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Generalized Empirical Method: A Context for a Discussion of Language Usage in Neuroscience

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This article extends a distinction between the data of sense and the data of consciousness discussed in a former article (Henman, 2013) as a context for a discussion of language usage in neuroscientific literature. Such usage attributes mental acts to biological processes. In doing so, an unintentional neglect of the data of consciousness is perpetuated as well as a denial of the empirical nature of conscious acts or states. Such usage can also contribute to an inhibition of a more adequate understanding of biochemical processes. Discussions of a) objectivity, b) knowing as a conscious activity and c) the biological process of evolution will provide further contexts towards a shift in methodology providing the possibility of a more adequate understanding of the relationship between the cerebral organ and consciousness.

Keywords: reductionism, methodology, neuroscience, evolution theory, objectivity.

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INTRODUCTION

In a paper on Generalized Empirical Method (Henman, 2013), a distinction was drawn between the data of sense and the data of consciousness. That distinction laid the groundwork for an affirmation of a theory of knowing as a conscious activity that can be empirically acknowledged through reflection on one's scientific performance (Henman, 2013, p.51; Lonergan, 1970, p.xiii). This article appeals to that distinction as a context for a discussion of particular language usage in neuroscientific literature that attributes mental acts to biological processes. In doing so, an unintentional neglect of the data of consciousness is perpetuated, as well as a denial of the empirical nature of conscious acts or states. This also contributes to undermining the possibility of a more adequate understanding of biochemical processes. Discussions of: a) objectivity, b) knowing as a conscious activity, and c) the biological process of evolutionary theory, will provide further contexts towards a shift in methodology providing the possibility of a better understanding of the relationship between the cerebral organ and consciousness.

To provide a context for the above discussions, what follows is a quotation of Bernard Lonergan's definition of Generalized Empirical Method and his position on reality and knowing.

> "Generalized Empirical Method operates on a combination of both the data of sense and the data of consciousness: it does not treat of objects without taking into account the corresponding operations of the subject: it does not treat of the subject's operations without taking into account the corresponding object" (Lonergan, 1985, p.141)

Lonergan's position on knowing is referred to as critical realism. He outlines in his book, **Insight: A Study of Human Understanding** (Lonergan, 1992) the intellectual acts of knowing as experience, question, insight, and judgment.[a] These acts can be acknowledged, at least experientially, by adverting to our own acts of conscious operations, or to our reflection on our performance when involved in either common sense knowing or theoretical knowing. This process he calls self-appropriation (Lonergan, 1992, pp.13-17). Lonergan also establishes that this process of knowing is how we know reality. The real is the verified. Verification is the establishment of an unconditioned or a verified insight. Reality is a correctly understood experience (Lonergan, 1992, p.123, 230, 278; Lonergan, 2004, 126-127; McShane, 1975, p.42). In a correct judgment we know reality. Experiencing and the subsequent operations of the intellect are components of both knowing and reality. As a whole they constitute a heuristic structure leading to

knowledge and reality. Lonergan's cognitional theory, epistemology and generalized empirical method provide a context for our discussion on objectivity and its relationship to reductionism. These discussions provide a methodical foundation for understanding the relationship between the brain and consciousness. We begin with a quotation from Lonergan which describes the problem of reductionism in the following manner.

> "In this fashion, intelligence is reduced to a pattern of sensations; sensation is reduced to a neural pattern; neural patterns are reduced to chemical processes; and chemical processes to subatomic movements. The force of this reductionism, however, is proportionate to the tendency to conceive the real as a subdivision of the 'already out there now'. When that tendency is rejected, reductionism vanishes" (Lonergan, 1992, pp. 282-283)

LANGUAGE USAGE DATA

The discussion begins with a focus on the use of language that mediates a reductionist tendency in meaning in neuroscientific research. That usage is not a pure form of reductionism in as much as reductionism assumes that what is being reduced is known at least empirically. In the case of conscious acts, they are presently unintentionally neglected and therefore empirically unacknowledged by the scientific community as data to be understood.

