

The PHYSICS of THOUGHTS

By Ron Spielman

Preamble

This preamble is an explanation why this paper has been submitted for publication to PsychoanalysisDownunder.

I recently read Paul Schimmel's contribution to PsychoanalysisDownunder Issue Number 18. Paul argues cogently that Neuropsychoanalysis and Psychoanalysis occupy entirely disparate epistemological and ontological worlds and any attempted rapprochement is doomed to fail.

My paper "*The Physics of Thoughts*" was begun by me around 2005 and has been "a work in progress" ever since until reaching its present form.

I have long had an ambivalent attitude to Neuropsychoanalysis. Paradoxically, I have long felt that arguments like Paul's are valid ... but ... equally, I have felt that endeavouring to discover how our physical brain supports the highly sophisticated mental processes familiar to us psychoanalysts, is a project worth pursuing.

Perhaps Freud's "*Project for a Scientific Psychology*" was an early manifestation of this hope for a 'neuroscientific basis' for psychoanalytic processes.

Further, there appears to me to be a state of affairs in recent decades in which Psychoanalysis has been 'awaiting' some form of revelation(s) from Neuroscience which will 'demystify' Psychoanalysis and enable it to join the 'family' of neuroscientists. The 'traffic' has so far been predominantly 'one way': from neuroscience to psychoanalysis.

I consider the present 'contribution' to be based in Psychoanalytic clinical thinking and 'offered' for consideration by neuroscientists – and, hopefully, 'endorsed' by psychoanalytically-oriented thinkers.

I have long felt that psychoanalysts freely (glibly ?) describe psychoanalytic mental processes almost as if they are 'concrete'. I know that this is not really so, but take, for example, the psychoanalytic concept of an "internal object". Analysts talk about them and their relationship with one another, as well as their influence on the behaviour of the individuals to whom we might be referring at any given moment, as almost 'real' phenomena. Yes, they are 'real' - at least 'psychically real'. And when we analysts talk to each other we know what we each mean.

Nevertheless, this still begs the question how does the physical brain supports the development of each individual's "internal objects" and consistently maintains their consistency and function ?

The capacity to think is a quintessentially human function. Thinking can only proceed by generating thoughts and using them for either private or social purposes.

What can be more ephemeral than a thought ?

Yet, once generated a given thought can be remembered and retrieved for future use. Indeed, all human knowledge and culture has its origins in individual thoughts by myriad individuals throughout human history.

The title of my paper, "*The Physics of Thoughts*", is intended to provoke an experience of paradox in the reader (how can a thought be physical ?) yet it encapsulates my quest (ill-fated according to those, like Paul Schimmel, and many others, critical of the neuro-psychoanalytic project) to discover how the physical brain neuro-physiologically supports the sophisticated mental processes which we psychoanalysts experience in ourselves and our analysands.

Since beginning my admittedly highly speculative paper, I have come across a number of papers in the non-psychoanalytic literature suggesting that my hypothesised basis for thoughts having a "physical" basis (electromagnetic wave phenomena) may find some support in current and future scientific thinking. [These are referenced at the end of the paper].

So, I offer my paper "*The Physics of Thoughts*" as a serious effort by a "DownUnder Psychoanalyst" trying to accomplish what I consider a legitimate scientific quest: to further our understanding as to how the physical brain accomplishes the complex empirically experienced phenomena of forming thoughts, remembering them, retrieving and expressing them – and, above all, how these *thoughts* and *memories* influence an individual's current behaviour – without which there would be no Psychoanalysis at all !

The PHYSICS of THOUGHTS

Abstract:

This paper will propose the possibility that thoughts themselves are “physical” – that is, that known physical phenomena can support the experienced phenomenology of thinking itself. It is argued that current explanations of brain activity relying on chemical activity (neurotransmitters) and electrical activity (trans-membrane action potentials and conduction) would likely be too slow to accomplish the speeds of mental activity as empirically experienced. An argument will be advanced that electro-magnetic wave phenomena could feasibly account for mental activities – especially those dependent on rapid memory retrieval.

The long-standing arguments about theories of mind have involved the vexed question as to whether “the mind” is a result of knowable neurophysiological processes – or – is somehow independent of the physical processes which take place in the brain and arises (somehow) in a realm of its own, as yet not understood.

Those who (like Descartes) think the mind is a “substance” of its own, have been called “dualists”, while others insist that ultimately the mind will be understood solely on the basis of neurophysiological processes. Those who hold this view are the “monists”.

These arguments have been widely canvassed over recent decades and it is fair to say that, at the present time, the “monists” hold the ascendancy. A fundamentally “monist” position is held by many who assert that “the mind” is an “emergent phenomenon” of the brain. This position holds that whatever “mind” may ultimately turn out to consist of, it will basically do so as a result of brain processes. That is, “no brain – no mind”. This seems logical enough.

