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My journey in Science and Art

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My journey in science and art

By Dr. Constantinos Zeinalipour-Yazdi

An autobiography of the scientific and artistic journey of a computational chemist from the time of his undergraduate, postgraduate and academic time. It outlines various discoveries made regardless of the unemployment risks that young scientist face nowadays. Some discoveries where a matter of luck but other come after years of systematic studies. Strong bonds with scientists are formed from this scientific endeavor.

May 2024

London

Dedication

The book is dedicated to my Father who has always inspired me to reach my full potential in science

1. The influence of magnetic fields on human health and the rhythm of heart

Magnetic waves are all around us. Cellphones and living organisms produce magnetic waves and it is important to analyse these waves and their effects on human health. Here I provide conceptual evidence of the importance of magnetic fields in human health through their action in neural Rosettes. Neural Rosettes that are postulated that in humans may be the generators of magnetic fields that may help humans to interact with other living beings.

From basic physics is well known that wherever there is an electric current based on Maxwell's equations there will be an electromagnetic field. Some animals are capable in sensing these magnetic fields. An example is the ampullae of Lorenzini which are electroreceptor organs that sharks developed to sense the electromagnetic field that living organisms produce.(1) There are hundred such electro-receptors in a sharks head which help sharks detecting pray hidden in sand by sensing their magnetic fields. These sensors may also be used for orientation and navigation purposes by sensing Earth's magnetic field.(2) Current western medicine uses machines to measure the electromagnetic fields of various organs to determine the health of a patient. Some typical examples are the electrocardiogram (ECG or EKG) where the heart's electrical potential is measured at 12 different angles around the heart and recorded over time, mapping the direction and magnitude of the heart's electrical depolarisation. Another example where electric fields are measured in medicine is the electroencephalogram (EEG), which measures the electromagnetic fields produced by neurons in the brain. These 'brainwaves' can be observed in EEG signals in the frequency domain. Therefore the EEG signal can be used to diagnose epilepsy.(3) It can also be used for the diagnosis of tumors, stroke and other local brain disorders. It is therefore important to understand the effect of magnetic waves on human health and understand the mechanism in which mental health is affected by such waves (see Fig. 1).



Fig. 1. Drawing by Constantinos Zeinalipour exhibited in the online art exhibition “superposition of waves” in London that shows the importance of waves in humans and their interaction.

1.1 Magnetoreceptors in sea turtles

The ability of sea turtles to find their way to the sea or to travel migratory pathways that are very complex has fascinated marine biologist for some time.(4) This ability of the sea turtles has been attributed to their advantage of sensing magnetic fields such as earth’s gravitational field using magnetoreceptors.(5) It is reasonable to expect that the Earth’s gravitational field may vary from on location to the other, since the local topography and geology may vary having regions of higher density, deeper tectonic structures, deeper sea levels and mountains which can all affect the intensity of the gravitational field at a certain position on the surface of the Earth. In the sea the

turtles may record the intensity of the gravitational field and use it later for navigation. These so called 'magnetic maps' help turtles to navigate the topography of the sea over large distances and in complex routes.(6) A recent study has confirmed that adult turtles use Earth's magnetic field for their movement across the ocean in pathways that are too complex to be explained otherwise.(7) The exact mechanism of the magnetically induced navigation of sea turtles is however not yet well understood.(8) Especially what organs do sense these magnetic fields and how the magnetic maps are stored.

1.2 Electromagnetic induction in coil conductors

From physics we know about electromagnetism, an eddy current is a loop of electric current induced within conductors by a changing magnetic field in the conductor according to Faraday's law of induction.

A coil of copper when connected to a galvanometer that measures the potential across the coil can induce small electric currents when the magnetic field that enters the coil changes intensity. It is the relative motion of the magnetic field within the coil area that induces the electric current at the galvanometer. A stationary magnet would not induce any current and only a magnet that is moved in and out of the center of the coil would induce an electron current. Therefore it is only changes in the magnetic field, which are recorded by this closed circuit. This was first explained by Michael Faraday in 1831 and is known as electromagnetic induction and is due to electromotive force abbreviated as emf. We observe that such circular structures of conductors are also present in neural Rosettes which are circular bundles of neurons.

1.3 Magnetoreceptors

Magnetoreceptors are organs in animals or devices in labs that can detect magnetic fields. Some have hypothesized that these magnetoreceptors are made of small particles of magnetite which is an iron oxide with magnetic properties. These magnetic particles transduce the magnetic fields into nerve impulses. Photoreceptors have also been postulated to generate nerve impulses from magnetic fields. In some animals cryptochromes which are light sensitive

proteins have been postulated to form the some sort of magnetic compass. Some fishes such as sharks and rays have electroreceptors which can also sense magnetic fields generate very weak magnetic currents. This has been postulated on the basis of these fishes navigating in very complex marine environments. The exact mechanism of this magnetoreception is not well understood as it is for other sensory reception systems such as smell, hearing and vision which is usually attributed to certain cells that transduce the sense into electrical impulses.

