Information and Spirit

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Abstract: Definitions that relate to each other are derived for Information and spirit. An experiment that seeks to stimulate the phonological store is described and the responses obtained analyzed, using a unique monitoring method based on variations in electrical permittivity when neurons fire. The importance of the non-sensory inputs to the sub-vocal rehearsal system in the phonological lop is mentioned. An experiment is outlined wherein a mental stimulus is applied to the subject and the electrical response is monitored and converted to audible speech. This is thus non-vocal speech and its characteristics are examined in relation to the original stimuli. The results revealed openings for further research.

Key Words: Information, spirit, question & answer, phonological loop, neurons, electrical permittivity.

INTRODUCTION

This paper takes a fresh look at the subject of Information in relation to spirit.

DEFINITIONS AND SYMBOLS

We will begin with the word *spiritual*.

This word is so loaded with emotional and attitudinal "baggage" that it is almost unusable in the context of this paper.

Among the multiple "definitions," when used as an adjectival noun, we might find,

- Going to Mecca
- Living in an Ashram
- Marriage in a Catholic Church
- Not eating dead animals

And so on.

(Appendix **1** looks into this in more depth).

Obviously, no definition of the kind shown above is suitable to use as a general definition.

It is proposed therefore to derive Working Definitions - definitions that are suitable for use in the context of this paper.

The working definition for spirit is as follows: -

Spirit – an animated form without substance, pure information, sometimes conceived of as the source of otherwise apparently acausal activity.

The definition could be subdivided as follows, Internal and External. Where an Internal might be the soul or other entities such as those dealt with at the spirit Release Foundation at the Royal College of Psychiatrists in London [1].

And an External might be an Angel, spirits contacted during séances, and the like.

We turn now to Information.

We should remind ourselves of Weiner's statement, which - if not exactly a definition - nevertheless clarifies our understanding of information considerably.

'Information is information not matter or energy'

—Norbert Wiener, *Cybernetics (1948, p. 155)*

Further contextualisation can be found in the Edinformatics article on Cybernetics, in which, writing of the new cybernetics, it says,

'[One of the]characteristic[s] of new cybernetics is that it views information as constructed and reconstructed by an individual interacting with the environment. This provides an epistemological foundation of science, by viewing it as observer-dependent [2, 3].

The working definition to be used in the context of this paper is,

Information is that of which one can be aware.

SYMBOLS

Epsilon (ε), the symbol for Electrical Permittivity [4].

Permittivity is a property of space and is an indication of how much electrical energy can be contained within a given volume of space for a given applied electrical force.

In this paper the instances that we will be dealing do not involve capacitors as such, but a rough biological equivalent so to speak, neurons.

For a more in-depth discussion see Appendix **2**.

Prior to firing, a neuron has a charge differential across the cellular membrane, due to the disparity between Sodium and Potassium ions. When it fires the differential is released as a pulse of electricity [5]. This is what is commonly measured in EEC and EMG. But what has also happened at the time of firing is the equivalent of a change in ε – and that is what we monitor.

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Table 1. Brain Grey Matter[1]

Frequency [Hz]	ε
63096	4548.1
100000	3221.8
158490	2339.2
251190	1744.2
398110	1338.4
630960	1058
1000000	860.42
1584900	716.21
2511900	603.49
3981100	505.56
6309600	411.58
10000000	319.67

MATERIALS AND METHODOLOGY

No special materials were used in the following experiments.

Apparatus

The apparatus used in the experiments was a custom designed Epsilon Monitor (EM). This monitored changes in **ε** using a high frequency (HF) test signal. The method used was similar in some respects to equipment producing Electrical Impedance Tomography (EIT) [6], but with three principal differences.

1. EIT monitors impedance (Z), which has two components Resistance and Reactance.[2] The EM monitors changes in frequency, produced by changes in capacitance, which in turn relate to changes in **ε.** ($\delta f \alpha \delta C \alpha \delta \varepsilon$).
2. EIT produces a visual display; the EM produces an audible output.
3. EIT monitors a large number of individual sectors; the EM monitors one general area.