What follows are specific terms that refer to mental operations but, in the context exhibited below, are attributed to biological processes. They are as follows: **information**, **decoding**, **storage**, **memory**, **determine**, **represent**, **recognize**, **process**, and **knowledge**. The following quotations contain examples of such usage taken from a current text in cellular and molecular neuroscience (Byrne et al, 2014).

"…with respect to the type of **information** transferred to the neuron" (Byrne, 2014, p.4)

"…is responsible for transmitting **information**. This **information** may be primary…or processed **information**…" (Byrne, 2014, p.5)

"…are correlated with the type of **information** processed by the particular neuron…" (Byrne, 2014, p.5)

"…how **information** is processed in the cerebral cortex" (Byrne, 2014, p.8)

"…DNA **information** is copied into messenger RNA…" (Byrne, 2014, p.149)

"How does DNA store genetic **information**?" (Byrne, 2014, p.150)

"…the **information stored** in genome can be transmitted to new cells…" (Byrne, 2014, p.150)

"…transcription and translation are induced and required for **memory storage**" (Byrne, 2014, p.162)

"…biophysical and biochemical properties as well as the ways in which neurons are connected to each other to **process information and generate behaviour**" (Byrne, 2014, p.591)

"However, in most other examples of memory, it is considerably less clear how the **information is retrieved**. This is especially true in memory systems that involve the **storage of information** for patterns, facts, and events" (Byrne, 2014, p.623)

"…V4 is thought to **represent** various aspects of the form and identity of visual objects" (Knierim, 2014, p.567)

"…a downstream neuron can **determine** whether the odor was apple or cherry + apple by decoding whether PN2 fired on all 3 cycles of the LFP or on only the second and third cycles" (Knierim, 2014, p.570)

"…thus a neural system that has **prior knowledge** about the probabilities of such inputs…will successfully decode the image…" (Knierim, 2014, p.575)

"…the decoder system may **recognize** that it is highly unlikely that an elephant is in the living room.." (Knierim, 2014, p.575)

"… based on its anatomical connectivity with the eyes, we can deduce that the lateral geniculate nucleus (LGN) of the thalamus **represents** visual **information**" (Knierim, Byrne, 2014, p.563)

I have bold-faced particular terms in the above quotations to focus the reader's attention on the possible meaning of these terms. I have obtained samples from one main text but perusal of other texts in neuro-scientific literature reveals similar usage. Can the operations that the terms **interpret**, **determine**, **knowledge**, **recognize**, **decode**, **information**, **recognize** and **formulate** refer to be empirically located in cellular processes? Do cellular processes have these abilities? The following reflection will focus on the term **information**.

WHAT CONSTITUTES INFORMATION?

I have cited 13 uses of the term **information** in the sampling provided from the referenced text. There are many more. This is sufficient for our purposes. The Oxford English Dictionary (O.E.D.) defines information as facts or knowledge provided or learned. A definition serves its purpose only if the recipient of the definition understands the various terms and the relationships

between those terms. If there is no understanding the phrase is data to be understood. So, what is a **fact**, what is **knowledge** and what is it to **learn**?

The bold-faced terms need to be understood if this definition is to be helpful in our discussion. If an adult says to a child of age 2 that a snow storm is coming tomorrow and the child does not know what the terms, snow, storm and tomorrow mean, is it **information** for the child? What is missing is an understanding of these three terms in the child's mind. For the child the words are data to be understood. The statement becomes **information** only once the child understands the terms and how the meaning of each term relates to the meaning of the other terms. Such understanding is learning and knowledge and the occurrence of the storm has the potential to become a fact for the child. In the same manner the definition of **information** becomes **information** once the individual terms are understood.