This paper will adopt this “emergent phenomenon” position. However, this still begs many questions. It will be the intent of this paper to explore some of these questions, especially from the point of view of “reverse engineering”. That is, the paper will outline some empirically established “facts” about mental processes and question what neuro-physiological mechanisms would be required to support the existence of these empirically observed phenomena. Further, some of the empirically observed phenomena addressed will be some of those encountered clinically in the practice of psychoanalysis.

Any attempt at *emulating the mind* must begin with the “best possible” understanding of how the human mind does indeed function!

While there are a multitude of *mental processes*, many of them cognitive, the main focus in this paper will be on *the psyche* – that is, psychic processes, having to do with the *experience* of being an individual person.

Broadly speaking, the main question will be “where does this aspect of the mind *reside* ?” – and what kind of known neuro-physiological and physico-chemical processes could support this aspect of mental function.

Sigmund Freud, in his *Project for a Scientific Psychology*, asserted that psychic processes would ultimately be shown to be resultant upon biological processes – but at the time of his writing that “project” was beyond then-known science. He did venture that in another century, perhaps, this advance would be made. This paper – a century after Freud’s *Project* – calls upon advances in science to speculate further as to the basis of mental processes in knowable biological processes.

Let me begin with an analogy: a transistor radio, not “switched on”, can be clearly understood to be a physical entity, reducible to its many components. With a charged battery in place to provide energy, and now switched on, the transistor radio can be “tuned in” to any available “broadcasts” of the appropriate frequency electro-magnetic spectrum of radiation.

Whatever music or voice transmission from the relevant broadcasting “station” is “received” by the apparatus – and in turn “played” by the radio - will be the counterpart of an “emergent” property of the brain ... in the radio. That is, the music or voice “emerges” as a result of the physical arrangements and connections of the components of the radio, which are designed to produce “sound waves” which the human ear can discern and “send” to its brain as a perception of voice or music.

Importantly, however, the actual *content* of whatever music or voice is “produced” bears *no relationship whatever* to the physical components of the radio – it bears only a relationship to the frequency waves broadcast elsewhere and subsequently received by the physical components of the radio – and, in turn, reconstituted as the sounds originally broadcast.

[It is important here to acknowledge that whatever “emerges” in the above analogy derives from the radio’s “external world”. In the case of the human mind, the analogous “broadcasts” derive from the “internal world”.]

The radio will produce sound only as it “exists” in the form of radio frequencies which are in the neighbourhood of the radio *at that very instant in time*. The radio merely transforms the inaudible radio wave frequencies into audible sound. [... as the human eye and brain together transform invisible electro-magnetic (light) frequencies into *experiences* of seeing objects !].

Consider now, a transistorised compact disc player. Again, there are physical components capable of producing sound. This time, there is no external “broadcast” to be received. Once again, an energy source (a battery) is required. Also, a “CD” (compact disc) needs to be inserted into the apparatus and the apparatus activated.

The CD player will accurately and reliably produce an audibly transformed replication of whatever sounds were inscribed (“recorded”) by the relevant laser-based mechanisms on the compact disk. This disc can be played and replayed – or, another disc can be inserted and likewise reliably played to reproduce the original sounds.

This “analogy” has been laboriously outlined to establish a number of points necessary for the paper’s arguments.

1. The radio can respond to the relevant wave frequencies of the moment (the present) – but has no “memory” of the past. It has a present – but no past.
2. The CD player has the capacity to play and replay “stored” information – it has the equivalent of a “memory”. However, its “memory” is static and unalterable. It has a past – but no present.
3. The nature of the sounds produced are entirely related to either the properties of the frequency waves received by the radio, or the laser-encoded information stored on the CD player – but in no way are they related to the physical components of either apparatus.

If this crude analogy can be accepted in the service of making a few points about the mind-brain “problem”, they are that while the *physical* make-up of multitudes of human brains may (for all intents) be largely extremely neuro-anatomically “similar”, the minds (psyches) of those individuals will be as *dis-similar* as their physical brains are similar.

Their *psyches* – i.e. their individual personalities – will each have different “presents”, and different “pasts”.

Using the above analogy, individual persons will be “tuned in” to different present experiences (analogous to, but in no way equivalent to, the notion of “tuned in to present ‘broadcasts’”) and have vastly different “pasts” (analogous to the recorded information encoded on any one of a myriad compact disks).

Thus, the labored point (empirically indisputable) is that individuals “respond *to*” and are “activated *by*” a combination of their present and past experiences – their *memories*.

The main question which this paper seeks to address is “where does this past experience (memory) *reside* and *of what is it composed* ?”