To use the EM the HF test signal is applied transcutaneously, separately, to each of the hands of the subject. The level of the signal however is below that of a Transcutaneous Electrical Neural Stimulation (TENS) system.

The HF test signal is picked up through a cranial inductive loop and it is then passed to a detector circuit where variations in the monitored signal are detected and exhibited as an audio output.

The table below shows how the Electrical Permittivity (**ε**) of a given tissue sample varies with frequency. In this case the tissue was the brain's grey matter. The table is produced by the Italian National Research Council [7] and is a replication of earlier results obtained at Brooks AFB in the US.

As can be seen the value of **ε** varies with frequency. In the EM the value of the applied frequency is dependent on the value of the capacitance measured by the monitor and this in turn is dependent on the value of **ε.**

This is equivalent somewhat to phase modulation, or even frequency modulation. When the frequency or phase modulation is detected then audible speech segments are exhibited.

It is believed that these come from or via the part of the phonological loop/working memory [8] known as the phonological store. (PS) (See below).

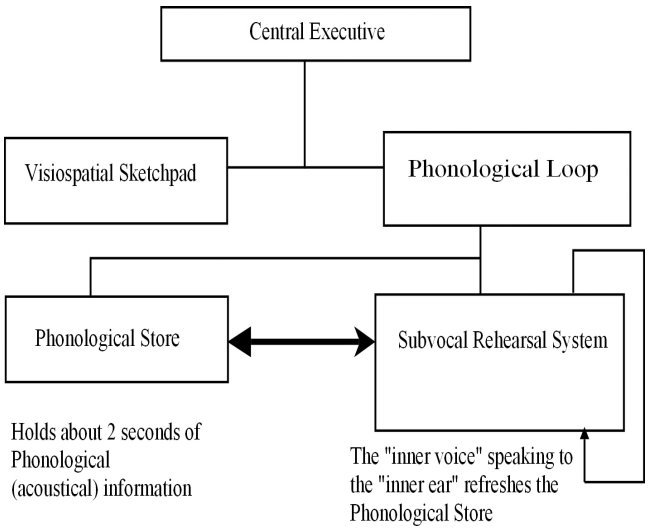

Fig. (1). Working memory showing. The phonological loop[3].

Next, considering the Phonological Store and what goes on in the Subvocal Rehearsal System (Fig. **1**).

A signal flow diagram is shown in Fig. (**2**), including the ubiquitous Comparator functional block.

The results of the sound waves entering the ear are compared with the reference input from the phonological store. This is produced in the form of neural impulses from the PS. The listener has no sense of this happening. When a match is obtained then the process stops.

The process is the basis of pattern recognition, in this case speech recognition.

For speech to be recognised the incoming words have to be matched by words already in the PS.

[1] IFAC-CNR, Florence (Italy), 1997-2007. Application prepared by Daniele Andreuccetti, Roberto Fossi and Caterina Petrucci, based on the parametric model for the calculation of the dielectric properties of body tissues developed by C.Gabriel and colleagues at the Brooks Air Force Base, U.S.A.

[2] $Z = (R + Xc) = (R + 1/j\omega C)$, where R is Resistance, X is reactance, C is capacitance and ω is 2π x Frequency.

[3] With permission, after a diagram from the Dept. of Psychology, McMaster University, Canada.