The exact location of magnetoreceptors in humans and animals is not currently known. In principle because magnetic fields can penetrate biological tissue unimpeded they could be located anywhere in the biological body and therefore are difficult to be located. Secondly magnetoreceptors might be tiny and dispersed throughout the body of humans and animals. Thirdly it is currently unknown if the magnetoreception induces chemical reactions within the body or if the mechanism of forming nerve impulses is more direct. Therefore it has been very challenging in order to study these mechanisms in humans and in animals.

1.4 Electromagnetic induction

It is known from basic physics that an electrically conductive bar that moves through a magnetic field induces positive and negative electrical charges at the edges of the conductive bar. This happens in all cases except when the bar moves parallel to the magnetic field lines. This charge separation generates a constant voltage across the bar that depends on the speed and direction of the magnetic field. This voltage generates small electric currents that maybe result in nerve impulses.

This mechanism of magnetoreception has been postulated in elasmobranch fish such as sharks (Kalmijin 1978), rays and skates. The bodies of these fish are conductive and contain sensitive electroreceptors called ampullae of Lorenzini. It is postulated that these electroreceptor can monitor weak electrical currents generated by electromagnetical induction. This mechanism is possible in aqueous media that are electrical conductive but would not work in

ambient air that is electrically insulating. Therefore the mechanism of magnetoreception may in principle be different in land animals than in sea animals.

1.5 Magnetite crystals

Another postulated magnetoreceptor are small crystals of the mineral magnetite, which is an iron oxide (Fe_2O_3) and is known to have magnetic properties. These crystals are found in sizes up to 50 nm in animals and if allowed to rotate freely can align themselves with external magnetic fields as they are permanent magnets. These magnetic particles are thought to activate secondary receptors such as mechanoreceptors or that they are connected to ion channels by cytoskeletal filaments. In these structure the magnetite particles rotate and therefore open an ion channel that generate an nerve impulse. This mechanism remains however to be proven and could form the basis of a magnetic compass in humans and animals.

1.6 Chemical megnetoreception

In this hypothesised mechanism radical intermediates in reaction are intermediates in chemical reactions that are triggered by the Earth's magnetic field. This idea has been expressed as the radical pair hypothesis. In this process o molecule A acts as an electron donor and a molecule B acts as an electron acceptor forming a pair of radicals. These radicals can have spin antiparallel forming a singlet state or be spin parallel forming a triplet state.

1.7 Magnetic fields in neural Rosettes

It is well known from basic physics that charges that are moving in a conductor will generate magnetic field lines co-centric to the conductor. If the conductor is in a circular configuration and electric current passes through it, then the magnetic field lines are perpendicular to the circle, in the center of the circle and almost all of the surface of the circle. Therefore in principle a bundle of neurons which carry a nerve impulse due to exchange of potassium and sodium ions through its membrane, will generate a magnetic field which is strongest in the direction perpendicular to the nerve bundle. Such neuron bundles are often

present in neural Rosettes which is a radical arrangement of elongated columnar nerve cells which have also been made in vivo by human stem cell research.(9) Based on visual evidence of such neural networks I theorize that in such neural Rosettes the orientation of the neurons is either clockwise or counter-clockwise as this would generate a strong magnetic field during a neural impulse. Such magnetic fields would be maintained through evolution as they can cancel external magnetic fields. Such external magnetic fields may introduce circular induced currents within our body, which maybe counteracted by the action of such neurons. These externally induced electric currents could affect the function of various organs, with the most important that of the heart which requires to maintain a steady rhythm. It is possible that a person which has developed such neural Rosettes which sometimes happens in autistic adults, will become affected considerably by external magnetic fields. These magnetic fields maybe brainwaves or waves that originate from the visual cortex. These waves may reside in the talker if students don't keep eye contact with the talker, where eye contact is a basic mechanism of returning the information that is transmitted through such nerve impulses in vivo and ex vivo. This could also be the basic mechanism that stress is transmitted between humans and animals and in which it causes physical and mental disease. As these external magnetic fields can generate in vivo nerve impulses that cause the contraction of muscles and organs, which if happen for prolonged times may cause inflammation of the tissue that is exposed to such small electrical currents. They can even cause heart palpitations when the electric current generated from the external magnetic field at the neural Rosettes is transmitted to the heart, interfering with its regular function. The human body in an attempt to overcome such external disturbances of its function will attempt to counteract to these external perturbational forces by pumping more blood into the brain. More blood inside the brain means more nutrients (e.g. ATP) will be available to generate a nerve impulse. This nerve impulse when in reversible direction with that caused by the external magnetic field, will have the effect of canceling the external magnetic field. If, however, the external magnetic fields are too strong and for prolonged times then the human body is unable to counter-act to these magnetic fields. This is when the human

body and the brain in particular will absorb energy in the form of neuron impulses generated by the external magnetic fields.