Let us establish some further empirically indisputable facts on which the paper will rely:

1. Past experience is (largely) what differentiates human individuals and constitutes their personalities.

As disparate a group as clinical psychoanalysts and Jesuit priests have no doubt that childhood experience is what ultimately shapes the adult personality. Psychoanalysts since Sigmund Freud have repeatedly confirmed that childhood experiences contribute massively to adult behaviour, while Jesuit priests (after St. Ignatius of Loyola) aver: “give me a child until the age of seven, and I’ll give you the man”.

The alternative would be an organism analogous to the transistor radio: an organism that responds only to the present.

What is being established here is the fact that the higher (and some not so high) organisms have *memory*.

2. Memory is not *veridical*.

Many studies have established that memory itself is somewhat (if not considerably) “plastic”. That is, memory does not necessarily reliably record actual events. Psychoanalysts since Freud have worked with the notion that memory can in fact be unconsciously “altered” during life in response to later experience [Freud’s *Nachtraeglichkeit*].

3. Memory is not highly localised in the brain.

Again, many studies have established that quite large quantities of and different parts of the cerebral cortex can be removed or damaged, without significantly diminishing memory. Such studies have been conducted with lower animals, while comparable naturalistic studies in humans who have sustained brain damage incurred in accidents, in wartime, and as a by-product of brain surgery for neoplasm or epilepsy.

[N.B. This non-localisation has to do with *stored* memories. *Gateways* for the encoding of memory are probably much more localised, as (for example) the respective damage sustained by alcoholics in Wernicke’s Encephalopathy and Kosakoff’s Psychosis would suggest. Localisation of a necessary memory *reader* is (as yet) a largely unknown phenomenon.]

4. Memory is *dynamic* – and not static.

Psychoanalytic observation in the consulting room has allowed the disciplined empirical observation of behaviour that occurs in day-to-day life. One of these empirical observations was made at the outset of the psychoanalytic research program by its earliest proponent, Sigmund Freud. This is the phenomenon called “the repetition compulsion”. This involves the apparent compulsion to repeat certain experiences of the past with new figures in the present. Generally, these experiences are of an unsatisfactory or traumatic nature.

It is well known – both within psychoanalysis and within psychiatry and psychology – that many past traumatic experiences remain unresolved in some significant manner and exert an active influence on present experience and behaviour. The point here is that not only the *fact* of the trauma and its associated affects, but also *the content* and *significance* of the past trauma are represented in the present behavioural manifestations of it.

THE ARGUMENT PROPOSED:

A “reverse engineering” approach to the problem of “the mind”.

If we can agree that “no brain – no mind” and that the individuality of persons resides in their experience of themselves as a “self” (from the inside) or our characterisation of them as a “personality” (from the outside), then our problem involves describing the workings of “the mind” as it is involved in the manifestation of personality and the experience of self – and, then, trying to conceptualise what kind of neurophysiological system would have had to be “engineered” (by evolutionary processes) in the first place to produce these workings.

1. A system of rapidly *encoding* experience
2. A system of rapidly *storing* experience
3. A system which rapidly *accesses* stored experience
4. A system where stored experience *actively finds expression in the present*
(in some recognisable form)

As the perspective of this paper is a psychoanalytic one, it needs to be acknowledged that *both* conscious and unconscious mental processes are being taken into consideration. That is, that present behaviour is readily influenced by unconscious mental processes. These involve both unconscious perceptions (as in unconsciously determined interpretations of current stimuli) and unconscious motivations (as in unconsciously influenced decisions in choice-making behaviour).

Thus, point 4 above is a system requirement which takes into account the *empirically derived* fact that stored experience is *actively* involved in determining the nature of perceived experience and in contributing to the motivational influences on present behaviour.

The empirical phenomenon – derived largely from psychoanalytic clinical experience – involving a *compulsion to repeat* past experience in some form requires that past experience has some mechanism of pressing forward its influence.

To summarise the main burden of this argument: on empirical grounds alone, there needs to be a memory “system” which functions very rapidly (especially in regard to *retrieval* of memories and experience) and which permits the stored encoded memory of experience to have recognisable influence on the present-time behaviour of the individual.

To date, it would appear that the main focus of attention on memory systems has been on biological systems involving either bio-chemical mechanisms (as in feeding homogenised earthworms which have “learned” to perform tasks to naive earthworms) or electro-physiological mechanisms (as in localised or diffuse interconnections between cerebral neurones).

It is contended here that both bio-chemical and electro-physiological systems would conceivably fare well in delivering encoding and storage requirements – but would **not** be able to deliver on the requirement of *rapidity of response* as empirically experienced by any introspective person. Empirical experiences of memory retrieval are **extremely rapid** – especially if one considers those instances when long un-remembered (but not forgotten!) memories “pop” into mind with extreme rapidity in response to a relevant stimulus.