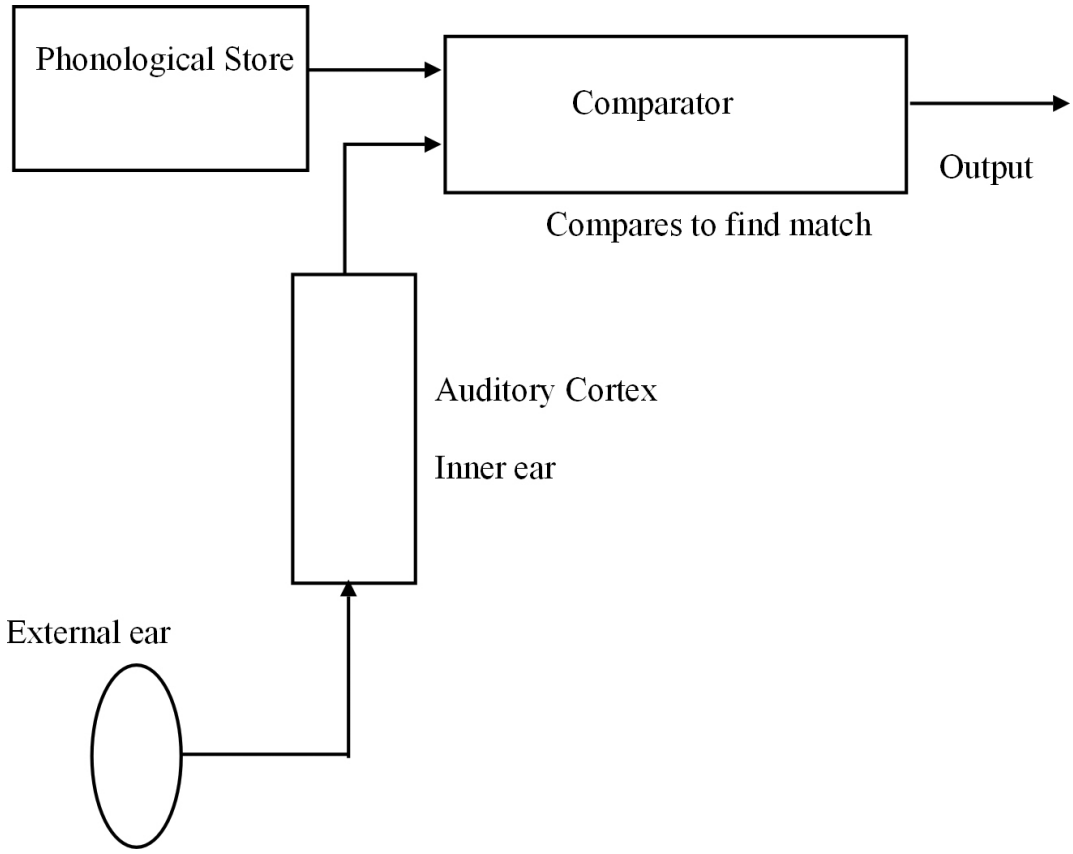

Fig. (2). The phonological loop as a comparator system.

The end result of monitoring using the EM is that phrases are detected that seem to have come from or via the PS section of the phonological loop.

METHODOLOGY

Preamble

Some characteristics of the phrases which would be picked up were already known from previous tests.

- For example, all the phrases recorded were short. The most probable duration for a phrase was between 1.6 and 1.8 seconds long.
- A phrase was most likely to be in the native language of the subject, with occasional excursions into other languages known to the subject.
- There was some degree of correspondence between the content of the phrases and the reported inner speech in cases of schizophrenia.
- There was a strong resemblance between the phrases and what has been referred to as the 'Electronic Voice Phenomenon'. (EVP). In the case of EVP, (which is in itself a subject of more complexity than can be covered here [9-11], the phenomenon is that of the appearance of phrases with no apparent causative agency. These are thus attributed to spiritual sources, and so become an ideal "tool" for the exploration of the relationship between information, spirituality.

Which is why, on a step-by-step basis, this experiment was chosen for a 2 year funded programme.

- Hand movements actuating the motor cortex lead to increased results, this having a resemblance to actuation of the auditory neural regions when silent lip movements track what is being read; and also to the twitching behaviour that indicates the onset of verbal hallucinations in some cases of schizophrenia.

Research Objective

The objective of the program was to compare the results of eliciting electrical signals derived from each of the subjects in response to a small set of verbal stimuli in the form of questions, (hereinafter described as Stimuli); and then, after decoding the signals (hereinafter described as Responses) to compare the Stimuli and Responses, in particular by a comparative examination of their informational content, to determine if the source(s) of the Responses exhibited intelligence.

Laboratory Experiment

Protocol

Four subjects were chosen from those who had already been tested using the EM, on the basis that they were available and had already produced good results, meaning that in prior trials their PS had elicited an above average number of phrases.