What constitutes information are conscious operations resulting in correctly understanding data. Until such understanding occurs, what is named **information** in the samplings is in fact data. The sampling offered above uses the term **information** as an attribute of cells and neurons that is passed on from one cell or neuron to another cell or neuron. Do the cells pass on correctly understood data? Think of a mechanism such as an internal combustion engine being made up of many parts, each part functioning with the other parts to achieve one overall function, moving an automobile from one place to another. The overall purpose is achieved because each part works integrally with the other parts. But each part does not hold the overall design in its particular design or function. The design is in the mind of the designer and the designer has an image of the overall pattern and seeks out the parts that will function together to achieve that overall function. Shifting this analogy to the biochemical processes of cells and neurons we have processes each with a function, but no overview of the design of the human anatomy or the brain is innate to each cell or neuron. Biochemical processes do not pass on information any more than the parts of an engine pass on information to the other parts. With this understanding in mind, is the use and attribution of the meaning of the term information to biochemical processes an inhibition to understanding the data of biochemical processes that are occurring? (McShane, 1970, p.187) This question requires further methodological points regarding objectivity and emergent probability which follow.

WHAT IS OBJECTIVITY?

It will be helpful to provide a quotation from Charles Osgoode, an experimental psychologist.

> "What is the environment? The answer to this question comes promptly-the environment is "out there". It is this book, the walls of this room, the people passing to and fro; it is everything that is outside of us. This answer is of course a rational one, but it is founded upon an elaborate system of inferences developed through a lifetime of experiencing. If a forefinger is placed along the lower ridge of the eye socket so that its tip is against the nose and the other eye is covered, pressing the eyeball gently and moving it up and down will cause the environment to jump back and forth. Now this is manifestly unreasonable! Any force sufficient to shake the room would also have been felt as vibration. But what, then, is the explanation of this phenomenon?" (Osgoode, 1953, p.1)

The key term in this quotation is explanation. It is, in fact, an explanation that is required. A correct explanation is achieved when an insight has been verified. An explanation is a cause, or a cause is an explanation. Once an explanation has been verified one has 'created' knowledge or an understanding of experience. Reality and knowledge are instances of correctly understood experience. There is no objective reality "out there" beyond the human mind. And if there were, one could not somehow get outside oneself in order to have some super look. And even if one could, and there was something "out there", he or she would still be faced with the question; What is it? raising again the issue of objectivity.[b] There are further experiments on experiential objectivity that one can carry out, such as the image changing when removing glasses. Which image is "out there"; the hazy image or the clear image? Can the hazy image be "out there"? If not, where is it? (McShane, 1975, Ch.5) The Nobel recipient in 1967 for physiology and medicine, H. K. Hartline, over a period of twenty years showed in his experiments with the Limulus, the horseshoe crab, that visual images originate in the photo-

receptor cells (Hartline, 1967). John Dowling states that more recent work has confirmed Hartline's position (Dowling, 1992, p.210).

A second quotation from Knierim:

> "… the lateral geniculate nucleus of the thalamus represents visual information" (Knierim, 2014, p.563)

Where is this visual image that the LGN of the thalamus represents? Do these processes represent some "other" reality or are they, in fact, processes of emerging complexity manifested as a visual experience in consciousness? Are such processes representatives of anything?

A quotation from Bernard Lonergan on objectivity situates the role of data in human knowing.

> "If objectivity is a matter of elementary extroversion, then the objective interpreter has to have more to look at than spatially ordered marks on paper; not only the marks but also the meanings have to be 'out there'; and the difference between an objective interpreter and one that is merely subjective is that the objective interpreter observes simply the meanings that are obviously 'out there,' while the merely subjective interpreter 'reads' his (or her) own ideas 'into' statements that obviously possess quite a different meaning. But the plain fact is that there is nothing 'out there' except spatially ordered marks; to appeal to dictionaries and to grammars, to linguistic and stylistic studies, is to appeal to more marks. The proximate source of the whole experiential component in the meaning of both objective and subjective interpreters lies in their own experience; the proximate source of the whole intellectual component lies in their own insights; the proximate source of the whole reflective component lies in their own critical reflection. If the criterion of objectivity is the 'obviously out there,' then there is no objective interpretation whatever; there is only gaping at ordered marks, and the only order is spatial" (Lonergan, 1992, p.605)

The "out there" experience of spatiality is a result of the extroverted character or quality of animal/human consciousness (Hartline, 1967). Now, if sense data are not "out there", then the visual images, sounds, smells, tastes and touches are in fact integral patterns of our brain chemistry.[c] Brain scans and graphs are more of the same.