However, even *encoding* can be extremely rapid – say in remembering a name or telephone number, and being asked to repeat it immediately.

Further, when one tries to conceptualise (imagine) the number of likely “connections” between neurones and the associated number of synaptic “crossings” which would be required, in even a relatively simple “piece” of encoded memory, then a finite amount of time would be involved (each and every synaptic crossing would require a finite measurable number of milliseconds), which – it is argued here – would far exceed the *actual* time as empirically experienced by any introspective individual.

What kind of system could – conceivably – meet the demand requirements of encoding, storage and rapidity of retrieval, together with the requirement of actual *unconscious* influence on the person’s behaviour ?

ENCODING, STORAGE and RETRIEVAL

Nowadays, there are many readily recognisable forms of encoding of data within a number of biological and physical modalities.

BIOLOGICAL EXAMPLES:

The genetic code is comprised of sequences of nucleic acids, linked in large numbers to form the (now) familiar *genes and genome*. Immuno-globulins encode past experience with identifiable antigens to form appropriate antibodies. Neither of these bio-chemical systems require rapid responses (in terms of milli-seconds), in either encoding or retrieval.

Examples of neuro-physiological systems which have evolved to encode and store “memory” are the cerebellar neuronal connections which store past experience of development of skilled movements. These are seen at their most highly developed in, say, elite athletes or virtuoso musicians, each of whom are able to repeat the most complex practiced movements with extreme rapidity. Retrieval may be extremely rapid, but encoding is probably painstakingly slow.

[In the case of a batter facing a baseball pitcher or a batsman in cricket facing a fast bowler, the *actual* distance from pitcher or bowler to respective batter or batsman, bears a computable relationship to the response times biologically possible for perception of speed and direction of the ball and the required response.]

These albeit few examples of biological systems involving storage of experience and retrieval of appropriate responses are offered as representative of *known* biological systems dealing with “memory” (i.e. stored experience).

NON-BIOLOGICAL EXAMPLES:

The field of recording of music and speech in the radio and TV arena would be readily recognisable instances of encoding and storage of experience. Audio-tapes and video-tapes are all-too-common examples of encoding sound and vision in electro-magnetic wave forms on suitable magnetic tapes and retrieving them with the relevant equipment. High degrees of reliability (fidelity) can be achieved in storage and reproduction.

In this instance, encoding and storage are almost instant, as is retrieval. For example, a skilled sportsman can alter a previously stored response where required.

A familiar sight now in supermarkets is the almost ubiquitous “bar code”. Here, considerable amounts of data can be encoded in the thickness and frequency of the vertical “bars” comprising the barcode. Here, encoding is via a man-made arbitrary system. This is analogous to any secret code ever devised – say in the course of espionage – where the encoder must make the nature of the artificially designed code known to the decoder. Else the message cannot be retrieved !

THE RELATIONSHIP BETWEEN THE DATA TO BE ENCODED AND THE MEDIUM IN WHICH THE ENCODED DATA IS STORED:

This is an important consideration.

Varying degrees of *transformation* of the data are involved in the different examples.

The example of sound and vision recordings on either audio-tape or video-tape probably represent the least transformation of all. In these cases, sound and sight are electro-magnetic wave forms and are stored in a magnetic medium in the case of magnetic tapes.

In the case of Compact Discs (CDs), the sound or light is transformed to some degree via laser etching technologies into the tiniest “etchings” on the disc, which are then “read” back into electro-magnetic waves of sound and light.

In the case of encoding and storing of data on computer discs, by humanly designed “convention” the letter “a” (for example), when typed on the keyboard, is transformed into a standard sequence of “bytes”, magnetically stored, and retrieved and *re-presented* back on the screen as a re-constituted “a”. The “a” itself has derived from human sources and has no intrinsic “a-ness” about it. Likewise, the computer technology utilised to represent the “a” in electro-magnetic form is arbitrary (but needs to be highly consistent among users).

It is highly probable however, that the physical configurations of an antigen have some influence on the physical configurations of the relevant antibody. Here, the physical characteristics of the antigen will be “recognised” by fitting – in a real and physical sense – the corresponding physical configurations of the antibody.

In the case of the genetic code, there is no conceivable relationship between the physico-chemical realities of a sequence of nucleic acids in a genotype and the physical realities of the resultant phenotype. Nevertheless, the genetic “code” replicates the relevant sequences of amino acids and proteins with considerable reliability, to form tissues and organ systems throughout biology.

What is being argued here is that in some instances there is a necessary relationship between the data to be encoded and the resultant “code”, while in others, the relationship is entirely arbitrary – but necessarily stable and internally replicable.

To turn now to the arena of immediate concern, i.e. that of encoding human experience, consider (for example) the requirement of encoding the memory of something everyday, such as having seen an elephant for the first time. A child with established speech, seeing an elephant for the first time, will have to encode the visual experience and allocate to it a name.

