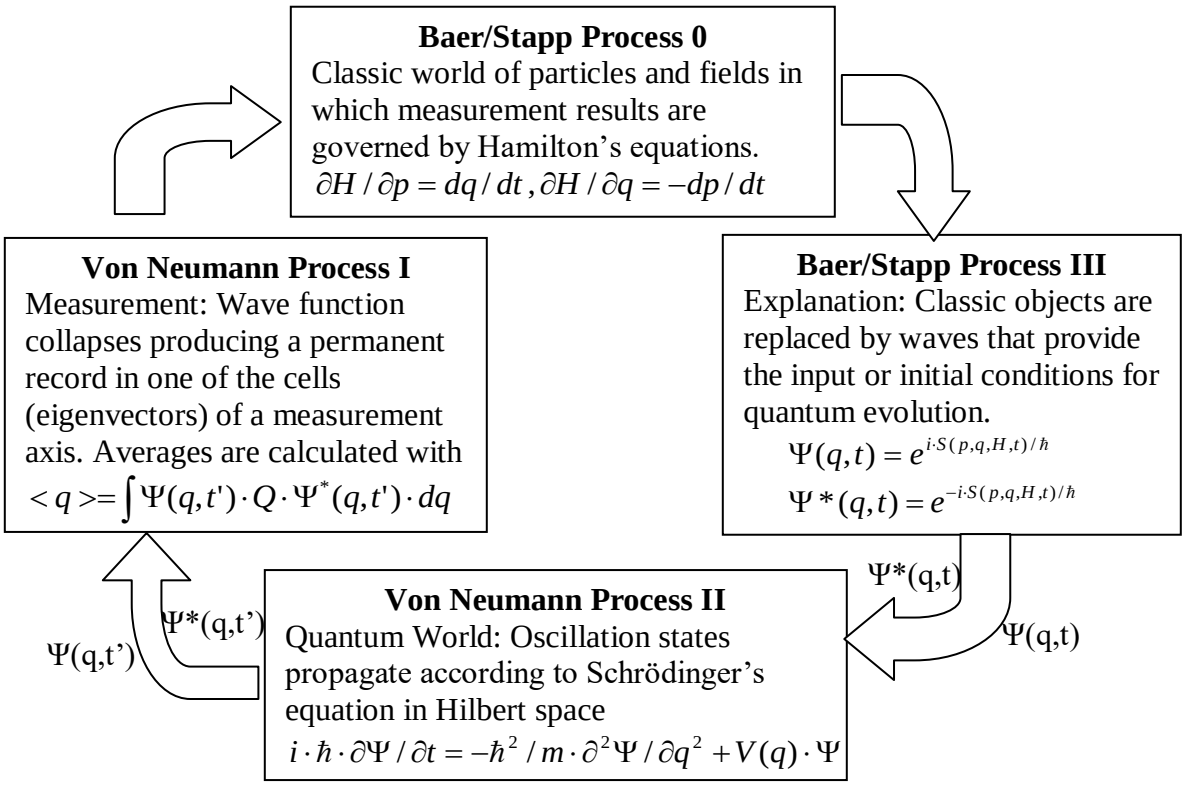

Fig. 4. Action Cycle in Quantum Nomenclature (Baer 2020e)

Figure 4 shows the same flow diagram depicted as the main round circle in the abstract action flow shown in Figure 3. Only the abstract states are here identified in both classic and quantum physics nomenclature. Here the classic world, which is taken to be the thing appearing in front of the Reader's nose, is characterized by objective observable parameters that are packaged into a non-relativistic action function 'S()' replacing the observable fused 'a, **a**' notation in Figure 3. The observables are explained by oscillatory motions 'ψ' calculated by using the function 'S()' as the phase in a complex exponential. 'ψ' then becomes the theoretical entity '**A**', which represents a component in the model. Here we show the time propagation formula used to calculate the next expected measurement result. These are measured through detectors so the Von Neumann Process I is identified with the detector operations [**a** = Dc(**A**)], which reproduces the next classic action pattern. By applying the scientific method, we compare the calculated model output with actual measurement results we find the best probability amplitude 'ψ' that our theory – here quantum theory-- claims is really out there.

Quantum Theory as well as classic physics theory does not include the observer, and therefore the oval cycle in Figure 3 executing the meaning of the symbols does not show up in Figure 4. This is because standard Copenhagen School quantum theory is considered an instrumentalist theory, and physicists are encouraged not to interpret the meaning of 'ψ'. Any such interpretation would be an 'a-type' symbol in our four-noun type nomenclature. Of course, interpretation of quantum symbols still happens in real life. Quantum physicists still construct and tear down their apparatus. They still describe what they are doing with 'a-type' symbols. However, these

operations are handled by reverting to classic physical nomenclature as motion of observable objects. For this reason, quantum theory is incomplete, as Einstein insisted.