The point to this discussion is that such usage as provided in the beginning of this section is misleading and contributes to bolstering up the reductionist tendency. We grow as children in the commonsense horizon developing a "sense" of reality as what is solid and out there. As Osgoode and Lonergan remind us, there is more to the picture. Objectivity is not achieved by looking at the data; objectivity is achieved by verifying one's insight into data and that may be as simple as just verifying that there is data. Such verification is a judgment and understanding is still in play. We cannot escape the need for understanding, but we can be led into and remain in the commonsense mode of reality throughout our lives, even if we are a scientist. McShane offers the following statement on the need for an adequate personal position on objectivity.

> "It is clear that one cannot handle the senses with scientific clarity without an accurate personal position on objectivity and extroversion" (McShane, 1976, p.93)

The commonsense horizon (Lonergan, 1973, p.235) is what we all live in and move about in every moment. So, for the person of common sense, reality is the "already out there now real", but for the scientist, reality is a verified explanation and not some subdivision of the "already out there now" (Lonergan, 1992, p.523). Reality, or the real, is known in the judgment reached through the heuristic combination of the conscious cognitive acts. These acts constitute knowing and reality, and both are reached by correctly understanding experience or data. Objectivity is the product of authentic subjectivity, asking and answering all the relevant questions until an insight or explanation is verified.

When these two different horizons are not adequately distinguished there is a mixing or meshing of common sense and theory in scientific research (Lonergan, 2004, pp.10-11; McShane, 1975, Ch.1: Horizons; Shoppa and Zanardi, 2014, p.19). So, the neuroscientist works at gathering data, describing structures and processes of cells, determining functions and relationships of functions between cells and more. Without distinguishing between the two notions of reality, the order and expression of the above procedures become meshed in such a manner that the researcher is moving in and out of the two different horizons unaware that he or she is doing so (Lonergan, 1992, pp.318-324). Shoppa and Zanardi have explored this in their latest work and offer the following on this meshing of horizons in relationship to development.

> "That history is ongoing, development is incomplete, and the proof lies in the mixture of descriptive and explanatory terms in almost every science" (Shoppa and Zanardi, 2014, p.40).

They add in a footnote the following to the above statement:

> "In the neurosciences this mixture appears with some frequency in common references to "mechanisms in the brain" and "communication of information" along the neural pathways" (Shoppa and Zanardi, 2014, p.40).

In view of the lack of distinction between the two horizons, the reductionist inclination is reinforced and becomes an inhibition to establishing a theory of thinking adequate to explain the relationships between the cerebral correlates and the acts and states of consciousness, and finally the distinction between the two horizons. Such distinctions are achievable through empirical reflection on one's own performance when doing science (Henman, 2013).

Abnormal development occurring in the cerebral organ can inhibit the development of intellectual potential. The activities of the cerebral organ are an underlying level to conscious activity (Lonergan, 1992, p.543). The point is that development in understanding does not occur in biological processes, it occurs in the mind. The tendency to attribute such activities to occurring in biological processes is "a stumbling block to the appreciation of what precisely is going on in cell biochemistry" (McShane, 1970, p.187).

Development in understanding initiates changes in the underlying biological processes, e.g., synaptic activity and dendritic growth accommodating that conscious development in understanding. The human person functions as an integral subject whereupon higher and more complex levels of activity integrate less complex levels of activity. When there are distortions on lower levels, higher levels are affected in their functioning. All that we are is brought integrally forward into consciousness including any distortions or abnormalities.