This energy can cause mental and physical disease if a person is exposed to high magnetic fields. This is evident by people living within 100m of high-voltage power lines or a person frequently using a cellular device will have on an average have a larger exposure of magnetic fields. Magnetic fields are also generated by humans so places with high human density such as a busy street, or a concert or a football match have high intensity magnetic fields, in terms of the information they possess and are therefore places where information stored within our brain can be altered and modified. This is why people in whom their brain wavefunctions are locked into a certain mode, due to the way waves superimpose, will go to such events, where the external magnetic field is strong enough to cancel out such standing waves in the human brain.

The exact ways in which information is stored in our brains is not exactly understood. But it is known that words are perceived by the human brain in the form of pictures most possible as it recognises only whole words and not individual letters according to a study of the University of Cambridge.⁽¹⁰⁾ This means that information can be stored in the form of a 2D or 3D superposition of waves that are generated due to the arrangement of functional groups with a strong dipole moment in proteins. So the particular folding and arrangement of proteins can cause a very small in size region of our brain to store information in the form of a picture. Also the mechanism in which information is stored in a picture is transmitted as nerve impulses is currently not well understood but could perhaps be something the various letters are transmitted in the form of a morse code and that the image is encoded into letters, where a letter is represented by an array of on/off neural impulses such as the Morse codes, where dots and lines are used.

It is postulated that another mechanism of the formation of in vivo magnetic fields is the flow of proton charge in H-bonded networks that are cyclic and which are found in proteins. These magnetic fields must be stronger than the ones generated by the diffusion of Na^+ and K^+ through neural membranes in Rosetta neurons. Information is also stored in magnetic fields external of the human body. This can be seen in the interaction of two humans which can have

their relationship encoded in a magnetic field between them. As magnetic fields can penetrate objects at any depth and can travel at infinite distance without significant reduction of their field strength. Information can therefore travel for a long distance and without significant alteration. Therefore two humans can interact in a long distance if such a communication channel is kept open.

The exact mechanism of this may not be exactly understood but there are many who believe that this is done through quantum entanglement with the so-called spooky force that acts from a distance. This force is nothing but magnetic forces. It is therefore true that the motion of planets and the position of stars can have an effect on a person's mental state. This may explain why there is higher criminality when there is a full moon, as magnetic forces during this time, which through the mechanism described earlier increases the blood pressure and stress in humans. It is therefore conceivable that one may encode information in the magnetic fields of stars and planets but also in the magnetic field that connects humans to animals. It is for this reason that couples are generally healthier than single people because information can be sorted and analyzed or even dismissed by two human brains rather than one, which is more efficient. Two humans can therefore exchange information by various routes but the most important is the optical, the hearing and magnetic fields.

Another part of our body that could generate strong magnetic fields due to its structure is the cochlea which is the hearing organ of the inner ear. Its spiral structure can set neural impulses into a circular path that can in principle generate magnetic fields which can transmit information into our brain about the relative orientation of the human body.

1.8 Magnetic fields and mental health

Many ancient religions and civilizations have used magnetic fields to health humans. This is depicted in a recent online art exhibition with the title "superposition of waves" (see Fig. 2).



Fig. 2. Drawing by Constantinos Zeinalipour exhibited in the online art exhibition “superposition of waves” in London that shows the importance of waves in humans and their interaction.

The use of magnetic fields to treat mental health disorders has been around after 1990 where it was suggested by Tofts that magnetic fields can induce electrical currents in the central nervous system.(11) Since then the two magnetic field based methods that have been developed is the transcranial magnetic stimulation (TMS) and repetitive TMA (rTMS) which are non-invasive methods that induce changes in the magnetic field of the human brain.(12) This has also become the key method of investigating the brain function in humans. There is some evidence that it may treat mental health disorders such as depression and anxiety disorders.(13)

A healthy human heart and brain can mean a lot in today’s society that operates in a state of saturation in major cities in the world. It is evident as technology and our understanding of human health and medicine progresses that the measurement of the human health will be based on external non-

invasive methods that map the magnetic fields of the human body. This is already broadly used in Magnetic resonance imaging (MRI) and has had great success in cancer therapy. We believe that closer analysis of the magnetic fields produced by neural Rosettes human may be important in a better understanding of the effect of external magnetic fields on our human health.

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