All subjects were volunteers, and were unpaid.

A series of 6 questions was designed with each of the questions being simple and requiring minimal engagement of intellectual processes. (The phrases from the PS are essentially from a subconscious source. Earlier experiments had

shown that procedures that required analytical thinking could prevent results being obtained). The questions were predicated on the assumption that the agency involved, be it a neural network, an Internal, or an External, was a discrete entity or entities.

Procedure

1. Each subject was asked to vocalise each of the given questions, in order, at 30-second intervals. The questions were as follows,

1.1. Can you hear me?

1.2. What is the time?

1.3. Are you happy?

1.4. Are you unhappy?

1.5. Where are you?

1.6. What is your name?

2. During this time the subject was connected to the EM and the results, recorded.

3. One round of all six questions was considered a session, and each subject would carry out many sessions over the eighteen months of the experiment phase.

4. After four sessions the recorded EM audio output was subject to editing, and any responses were "clipped" out. The entire selection of clips in a collection of four sessions was then randomised and sent out for analysis by listeners. This continued on a monthly basis for over a year.

5. The first listener – the Adjudicator - was chosen as previous work had shown that he was particularly good at interpreting the generally poor quality audio responses, and that his work was standard and reliable. As mentioned above, information is to some extent observer dependent, and so it was important that the first listener should be a known and standard listener, "calibrated" - and not some ad hoc variable choices who happened to speak the language.

5.1. Because of the randomisation process none of those listening knew *when* in a session a response had been recorded, which person had been the subject, or even which session the clip had come from.

5.2. It was the task of the Adjudicator to listen to each collection and to determine which category each response might lie in, if any. For example "*eight fifteen*" could be construed as a possible answer to the question, '*What is the time?*' In that case it would be annotated as belonging in category 2. Because there was always the possibility that this was purely a fortuitous response a great many sessions with identical questions were carried out.

6. The same collections were also sent out to 10 listeners in the UK and an equal number in the US. They were asked to carry out the same listening and classification tasks as the Adjudicator. They were unaware of the Adjudicator's findings and indeed in which way their results would be treated.

7. When all their results, and the results from the Adjudicator had been returned, analysis could begin.

RESULTS

In order to reveal the results, the responses had first to be de-randomised and then subjected to analysis.

ANALYSIS

The decisions of the Adjudicator were taken as being probably correct and the percentage of the other listeners who agreed with a decision was used as a weighting factor for that decision.

For example if the Adjudicator decided that a phrase was a response to Question 5 – (was in Category 5), and 100% of the other listeners showed the same result, then that decision was weighted as 1.

If only 50% of the other listeners returned the same decision the weighting would have been 0.5. If only 25% had returned the same response the weighting factor would be 0.25 … and so on.

The results were then shown on a 3-dimensional graph, with the height of a response illustrating the probabilistic value of a response as given by its weighting factor. The response is shown as a vertical bar. The time of occurrence of a response is indicated by its position on the horizontal axis, which is marked off in 5-second segments from 0 to 180 seconds – the length of one session.

The 3rd (z) axis is conceived of as a horizontal plane divided into 6 categories, and so the position of any response is determined by its Height, (y); its time of occurrence, (x); and its category, (z).

All sessions in a given month are plotted on the same graph – with the height of a bar being increased if there is a coincidence of the responses co-ordinates x, y, z.

As mentioned in the Protocol, each question had a 30 second interval before the next question. Any response falling with in its correct interval and within its right category was shown as a yellow vertical bar, any response falling outside these stipulations was shown as a red vertical bar (Fig. **3**).

This was the first month of the trials and as can be seen there are 16 bars, two of which represent two responses each, giving a total of 18 responses.

Of these, 10 are in the right category, and right time window, giving an overall correctness score of 55.5%.

The odds against one response being in the right category by chance are 6 to1 against; and the odds against a response being in its right time window are 180/30 = 6 to 1 against.

The chances therefore of a response being in both the right category and the right time-window are 6 x 6 = 36 to 1 against.

The chances of 10 responses being in the right category and the right time-window are 36 to the power 10 against, or 3.65615844 × 10e15, which is approximately 3.65 trillion to 1against.