THE FUNCTION OF THE CEREBRAL ORGAN

James Knierim offers the following statement on the function of the brain.

> "The essential functions of the brain and nervous system are to collect **information** about the external world and about the internal state of the body; to **interpret that information**; to **determine how that information conforms** with the needs and goals of the organism; and to **formulate** an appropriate behavioral response (if necessary) to accomplish those goals" (Knierim, 2014, p.563). [Bold font added by the author]

How did Knierim arrive at his statement? Knierim as a professor and researcher at the **Mind/Brain Institute** at John Hopkins University has what would be considered the necessary background to adequately speculate on the function of the brain. Reflection on his own performance would reveal that Knierim **decided** what **data** was **relevant**, **interpreted** that data, **determined** how that **interpretation** is to be organized and **formulated** the above statement. What was going on in Knierim's mind while he was writing this statement? First, he would have had a question relating to the essential functions of the brain (Byrne, 2014, p.563). That question might have been in the form: What is the function of the brain? That question is a conscious act seeking understanding or an insight, also a conscious act, into the function of the brain. That insight(s) he would formulate into an answer and eventually decide to write the above statement. So, we have data: Knierim's previous understanding of brain processes. We have a question on the function of the brain, various insights and formulation of those insights. In order of occurrence: Attention to data, curiosity expressed in a question, insights into the intelligibilities revealed by intellect in the data and finally judgment, or rather attending, questioning, understanding and judging. These terms refer to distinct mental operations that occur in the human mind, having biological correlates occurring in the brain. Through the exercise of his own mental operations, Knierim "determined" the function of the cerebral organ, the nervous system, and if he reflected on his own performance he would be able to acknowledge his own mental operations. There is intimated a dualism in Knierim's statement through his attributing conscious mental operations to biological processes while he was carrying out such procedures as conscious operations. To which group of operations does

he advert as a source of intelligence and what process does he use to make that decision? How would Knierim access those supposed biological operations? What empirical evidence is there to support Knierim's conclusions that biological processes carry out any of the operations that Knierim attributes to biological processes?

Biological processes function as schemes of recurrence within the parameters of chemical and physical laws and the randomness associated with the possibility of non-systematic events. The empirical occurrence of the cognitional acts as conscious, associated with the above terms, can be acknowledged by reflecting on one's own performance when involved in scientific work (Henman, 2013, p.51).Through the conscious process of reflecting on one's performance, one arrives at the conclusion that knowing is a conscious activity and there is no evidence-based data to verify that cellular processes carry out such acts. The neurophysiologist, Sir John Eccles, raised the point at the Pontifical Academy of Sciences gathering in 1964 when he stated; "the ultimate reality for me is my conscious experiences, including perceptions, memories, dreams" (Eccles, 1964, p.371). Eccles has worked extensively on attempts to understand the interface between the brain and the mind. Eccles, with a focus on acknowledging both brain and mind as separate entities and yet interfunctioning (Eccles, 1988), holds to that distinction. The distinction is not maintained in present research, where the approach is towards raising the chances of understanding the interface. Generalized empirical method will be a help in future work towards working out the interface.

If biological processes do not possess the ability to determine, what do they possess? There are patterns of intelligibility in data that the cognitive operations discover and seek to understand (Lonergan, 1992, p.101). Without those operations nothing is known. There is just "looking" at fMRI scans, graphs and electron microscopic images. Knowing is a conscious activity. The biological processes are unconscious events. Once an insight is verified, the researcher has reached a judgment. A judgment is not "out there" in the data. A judgment is "in" the mind of the researcher. This is a curious expression if one is reading with presuppositions of positivism or the notion that objectivity is a subdivision of the "already out there now". In order to understand these biological processes better, I draw on Bernard Lonergan's theory of evolution which he calls emergent probability (Lonergan, 1992, pp. 144-151). The following is a brief description of emergent probability from Lonergan's own writings.