Taking the name first. In whatever language the child is becoming raised, the name “elephant” will consist of a series of *phonemes*. These electro-magnetic sound waves will need to be transformed in whatever manner into either bio-chemical, neuro-physiological – or – some other modality. Difficult to conceive as this might be, what of the whole (complex) *gestalt* of the elephant itself – as well as the requisite links between these two: the word and the picture.

While this transformation will in no way be as contrived as is a human encrypted code, it will certainly not rely on any physical relationship between the sight and sound of an elephant and its cerebral representation. There are no sound waves or light waves within the brain.

But might there not be some other “waves” (or something closely analogous) whereby to *encode* the relevant data ?

THE SPECIAL PROBLEM of RETRIEVAL of ENCODED MEMORY

As has already been stated, the rapidity of empirically experienced memory retrieval places a special burden on any hypothesised memory system.

The assertion here is that known mechanisms based on either biochemical (as in protein or other chemical substances) or neurophysiological (as in cerebral neurones and their interconnections) storage are likely to be too slow to deliver the ultra-rapid retrieval rates as empirically experienced.

To mention only one common phenomenon: slips of the tongue and other parapraxes. These phenomena are experienced as almost instantaneous. For a memory system which depends on a form of “searching” (as in computers) for retrieval, ultra-high speeds would be required which would be beyond biological tissues. Otherwise, a degree of physical propinquity would be necessary to overcome speed-of-search considerations. For both biochemical and neuronal based storage systems, the similar stored elements would need to be physically somewhat close and localised. Current memory research suggests memory is diffusely located and not localised at all.

What kind of memory system could be independent of such localised physical biological phenomena, such as biochemical substances or neuronal connections ?

An HYPOTHESIS:

“Give me a fruitful error any time, full of seeds, bursting with its own corrections. You can keep your sterile truths for yourself.”

[Vilfredo Pareto – quoted by Francis Crick in heading his Chapter 16 (Mainly Speculation) in his book *The Astonishing Hypothesis* (1994). The present hypothesis is offered in the same spirit.]

In this spirit, the following hypothesis is advanced:

A potential system which meets the empirically derived requirements suggested above could be provided if some biological mechanism of generating the equivalent of frequency wave forms could be conceived.

Many current works refer to “oscillations” of varying sorts in cerebral tissues [see Crick, and others]. Although the authors of these works almost certainly imply electro-physiological “oscillations”, the speculative “shift” ventured here is toward “electro-magnetic” energy forms. Reasons for this, and supportive “evidence” from a variety of sources will be offered.

Advances in understanding of cerebral neuro-physiology now encompass the phenomenology of *neural networks* and concepts involving *connectionism*.

Indeed, the work of Zeki and Bartels (1998) hypothesises a *neurocomputational model of consciousness* involving “**multiple micro-consciousnesses**”. The hypothesis of the present paper benefits highly from a pre-existing hypothesis which could translate equally well into the “demand requirements” for “**multiple simultaneous un-conscious-es**”.

These now almost more than putative phenomena seem now well recognised as playing a possibly very important role in cerebral mechanisms of a variety of types.

It is hypothesised that experience is (somehow) encoded within the interconnections between cerebral neurones (of which there are known to be more than sufficient numbers present in the brain). Neural networks have the important property of being able to modify themselves when exposed to new experience. That is, they can learn.

However, this encoded stored information is not *statically stored* – but, by the nature of the operation of the neural network, exerts a *dynamic presence* within the brain. Put crudely, the “output” of these putative neural networks is always “switched on” and having the equivalent of an electro-magnetic wave form “presence” within the brain.

In some way comparable to the barcode phenomenon, unlimited amounts of data (information) can be encoded within frequency wave forms.

This is the everyday case with telephonic and other broadcast and transmitted communications which saturate the world's atmosphere and subserve many complex requirements. Remote control of domestic appliances relies on this technology. Consider, for example, the finely tuned and complex control of immensely far distant spacecraft by the medium of electro-magnetic transmissions from "mission control" on the planet earth.

The marvel is that these myriad electro-magnetic "transmissions" do not (apparently) interfere with one another and maintain their integrity over distance and time. Perhaps, something analogous is possible within cerebral tissues.

Thus, it is hypothesized that all memories – both personal and acquired language and knowledge – are encoded in electromagnetic 'waves', generated (somehow) by neural networks. These, like the ubiquitous electromagnetic broadcasts, on which our modern civilization depends, are constantly 'present' without interfering with one another. They are almost instantly accessible to retrieval mechanisms in the brain.