The very complicated results for later months are given in another paper now under submission.

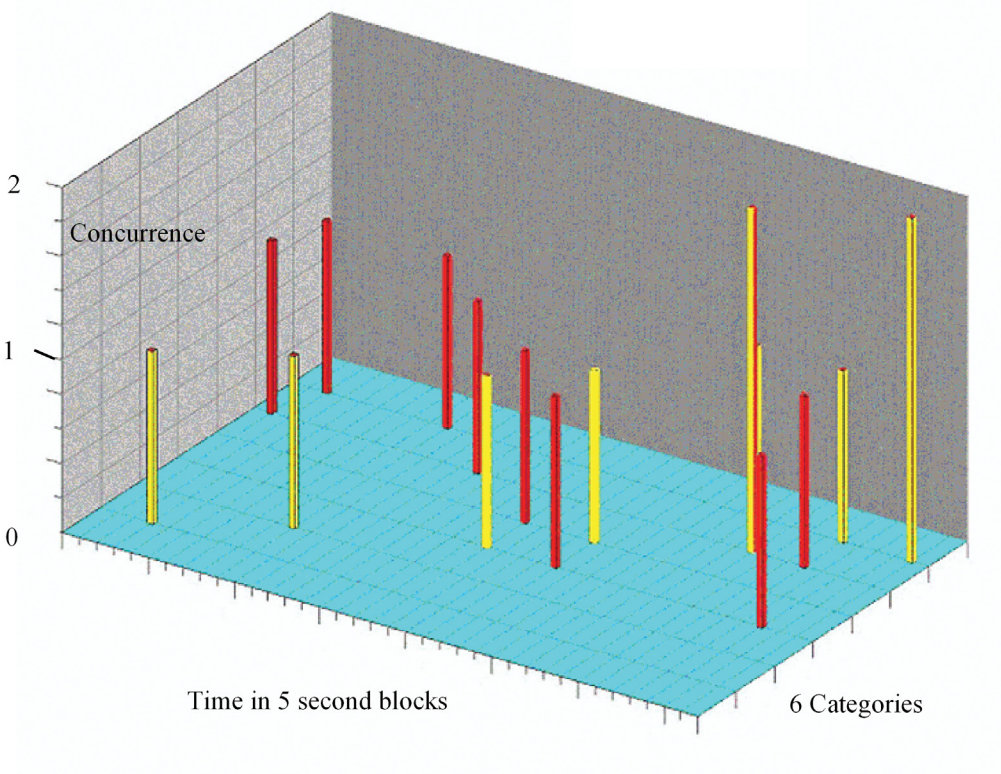

Fig. (3). Electrical equivalent circuit of a neuronal cell.

The results were best at the beginning. But after 3 months, questions were being "answered" before they were asked, and then the relevance of responses to the questions being asked decreased rapidly, as though the questions no longer had any impact. Instead, the responses began to take the form of one response seeming to be a response to an earlier response.

The unexpected phenomenon of answers being received before questions suggest two things- (a) precognition; or (b) a learned protocol – "they" knew what was coming.

We had to stick to the procedure for which funding had been obtained and so did not have the luxury of pursuing other paths.

The matter, at this date, is still unresolved and the program and the personnel involved are long gone.

And then after many months, the protocol ceased to produce results connected to the primary objectives - Responses no longer being correlated with Stimuli.

Instead what the results seemed to show were that Responses were correlating with earlier Responses – as though a theme was being followed.

In the circumstances it has not been possible to investigate this at present.

CONCLUSIONS

From the results obtained it seems quite evident that questions can stimulate a response, and further, that up to more than half these responses may be in context.

This meets the two objectives stated earlier.

However, there are other previously unknown phenomena which require further research to be fully understood.

DISCUSSION

(The Appendices may also be found useful)

In endeavouring to understand the results obtained in the later months of the experiment it soon became clear that we were working at a leading edge in this area.