> "For the actual functioning of earlier schemes in the series fulfills the conditions for the possibility of the functioning of later schemes. As such conditions are fulfilled, the probability of the combination of the component events in a scheme jumps from a product of a set of proper fractions to the sum of those proper fractions. But what is probable, sooner or later occurs. When it occurs, a probability of emergence is replaced by a probability of survival; and as long as the scheme survives, it is in its turn fulfilling conditions for the possibility of still later schemes in the series. Such is the general notion of emergent probability" (Lonergan, 1992. p.145)

The above definition of emergent probability is descriptive and filling in the explanations will be the work of the various researchers in the fields and sub-fields of neuroscience. But for our purposes here it will serve to provide a contextual image for the following discussion of cellular and biochemical processes helping towards discovering the function of the cerebral organ.

If the brain is not the source of judgments, just what is the function of the brain? To understand the function of the brain we must first understand what is occurring along the neural pathways. This can be achieved by first understanding the cellular and chemical processes and secondly by determining the functions of these activities and then finally the relationship between the various functions (Lonergan, 1992, p.489). The neural pathways do not carry information from a sensory site to the cerebral organism. So some transformation of cellular activity at the sensory site is initiated and this transformation in turn initiates a transformation of the biochemical cellular processes within the neural pathways. That transformation is a more complex level of functioning than that occurring at the sensory site. The change in cellular activity at the sensory site is a change in the normal scheme of cellular activity, a new pattern of activity occurs. The transformation initiated in the neural pathways

is a change in its normal routine of activity. The transformation is eventually integrated by the functioning of the cerebral organism. All along the line we have data that consists of changes in biochemical activity and changing schemes of recurrence with different functions. There is no encoding of information on the axons in this activity. It is a series of transformations from different levels of activity that have functions and each level of functioning serves to initiate new schemes of recurrence with higher levels of functioning. And these functions can be determined by the mind's conscious operations of relating one level of activity to the former and succeeding levels of activity. These transformations consist of an increasingly more complex activity of cellular and bio-chemical processes and activity moving towards an integral finality that is a conscious experience and only experience. Lonergan describes briefly the process in the following quotation.

> "… chemical elements and compounds are higher integrations of otherwise coincidental manifolds of subatomic events; organisms are higher integrations of otherwise coincidental manifolds of chemical processes; sensitive consciousness is a higher integration of otherwise coincidental manifolds of changes in neural tissues; and accumulating insights are higher integrations of otherwise coincidental manifolds of images and data" (Lonergan, 1992, p.477)

The cerebral organism functions as an integral operator of biological processes. The cerebral organism is a higher level of activity that organizes neural pathway activity in a manner effecting awareness of activity: the human subject is conscious of an experience. There is an upward dynamism in which activity is reorganized by more complex systems so that what is cellular activity is experienced as sense data.

Where and how is the empirical evidence of these upward transformations of schemes of recurrence to be located? The intelligibilities discovered by intellect in data, through present neuroscientific work, provide sufficient evidence for these transformations. Knierim offers the following.

> "Many neural circuits are fairly simple and are relatively well understood. These circuits may be little more than a sensory neuron synapsing with a motor neuron, […] a stimulus causes a sensory neuron to fire, which causes a muscle to twitch. […] These concepts are essential for describing more complex neural circuits that are formed from networks of thousands or more neurons" (Knierim, 2014, p.565).

This image is methodologically descriptive, not explanatory of the transformations. The image does serve to note, at least descriptively, an increasing intelligibility, but not intelligence, as we move from simpler to more complex levels of activity and functioning. An explanatory account of the transition from genetic composition to the synthesizing of proteins, to the formation of cells, to the emergence of organs and organisms, to conscious awareness, is a major challenge for neuroscience and evolutionists that will require a proper method of approach and the collaboration of many in the related fields before adequate results are forthcoming. There is a forward dynamism in biological processes towards the eventual awareness of experience. That dynamism is not "known" by biochemical processes. Unintentional reductionism is one of the hurdles to overcome, in order to provide the proper method required to understand this increasing dynamic complexity.