EMPIRICAL EVIDENCE in SUPPORT of the HYPOTHESIS

In a broad sense, the hypothesis calls for mental contents (thoughts, memories, ideas, etc.) to be borne (encoded) in some form of "electro-magnetic wave" phenomenon – rather than in the more familiar "electro-physiological", membrane-potential based propagation of nerve impulses.

Granted, there is, as yet, no direct evidence of this kind of "energy" being generated in brain tissue ... but perhaps it has not yet been looked for definitively enough.

Nevertheless, in popular language the phrase "brain waves" is often enough heard. We know that the *lingua franca* often reveals "folk wisdom" which may in turn prove to have some scientific validity. What of the phrases "that rings a bell" and "that strikes a chord". These two phrases reveal an aspect of the individual's experience of the operation of their own mind which must have widespread resonance (sic.) among fellow human beings.

The point here is that popular language (at least in English) seems to point toward empirical experience described as imagery related to properties of the electro-magnetic wave spectrum.

"UNCONSCIOUS INFLUENCE"

[It should be made clear here that in the current context "unconscious" is being used primarily in the sense of "un-aware", but that this includes the psychoanalytic sense of unconscious – as in "repressed" mental content and associated usages.]

One relatively simple example of what is meant by “unconscious influence” is manifest in what has become popularly known as the “Freudian Slip”. This phenomenon, identified by Sigmund Freud, occurs when a person intends to say something and finds himself saying something else – but closely related. It is held that these “slips” are far from random, and are instead motivated by some underlying influence.

As an example, a patient who suspects she may have been sexually abused in the night when she was very young says of the possible perpetrator “I could hear his foot faults coming”. She had intended to say “foot steps” – but the (*unconscious*) underlying accusation is contained in the word “fault”.

Another patient, who had difficulty expressing her anger made the slip “livid memory” – for “vivid memory”.

Someone else spoke of going to a restaurant with their family. The restaurant was called “Nippers”. However, she said “we all went to *Nipples* for dinner.” The possible unconscious association of adults going for a meal with an infant being fed at the breast is not too far fetched (especially for a psychoanalyst !).

Each of these examples (the latter two most clearly) involve a substitution of a word or phrase which *sounds* similar to the intended one. The point here is that some ready substitution of similarly encoded stored data can be conceived of as having occurred.

In addition, the readiness in which the substituted word or phrase appears to be “available” implies that little “searching” for the substitute has occurred. It must have somehow been almost “there”, available for use. If the electro-magnetic wave form of storage of data were the case, then similarly encoded data would be accessed through the closely similar “patterns” in the respective wave forms.

PATTERN RECOGNITION

It is well known that the physiology of the human brain in many of its perceptive modalities relies heavily on pattern recognition. This no doubt is of evolutionary significance in that there would be considerable advantage in readily recognising situations and circumstances which have been previously encountered.

All learning revolves around the comparing and contrasting of new experience with old and developing ways of dealing with novel experience.

From a psychoanalyst’s perspective, this general phenomenon of pattern recognition is manifest in the well known specific clinical phenomenon of the transference relationship. Here, the patient “recognises” some aspects of the current relationship with the analyst as “belonging” to a pattern of past experience (say, to do with the relationship with the mother or the father) and experiences the current relationship “as if” *it were* the past

relationship. [This is necessarily a considerable simplification of a complex clinical experience for the purposes of this argument.]

A major application of the proposed hypothesis here allows for even discrete parts of a complex encoded experience of the past to be “recognised” as a pattern in relation to a current experience, and for the whole of the past experience to become “activated”. Empirically this is commonly seen in Post-traumatic Stress Disorder (PTSD), where even a discrete aspect of the traumatic past experience can rapidly bring the whole of the past traumatic experience into consciousness. Lesser instances of this phenomenon are encountered in every-day life as in the “that strikes a chord” or “that rings a bell” experience.

Psychoanalysts since Freud have relied on this mechanism manifest as *free association*, whereby trains of thought are pursued, driven by the similarity of the new thought to the foregoing thought. The therapeutic benefit deriving ultimately from the unconscious links between (initially) apparently unconnected thoughts leading to uncovering of clinically relevant material. The “linking” will ultimately be found to have depended on some underlying “pattern” in the chain of associations. While in the earliest days of psychoanalytic technique, this pursuit of “free associations” was definitively undertaken by requesting such associations, nowadays, empirical clinical experience has found that in the (non-directive) psychoanalytic setting, all material is inevitably linked by unconscious associations and does not have to be artificially requested.

Patterns of relating, recognisable to psychoanalysts as deriving from early part-object experiences, constitute the object of psychoanalytic exploration in the consulting room. It is contended here that the encoded experiences which relate to these early part-object relationships (especially so in the case of the more primitive personality disorders) are constantly “active” in the mind/brain of all individuals and exert their influence in current day behaviour via a mechanism relying on pattern recognition – the patterns being greater or lesser portions of sequences of electro-magnetically encoded “brain waves”.