Even in the most advanced areas of Cognitive Psychology, there was almost nothing defined about the process whereby questions and answers work, never mind the peculiar specialised area in which we were working. However, in order to understand the results we were getting we had to look into the question of how a question led to an answer. Without this understanding, our conclusions would not have much value.

The once popular theory - an analogy to how a digital computer of the time would do it – of the question initiating a search of a "library" - "fetching" and "carrying" the data (the answer) - this theory was totally inadequate, particularly on two grounds: -

- Timing
- And how did it know that an answer was the *right* answer?

Timing

Even taking into account the speed associated with Artificial Neural Networks (ANNs), neurological processes are extremely slow compared with current computers, and yet

answers to questions come too quickly compared with, for example, a current PC.

The situation is that an answer comes too quickly after a question to fit with behavioural theories based on computer architecture analogies.

There were two possibilities,

1) Rather like the Reduced Instruction Set Computer (RISC) architecture that came into vogue some years ago to speed up the operation of computers, could there be a special reduced set of answers for immediate use – a special stack of answers rather like what happens with the FAQs used on websites? Examining the results in detail suggested that this might be so. This is one of the areas that really needs proper research, however.

2) The other possibility related to the concept that every question is followed by an answer-shaped hole. In other words that a Gestalt type of process is involved. As it happens research done at UC Davis came up with some answers that were very relevant [12].

When a phrase has some phonemes deducted from it – perhaps replaced with noise – then the Phonological Loop - in doing its best to try to make sense of the remaining phonemes, will supply phonemes to replace the missing ones. This is similar to what we were trying to do with activating the PS.

The original research in the area of Phonemic Restoration was done by Warren and Warren in 1970 [13, 14]. They played to a number of subjects a recording of a series of phrases with the initial phoneme of the first noun in each phrase being deleted.

For example

- The ‘eal is on the table.
- The ‘eel is on the car.
- The ‘eel is on the orange – and so on.

When questioned afterwards each subject would insist that what they had heard was indeed –

- The meal is on the table.
- The wheel is on the car.
- The peel is on the orange – and so on.

We can almost certainly say that the missing phonemes were supplied by the PS – which is its job. And the missing phoneme would be supplied along the non-sensory route as shown in Fig. (**2**). The listener would not be conscious of that process – it would be subconscious.

But that raises a couple of questions.

How did “the subconscious” know to stick an ‘m ‘ on the front when the word ‘table’ had yet to be heard?

The answer is of course that the “Subvocal rehearsal system” went into high-speed circulation to find a phoneme that would complete the phrase to make sense – before the listener heard the phrase. And what the listener heard – without knowing the difference – was a combination of sensory and non-sensory inputs.

This has profound implications in the relationship of information to spirituality.

In the UC Davis experiments they used a more elaborate system based on tri-syllabic words with missing phonemes – the PS had to come up with at least three phonemes to achieve a satisfactory result. And there was an illusion of continuity even when parts of the word were missing. Quoting from their abstract [6].

‘The brain uses context and prior knowledge to repair degraded sensory inputs and improve perception. For example, listeners hear speech continuing uninterrupted through brief noises, even if the speech signal is artificially removed from the noisy epochs’.

Using fMRI brain scans they found that a Gestalt process was involved.

We already know that in biochemistry, receptor sites for particular proteins utilise a Gestalt type process. It is also common in biology to find that a successful process in one area is often repeated in another area.

In the case relating to the operation of the PL in the UC Davis experiments, a spoken test word would be introduced with a phoneme or phonemes missing. What the rehearsal component of the phonological loop does is to try to achieve comprehension by finding a match through successive approximation – a common technique in many fields.

Thus, if the test word was “*mxchanism*”, and the contextual environment suggested a system of some kind, then the PL might try - *machine, machinery, operation, operator, control, controller* … and so on and so on ... looking for ‘best fit’. This could take (relatively) some time and an increased blood-flow.

In the Gestalt method – fit a, e, i, o, u … all the phonemes in turn, in “the hole” (where the ’x’ is), to see which one resulted in a valid word. This is obviously a more efficient and faster process.

Thus, through these experimental results indicating that the speech process involves a Gestalt mechanism, the results obtained through the use of the EVP “tool”, though unexpected, and outside the experimental protocol, are nevertheless now more understandable.