What is necessary for such a study is an understanding of two aspects of what is called genetic method (Lonergan, 1992, pp.484-506); development and emergent probability (Lonergan, 1992, pp.144-151), or what has been traditionally called a theory of evolution. By emergent probability I mean an explanatory account of related and emerging schemes of recurrence, not limited to natural selection or Darwin's notion of the survival of the fittest (McShane 1970, p.233), that through the occurrence of a non-systematic event, establishes a new scheme of recurrence that functions as a new, higher and more complex level of activity (McShane, 1970, pp.218-219). The new level of activity systematizes the non-systematic event emerging from the former level. The new level of activity is operative as a scheme of recurrence exhibiting a new function that is also open to new possibilities through the non-systematic possibility. The cell has its own particular scheme of recurrences, and cells group to form organs and organisms, and those organs and organisms have their own schemes of recurrence that have different functions then those of

the cell. A new and higher level of functioning is occurring. In the same manner, the cerebral organ is a level of functioning through schemes of recurrence that admit and are driven to higher and more complex systems of functioning. This series of increasing complexity of activity and functioning find their final integral transformation as conscious experience. These transformations occur within the context of the physical and chemical laws functioning with statistical probabilities of the occurrence of a non-systematic event leading to higher levels of integral functioning. Research by Lonergan and McShane support this process as expressed in the three following quotations.

> "The non-systematic of one level is systematized on the next level without contradiction" (McShane, 1970, p.187)

> "For in the first place, an acknowledgment of the non-systematic leads to an affirmation of successive levels of scientific enquiry. If the non-systematic exists on the level of physics, then there are coincidental manifolds that can be systematized by a higher chemical level without violating any physical law. If the non-systematic exists on the level of chemistry, then on that level there are coincidental manifolds that can be systematized by a higher biological level without violating any chemical law. If the non-systematic exists on the level of biology, then on that level there are coincidental manifolds that can be systematized by a higher psychic level without violating any biological law. If the non-systematic exists on the level of the psyche, then on that level there are coincidental manifolds that can be systematized by a higher level of insight, and reflection, deliberation and choice, without violating any law of the psyche" (Lonergan, 1992, pp.229-230)

> "The function of the higher integration involves changes in the underlying manifold, and the changing manifold evokes a modified higher integration" (Lonergan, 1992, p.495)

Over the past few decades, neuroscience has provided an enormous amount of data in mapping the brain, describing the many processes of cells and synaptic events, dendritic branch growth and their functions, leading to advancements in surgical and therapeutic procedures. An understanding of the general function of the brain and the acknowledgment of the mental acts as distinct data would increase the probability of development in understanding the biological and biochemical processes of the cerebral organ.

The fact remains that there is no empirical evidence to support Knierim's conclusions that biological processes carry out any of the mental operations that Knierim attributes to biological processes. Experiments such as Libet's work and others, noting cellular activity prior to one's conscious willing, are not empirically-based evidence of the brain "thinking" (Cibelli, 2012). These processes do not admit the experimenter to experience any particular acts. But there is empirical evidence to support the occurrence of mental operations in Knierim's mind.

THE FUNCTION OF CONSCIOUSNESS

What is the function of consciousness, and in this case, of human consciousness? The function of consciousness is awareness (Lonergan, 1992, pp.344-346). Or more pointedly, consciousness is experiencing. But consciousness is more than a function. It is an awareness of the self. Explaining that relationship between the function of the brain and the function of consciousness will require that it be necessary to determine what consciousness is. A quotation from McShane provides methodical direction for that task.