5. Concluding Remarks

The expansion of noun types in itself is not a physical theory. Such a theory is in development by many individuals some of whom were cited in the first paragraph of Section 3. What the expansion allows, is for common English users to explicitly differentiate between what they actually experience and how they theoretically explain their observations by using noun symbols rather than weaker qualifying adjectives. This expansion avoids the collapse and effective elimination of what the 1st-person does to see what he sees in current science. Of course, when we look at the night sky and see a moon with a solid surface that we can rocket to and stand on, it may be unnecessary to separately identify the **m**oon of poets and lovers. The past success of current scientific thinking and the technologies it has generated is not in question. What is in question is the future of science.

Theory is an evolving and ongoing undertaking. What we know and believe today will undoubtedly be advanced by future generations. How long will those future generations be saddled with the belief that the objective world is the "truth" rather than a very useful assumption. Truths held by believers are hard to argue against. Useful assumptions have domains of applicability and may lose their usefulness when new challenges are to be addressed. If truths are recognized as assumptions, a door opens for progress. Bringing the ideas of quantum theory into the realm of ordinary life and recognizing that we are dynamic activities through and through rather than a rapid sequence of static objects is the main challenge science faces today. The expansion of noun types gives us the language to, at least, recognize that we even have the challenge and then the tools we need to meet it can be built.

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References

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

Baer W. (2020) Conscious Action Theory: An Introduction to the Event-Oriented World View, Routledge Press, ISBN: 978-1-138-66746-4 (hbk)

Baer W. (2020b) op. cid. Chapter 4,5

Baer W. (2015) On the Necessity of Including the Observer in Physical Theory, *Cosmos and History: The Journal of Natural and Social Philosophy*, **11**(2) URL http://www.cosmosandhistory.org/index.php/journal/article/viewFile/492/825

Bohm D., Hiley B.J. (1993) *The Undivided Universe*, Routledge, ISBN 0-415-06588 Chapter 15

Carnap R. (2000) "The Observation Language Versus the Theoretical Language", *Readings in the Philosophy of Science*, edited by Theodore Schick Jr., Mayfield Publishing Co., p 166

Chalmers D.J. (1997) "Facing Up to the Problem of Consciousness", *Journal of Consciousness Studies* 4:3-46, URL http://consc.net/papers/facing.pdf

Chopra, D., Kafatos M. (2017) *You are the Universe*, Random House ISBN 978-0-307-88916-4
Goldstein H. (1965) *Classical Mechanics,* Addison-Wesley, New York, see Chapter 10: "The Theory of Small Oscillations"
Hofstadter D.R. (2007) *I Am a Strange Loop*, Basic Books, ISBN 0465030793
Johnston C. (2007) "Symbols in Wittgenstein's *Tractatus*" DOI: 10.1111/j.1468-0378.2007.00253.x
Levine J. (1983) "Materialism and Qualia: The Explanatory Gap", *Pacific Philosophical Quarterly*, 64:354-361
"Explaining Consciousness: The Hard Problem", MIT Press, www.geocities.com/computerresearchassociated/consciousness.htm
Mitterauer B. , Baer, W. (2013) "Vorschlag zum näheren Anpassen der deutschen Sprache an die wissenschaftlichen Fortschritte des letzten Jahrhunderts", Humankybernetik (grkg) 54, 85-94.
Nagel T. (1974) "What It Is Like to be a Bat", *Philosophical Review*, Vol. 93, pp 435-450
Pinker S. (1997) *How the Mind Works*, W. W. Norton & Co., ISBN0-392-0454-8, p 84
Rovelli C. (1997) "Relational Quantum Mechanics", *Intl. J. Theo. Phys.* 35, pp 1637-1678 (1996), www.arXiv:quant-ph/9609002v2
Schroedinger E. (1926) "Quantisierung als Eigenwertproblem", Annalen der Physik, Vol 384, Issue 4, pp 361-376
Sotina N. (2014) "Derivation of the Schroedinger equation from the laws of classical mechanics, structure of physical vacuum", Physics Essays, Vol 27, No 3, pp. 321-326
Stapp H.P. (1993) *Mind, Matter, and Quantum Mechanics*, Springer-Verlag, Berlin
Stapp H.P. (2005) "Quantum Interactive Dualism", *Journal of Consciousness Studies*, Vol 12, No 11, pp 53
Tegmark M. (2014) *Our Mathematical Universe*, Random House, ISBN 978-0-307-59980-3, Chapter 10, p 243
Vitiello G. (2001) *My Double Unveiled: The Dissipative Quantum Model of the Brain*, John Benjamins Publishing, ISBN 9027251525