We are interested in question such as, is there some way in which we can define a difference or differences between information that does not seem to have a physical basis, (such as EVP), and information originating from a physical source, when, in some cases, they both sound the same, both have the same and appropriate waveforms and spectral plots?

This is an area that will require more and continuing research.

APPENDIX 1

Marriage in a Catholic Church

The Questions are: –

Why should spirituality be equated with information? On what basis?

Does this mean that religious practices are not spiritual, or does it mean that getting married within the Catholic Church, for example, is merely an information process?

One would hope that, if it is truly a case of Holy Matrimony, then the marriage in the Catholic Church would have a spiritual component, which indeed may be the main feature.

We have to ask which parts of the wedding are spiritual and which, not. Or are we to consider the whole thing as spiritual?

If so, then we must regard the altar as spiritual, the robes of the priest as spiritual, and so. Then there are the candles perhaps – are they to be regarded as spiritual. How about the groom's socks, or his shoes?

And the other problem with attaching cultural baggage – if the marriage in the Catholic Church is spiritual including its material attributes – how about a marriage in a Buddhist Temple, or a Chinese civil ceremony, or in a synagogue?

Is Holy Water to be considered as spiritual? Then how about Tibetan Prayer Wheels, or the chicken blood spilled in a voodoo ceremony by its priest, or the oil used in a coronation ceremony, the sacred mirror and the comb in Shinto, the comb and the sword on Sikhism?

To the person who believes that the chicken blood has been imbued with some power, the rite is spiritual. To the person who believes that the Holy Water has been imbued with some power, it has spiritual properties.

The conclusion must be that the spirituality comes from the belief of the believer.

Finally, in connection with that, just a thought experiment.

A Wedding in a Catholic Church

The officiating priest, a severely disillusioned man, is an atheist.

The bride is an immigrant looking for a passport. The groom will get $10, 000 for marrying her.

The congregation are the groom's employees whom he has given the afternoon off work to attend, to make it look like a proper wedding.

How spiritual is that.

The church is the same, the candles are the same, the priest's robes are the same, the form of words is the same – all the material things are the same.

Surely it is the non-material aspects – the love and commitment and promises, the memories and joy and sorrow that are spiritual – and the principal component of all of these is information.

Quod erat Demonstratum.

(Which was to be proved).

APPENDIX 2

Neurons – Their Capacitance Parameter

To clarify –a neuron is not a capacitor. A capacitor is an electronic component.

A neuron has capacitance – and so does a capacitor.

Neural networks – referring to Artificial Neural Networks, (ANNs), exist in software and have no involvement whatsoever with capacitors.

One thing that ANNs taught us, about a quarter of a century ago, is that the mind does not function like a digital computer.

The symbol ε (epsilon) represents electrical permittivity in this context, and is a property of free space (in-vacuo). But if a material exists within the space then the value of permittivity changes and the new value of permittivity is then compared with that of the in-vacuo value, and this becomes the relative permittivity.

All measurements relate back to one cubic centimetre and the value of ε is independent of the overall volume or weight of the test sample – if the ε of the sample is 1.3, then it does not matter whether the sample is 1 gm or 1 kg, the value of ε is still 1.3.

Consider a capacitor with two metal plates separated by air. Then the capacitance of the capacitor will be altered if the intervening space is filled with a slice of mica – because the ε of mica is much higher than that of air, and this means that the capacitor will be able to hold more charge between its plates.

Suppose now that there are small holes drilled through the sliver of mica – then its ε will alter slightly, because the holes contain air, and so the composite ε (mica and air) will be changed somewhat.

In a neuron a membrane separates electrically charged atoms (ions) and in the resting state of the neuron this charged state is maintained. It is maintained because the membrane is not permeable.

However, there are across the membrane tunnels called microtubules, which normally are also impermeable.

But when the neuron is "triggered" the microtubules become permeable – enabling a flow of electrical charges across the membrane. And it is this discharge that appears as a short blip of electricity – the neural impulse – that travels up the nerve fibre.