> "What is consciousness? The question is a massive empirical challenge of this millennium, moving up from the irritability of plants through higher levels of self-presence in plant and animal to the shades of human consciousness, where different consciousnesses of inquiry, judgment, planning and decision will be specified by investigating the chemical patterns of heterarchies of brain neurodynamics" (McShane, 2011, p.193, footnote 35).

The self-awareness of consciousness as our self-presence of existing is complemented by the expression of the heuristic sequence of cognitive operations as a solution to surviving in particular environments.

THE RELATIONSHIP BETWEEN THE TWO FUNCTIONS

We have two separate functions listed above of two distinct entities of the human person. The function of the brain is being an integrator of biological processes into possible intelligible patterns and being an operator towards higher schemes of recurrence (Lonergan, 1992, pp.488-492). The function of consciousness is awareness of these patterns as well as the occurrence

of cognition, the desire to understand discovered intelligibilities in data. The occurrence of correlates in the cerebral organ when conscious operations occur reveals that there is some form of relationship between these two activities or functions. What might that relationship be? The relationship between these two functions is that together they function as an integral collaborative solution to the survival of an organism within a particular environment.

> "… data on the schemes of recurrence which include, say, reproduction on protozoa, lead the biologist first to the physics and chemistry of each scheme and further to the correlations which define a particular capacity for dealing with environment" (McShane, 1980, p.68)

The task of future neuroscience is to explain that form of integral collaboration and to do that a transformation in methodology is required. Reductionism will only continue to inhibit this much needed transformation. The methodological pointers outlined above should provide the context for an understanding of the reductionist tendency of the other bold-faced terms listed in the second section of this essay. An adequate position on objectivity, generalized empirical method and emergent probability (evolutionary theory) outlined briefly in this essay would also contribute to answering Farina's question:

> "How is it possible to explain the infinite mystery and the paradoxes of human being(s) through brain mechanisms and physiological systems?" (Farina, 2014, p.61)

CONCLUDING SUMMARY

In conclusion, I suggest a main inhibition to progress and development in neuroscientific research to be the lack of reflection on performance. To date, the immensity of the data and literature in the various fields and sub-fields of neuroscience is commendable, but it requires systematic organization. Generalized Empirical Method will provide new data to be considered that will eventually lift present methods of experimentation, observation and conclusion to a level that can meet the challenges of our times by shifting attention to a combination of the data of sense and the data of consciousness. The future will bring forth more refinements in technology that will surely provide even more exacting data on cerebral activity. This data will still require an adequate explanatory method in order to provide a genetic sequence of systematic development. That sequence of development can be initiated by the scientist's reflection on his or her own performance. There are clues in Lonergan's description of genetic method and development that will not only subsume the problems of procedure in scientific research, but also provide a method for gradually assisting in neuroscientific development (Lonergan, 1992, pp.489-504). Reflection on one's cognitive performance while experimenting needs to parallel the intellectual energy and resources that are presently dedicated to neuroscientific experimentation. The activity of such experimentation provides the operative conscious data for such reflection. The conclusions regarding the randomness of biophysical and biochemical events, the objectivity of statistical science and the fact of emergence reveal that reflection on method is essential to understanding the content of any and all science (McShane, 1970, p.11).

Endnotes

a: Interpreters of Lonergan's cognitional theory have equated his thought with that of idealism. Such an interpretation misses the point concerning the role of judgment. Judgment is the result of a verified insight into data and it is only in such a judgment that knowledge is achieved. Insight is concrete and is the pivotal act towards knowing but without raising the IS question; Is it so?, nothing is known as verified. Such errors of interpretation result from an insufficient reflection on performance when one is involved in theoretic knowing.

b: Understanding this existential shift through scientific explanation resolves issues surrounding Husserl's numenology and Kant's noumenon.

c: Lysergic acid diethylamide (LSD) experiments manifest that visual images and other sense data are often distorted. Just where are these images, sounds, tastes, or smells? How can the human brain distort sense data if it is "out there"?

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