

EDUCATION AND DEBATE

Patient-practitioner-remedy (PPR) entanglement. Part 1: a qualitative, non-local metaphor for homeopathy based on quantum theory

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A metaphor for homeopathy is developed in which the potentised medicine, the patient, and the practitioner are seen as forming a non-local therapeutically 'entangled' triad, qualitatively described in terms of the transactional interpretation of quantum mechanics. *Homeopathy* (2002) 91, 239–248.

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Introduction

Previously, others and myself have argued for a reinterpretation of the concept of Vital Force in terms of modern non-deterministic complexity theory (see reference 2).¹ In this view, Vital Force is seen as an emergent property of billions of living cells, the totality of which generates an all-encompassing field that, by sustaining itself, organises the elements of that totality into an entity capable of resisting local entropic dissipation. By its very nature, this all-encompassing field is not localised in any one cell, organ, body-part, or consciousness: it is the resultant of the total organism. A metaphor for Vital Force was developed based on the gyroscope.¹

A vitalistic view of health raises profound questions about the nature of the therapeutic process, be it conventional or complementary. This warrants a more fundamental approach than that currently offered by deterministic biomedicine, with its strict

focus on molecular pharmacology. This implies particularly that homeopathy with its highly diluted remedies, repertorised and prescribed by the practitioner after thorough case-taking, are largely believed to be the agency for therapeutic action. This immediately places homeopathy in direct conflict with the biomedical model, with its concentration on the pharmacological action of drugs. How, it is asked, can a medicine, often diluted out of existence, possibly be the cause of any effect, let alone a therapeutic one?

That this question is so formulated reveals its origin in classical biomedicine. Continued attempts to give answers within this framework, eg, by continued double-blind placebo-controlled trials (see reference 3) (which overall have provided positive evidence for the clinical efficacy of homeopathy)^{3b,c} or even by invoking 'water-memory' effects, (see, for example, reference 4) in my view run the risk of confining homeopathy and any discussion of it, within a deterministic paradigm. This is in no way meant to condemn research in these areas: indeed, recent results suggest that diluted and ultra-diluted remedies may well be effective in their own right. Thus, Samal and Geckeler⁵ have shown that molecules of substances dissolved in water tend to clump together

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on dilution rather than getting further apart, as common sense would suggest, leading some to speculate on a possible molecular (ie pharmacological) mechanism for the action of the medicine at low potency. Also, Benveniste's highly disputed earlier work on ultra-diluted and succussed solutions of anti-immunoglobulin E⁶ has found support in the results from a pan-European experiment using similarly prepared histamine solutions⁷. Smith has for many years argued for electromagnetic coherence and memory effects in water⁸. If nothing else (and Benveniste's later work tends to support this), these experiments demonstrate how much there is yet to learn about that most common of planetary fluids, water.

However, the work cited above could have the effect of confining attention to the medicine as the sole therapeutic agent, at the expense of the perhaps equally important dynamics of the patient-practitioner relationship. From this point of view the time has come for the discussion of homeopathy to be moved out of the deterministic biomedical domain, and for theoretical models to be developed that more fully encompass and make sense of its experience, while at the same time not losing sight of the local importance of the medicine. Walach has forcefully argued for such a shift of emphasis and has developed a non-local model of homeopathy based on Jungian synchronicity and semiotics.³ Within the larger domain of complementary medicine, such a move away from purely biomedical explanations of the therapeutic process has long been argued⁹.

In recent years, there have been attempts to inject quantum theory and its concepts of non-locality, complementarity, and entanglement into areas outside the narrow confines of particle physics. Thus, McFadden and Al-Khalili have used quantum theory to develop a wave function describing the quantum state of the genome. Essentially, the wave function collapses as it becomes entangled with its environment: this, they argue, could help explain the (admittedly disputed) phenomenon of spontaneous adaptive mutation¹⁰. Problems of knowledge, consciousness and its interaction with matter have also been probed using quantum theory¹¹. And most recently Atmanspacher *et al* have generalised its mathematical and conceptual framework into a new, so-called 'weak' form that no longer restricts quantum theory to the microscopic domain,¹² but allows it to be reasonably applied to everyday macroscopic phenomena.