SUPPORT FOR THE PROPOSED HYPOTHESIS FROM CLINICAL PSYCHIATRY

(I) Obsessive Compulsive Disorder.

The disorder known as Obsessive Compulsive Disorder (OCD), is quite common, and may involve certain ideas, thoughts and behaviour patterns becoming involved in a reverberating loop of some kind.

(II) Transcranial Magnetic Stimulation (TMS)

In recent times, there have been increasing numbers of reports in the psychiatric literature of utilising TMS in a manner similar to ECT. Instead of delivering an electrical “jolt” to the brain (as in ECT), the brain is exposed to an intense magnetic field. Such (electro-)magnetic external fields could conceivably disrupt the (hypothesized) intra-cerebral

pathology producing reverberating electro-magnetic wave forms – and provide some ‘relief’ of symptoms.

Nevertheless, as with ECT, TMS is at this point based on no particular rationale – other than empirical claims of efficacy. The present hypothesis would provide both TMS and ECT (more so TMS) with a rationale. If depression is contributed to by reverberating thoughts of, say, worthlessness and hopelessness, these may be (at least temporarily) disrupted by the application of either magnetic or electrical fields.

(III) Clang Associations

Clang associations are a well known symptom usually associated with Schizophrenia. The patient classically speaks in a manner which includes rapid associations of ideas which seem based on the *sound* (i.e phonemes) of key words involved in the associations.

SUPPORT FOR THE PROPOSED HYPOTHESIS FROM OTHER DISCIPLINES:

[Regrettably, it is beyond the competence of the present author to explicate these phenomena beyond merely referring to them. Their existence is described in non-specialist literature and their potential relevance is assumed (if not hoped for)].

(I) Quantum Mechanics

At a sub-molecular level, there are known mechanisms wherein “quantum waves” are generated. It is possible that (either or both) arrangements of molecules in proteins, and activities of neural networks could generate some kind of “wave phenomena” which could encode data. [see Penrose and others]

(II) The work of Francis Crick [“The Astonishing Hypothesis”, (1994)]

In this work, Crick hypothesises that known rates of neuronal firing aggregate to produce certain stable rhythms (especially around 20 Hertz), which form the basis of human consciousness.

Although it has been argued above in this paper, that known electro-physiological neurological mechanisms might be too slow to subservise empirically experienced phenomena, nevertheless, ultimately the brain is comprised of neurones and it is to neuronal mechanisms that we must turn. Crick’s “Astonishing Hypothesis” rests on the importance of wave form generation, as does the hypothesis advanced in this paper. The difference here is the requirement that variations in frequency and amplitude of the wave forms themselves may encode the data of past experience (memory).

ANOTHER SPECULATION:

Central nervous tissue (what ultimately develops into the brain) derives embryologically from the *ectoderm* – that is from the external layers of the developing embryo, which are then invaginated and become deeply internal structures.

The speculation involves a notion that these human “ectodermal” tissues – as a result of evolution - derived *from* very early life forms which were “bathed” in electro-magnetic radiations (light !). It is hypothesized that specialized receptors for vision and hearing were “*induced*” by these very electro-magnetic wave forms. The retinas and the lining of the internal auditory canal each derive from *ectodermal* tissues – and are sensitive to electro-magnetic wave frequencies. So, might not the cerebral tissues have an analogous aspect of its function in an “electro-magnetic” kind of manner?

ASSOCIATED PROBLEMS

This model (as do all models of memory encoding and retrieval) requires a decoder of the encoded data.

Such a “decoder” would be related to concepts involved in attention and consciousness. If, as hypothesised, all memory (more or less) is “present” at all times, then conscious attention must involve selection at some point among the myriad data-bearing wave forms which would exist.

It is known – again, empirically – that human beings can attend at any one time to only a limited number of mental processes. This number may be as few as three to five. However, its most highly developed form may be seen in chess masters, who can attend to significant numbers of chess games against simultaneous opponents – even when they are blindfolded!

SOME POTENTIAL BENEFITS DERIVING FROM THE MODEL

- (i) As already alluded to above, the hypothesis would provide a rationale for the effectiveness of both TMS and ECT.
- (ii) Some empirically encountered phenomena, such as dreaming might find support in the hypothesised mechanisms.

For example, the presence of patterns of relationships encountered in dreams reported in psychodynamically based treatments which bear a relationship to the therapeutic relationship might be explained. Similarly, the presence of so-called “day residues” in many (if not all) dreams could result from the “presence” of such memory traces in the sleeping mind, as the work of encoding experience is taking place during sleep (as hypothesised by some theories).