Finally, contextualizing the whole thing, the following is taken from Medical-Wiki.

The full thing can be read on the student.doc page(s) on the Medical Wikipedia.

http://www.studentdoc.com/medical-wiki/The_neuron_equivalent_circuit

A more substantial cross-disciplinary treatment can be found at,

http://www.bem.fi/book/10/10.htm

The Neuron Equivalent Circuit

From Medical-Wiki

The electrical properties of neurons can described in terms of electrical circuits. This approach helps us understand how a neuron behaves when current flows into it (for example, when ion channels open), or why

unmyelinated neurons conduct more slowly than do heavily myelinated neurons.

The Neuron as RC Circuit

Current can flow across the neuronal membrane through a couple of paths.

Resistors: When there are open ion channels, current can flow through these channels. Each ion channel is a small resistor - and the more open channels in the membrane the more resistors in parallel (so an over all smaller resistance).

The amount of current that flows through these resistors is given by Ohm's Law:

$i = V/R = gV$

V is the driving voltage on the ion, which is defined as the difference between membrane potential (Vm) and the reversal potential of the ion (Eion), given by the Nernst Equation. The driving voltage on a given ion species (Na+, or K+ for example) is therefore:

$V = Vm - Eion$

Conductance (g) is the inverse of the resistance. Conductance increases (resistance decreases) whenever ion channels open, whether due to ligand-binding, voltage changes, or other gating mechanisms.

Capacitor: In electrical circuits, capacitors are structures that are conductor plates separated by a non-conductive material called a dielectric. A voltage across the plates of the conduction plates charges up one plate, pushing charge off the nearby plate. But the plates can only hold so much charge, so current only flows for a short while.

In the cell, the conducting plates are the intracellular and extracellular solutions, separated by the non-conducting membrane. Just like the electrical element, applying a voltage step across the membrane induces a brief current:

$i = C\ dV/dt$ (current is proportional to the capacitance C and the rate at which voltage changes with time)

The larger the cell the more conducting surface there is apposed to the non-conducting membrane, so the larger the capacitance. A given area of cell membrane has a fixed capacitance (the unit capacitance of cell membrane is approximately 1 microFarad per square cm), so the more membrane the greater the capacitance (Fig. **4**).

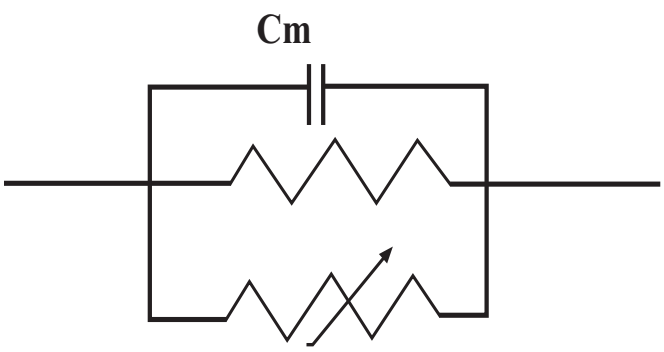

Fig. (4). Electrical equivalent circuit of a neuronal cell.

The RC-circuit: The cell membrane can be modeled by a resistor and capacitor in parallel. In the figure, there are two resistors drawn, one is the constitutively open potassium channels that make up the leak current and are the dominant determinant of the resting membrane potential (Rleak). The other is a "variable" resistor that represents other ion channels that can be opened when their gate is activated (for example, by voltage-gating or ligand-gating).

Time Constant

Whenever there is a step change in voltage across a membrane (or a step current injected across the membrane) it always takes some time to reach a steady state response. Because the cell never completely reaches steady state (it approaches it asymptotically) we instead measure the time it takes to reach most of the way (about 63% of the way) to its final value: the time it takes to get 63% is called the time constant, tau.

For any circuit composed of a resistor and a capacitor (an RC circuit) the time constant is equal to:

$$tau = RC$$

So a neuron's time constant increases with resistance (and decreases with the number of open ion channels) and increases with its surface area since capacitance is proportional to the surface area of the membrane (so larger cells take longer to reach steady state than do smaller cells).

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