- (iii) In addition to the actual content of thoughts and memories being encoded in the hypothesised wave forms, so too could qualifying considerations be appended (by relevant wave ‘patterns’).

For example, varying degrees of “permission” to access to consciousness could be attached to discrete memory wave forms. It is conceivable in this model that some code for “not to be admitted to consciousness” could be at the base of the well recognised clinical phenomenon of repression – and perhaps, explain the more extreme cases of Repressed Memory Syndrome.

- (iv) The plasticity of memory – and especially that variant described by Freud as *Nachtraeglichkeit* (the retrospective revision of memory in the light of later development) – could be accomplished by revised encoding in neural networks and consequent alteration of the form of the resultant wave-forms.
- (v) For modern psychoanalysis, in particular the current theories reliant more on object relationships than the earlier instinct-based theories, this hypothesis would offer a mechanism whereby the empirically observed phenomena – especially those involving unconscious influence of past experience in present day relationships – could be readily supported.
- (vi) Finally, “slips of the tongue” and other parapraxes would find ready explanation in a manner comparable to the “clang association” described in the phenomenology of schizophrenia. The unconsciously substituted phrase in the slip of the tongue would be as “present” as the consciously intended one. Similarities in the encoded wave forms would make the choice between the consciously intended word or phrase and the unconsciously offered word or phrase an issue at the point of decoding. The choice favoring the unconsciously determined phrase would be influenced by equally “present” unconscious feelings, ideas or motives, which would be vying for expression with all other thoughts, ideas, etc. through the attention/consciousness decoder.

POSSIBLE RESEARCH DIRECTIONS

The entire hypothesis advanced rests on the possibility of the existence of electro-magnetic wave forms in cerebral tissues. Detection of energies in such wave forms in deep space has been achieved by astro-physicists. It should be feasible for bio-medical engineers to utilise comparable technology to detect the presence of even minute quantities of such electro-magnetic energies during the course of open brain surgical operations.

ACTIVITY OF OTHER BIOLOGICAL TISSUES KNOWN TO INVOLVE ELECTRO-MAGNETIC FREQUENCY RADIATIONS:

1. Retinal tissue converts electro-magnetic wave frequencies into nerve impulses which are transmitted along the optic nerve to higher brain centers – as do auditory receptors convert sound frequencies into impulses along the auditory nerve.
2. Bats and some mammals (e.g. dolphins and whales) use echo-location as a means of navigation.
3. Bees seem to rely on detection of magnetic frequencies.
4. Although not yet definitively proven, there is suggestive evidence that users of mobile telephones are more than usually susceptible to tumours of the auditory nerve tissues as a result of exposure to levels of concentrated electro-magnetic radiation from their mobile telephones.
5. Similarly, people living in proximity to high tension electricity installations are suspected of being more susceptible to blood disorders (leukaemias) and other cancers, as a result of the electro-magnetic fields generated by these installations.

CONCLUSION

Drawing upon empirical experience derived from psychoanalytic theory and practice, the “demand characteristics” of human memory encoding, storage and retrieval are outlined and the concept of “reverse engineering” used to hypothesise what is required to “design” a model of human memory.

It is hypothesized that existing known neuro-chemical physiological processes cannot support the empirically required functions of speed of encoding and retrieval of memory – and especially the dynamic (as opposed to static) phenomenology of past experience so strongly influencing present behaviour in humans. Argument by analogy and from empirical data is advanced to support the hypothesis.

This hypothesis rests on the concept that only a system whereby cerebral tissues generate electro-magnetic wave forms (presumably via the operation of neural networks) can the known phenomenology of human memory – and hence thoughts – be subserved.

Appropriately designed research may – in the future - support or discredit this hypothesis.

POST-SCRIPT

Since the earliest draft of this paper in 2007, the present author, despite frequent scanning of ‘the literature’ using *Google*, has needed to wait until now, March 2022, to read the following in a published scientific paper:

“It is possible to continuously measure **living human brain dynamic electromagnetic fields throughout the entire brain** in a non-contact, non-invasive, continuous manner through the human scalp and skull in the standard environment. **The signals are unique to the individual human and can be differentiated from background activity.**” [my bolding]

This is the stated Conclusion of “Novel Method of Electromagnetic Field Measurements of the Human Brain”, Cureus 14(2) by Wiginton, J, Brazdionis J, Patchana T et al. (February 07, 2022).

Yet another recent paper carried the following:

“Here, we use methods of mathematical modeling, psychophysics, and electrophysiology to address shortcomings of the traditional view. Using a model of a generic cortical circuit, **we begin with the simple demonstration that cortical responses are always distributed among neurons, forming characteristic waveforms, which we call neural waves.**” [my bolding].

“Spatially distributed computation in cortical circuits”

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These quotes from the literature are taken by the present author as encouragement for the further development of the hypothesis advanced above.