Insofar as the patient-practitioner relationship could be explicable in terms of non-locality, complementarity, and entanglement, in this paper I will argue for a qualitative metaphorical description of the homeopathic process in terms of the quantum theory. First, however, it is necessary to give an overview of quantum theory, and a brief discussion on how it has been interpreted. In so doing, I will draw upon the

writings of Dr John Gribbin, who has done much to make quantum theory and its consequences intelligible to a wider audience (For some readable accounts of quantum effects, such as non-locality, etc, the following are suggested, see reference 13).

Quantum mechanics

Introduction: in the beginning

During the early part of the 20th century, the scientific understanding of the physical world underwent a profound revolution. Prior to this, scientists had believed that the universe consisted of matter, which was inert, lumpy (ie, composed of discrete atoms), localised in space and time, and governed by strictly deterministic laws (cause and effect, classical mechanics and thermodynamics). Energy and radiation (eg, light) were imagined as wavy and permeating the whole of space (electrodynamics). Observation, it was thought, changed nothing so that scientists could behave as if they were some kind of *deus ex machina*. It really seemed that apart from some fine-tuning and the odd inconsistency, there were no problems left for scientists to solve.

Light is lumpy: atoms have structure

One of the 'odd inconsistencies' that would not yield to classical theory was how matter and energy were related. In order to pin down that connection, scientists were eventually forced to conclude that at the atomic level at least, energy was not only wavy, it was also 'lumpy' (the 'lumps' being quanta or photons).

Then atoms, far from being inert indivisible lumps of matter, were found to have an inner structure. At first, this structure was thought to resemble a microscopic solar system, with most of the mass of the atom concentrated in a tiny nucleus and 'planetary' electrons orbiting at fixed distances. However, the dynamics of this model also could not be explained in terms of classical mechanics.

This predicts, for example, that an object's exact position and velocity can be known at the same time. For a car, a train, or even a grain of sand, such an idea is perfectly reasonable and demonstrable. Not so, it turns out, for objects of atomic or molecular proportions.

Uncertainty

It was shown that the very act of observation puts limitations on the accuracy of measurements. We can only talk about a most probable position or velocity of a particle, and not because of any lack of precision. Scientists realised a fundamental property of small atomic particles like electrons: is that they do not have a precise position and momentum at the same instant.

And the more we know about a particle's position, the less we can know about its momentum, and vice versa.

This concept was called *complementarity* (a term first used by the Danish physicist Neils Bohr in answer to Einstein's objections to quantum theory),^{13e} and was enshrined in Heisenberg's now-famous Uncertainty Principle—the amount of quantum uncertainty in the simultaneous determination of a pair of complementary variables (eg, position and velocity, or energy and time) is never zero^{13b}—which simply means that we cannot know the present in all its details with absolute certainty. What is more, the amount of uncertainty in the position of an object turns out to be inversely proportional to its mass. So for everyday objects, this uncertainty is vanishingly small. It is only for objects of atomic or molecular masses that uncertainty matters. The seemingly solid deterministic picture of the universe, painstakingly developed over three centuries, was crumbling. Worse (for scientists) was to follow.

Wave/particle duality

One of the properties of waves is that they can be diffracted. This means that they spread out when they pass through a slit, but only as long as the slit's dimensions are small compared with the wavelength. Light does this: in an experiment involving two narrow slits, a diffraction pattern of light and dark lines is produced as the waves overlap and interfere with each other.

X-rays (which are electromagnetic waves like light but of much shorter wavelength) are diffracted when they are directed at crystals, which have regularly spaced lattice structures of atoms that act like very narrow slits. The technique of X-ray diffraction is routinely used to probe the atomic structure of crystals.

But when particles like electrons are fired at crystals, it turns out that they too are diffracted. This is the basis of the famous double-slit experiment,^{13b} which demonstrated that electrons are not just particles: they also have wave-like properties which leads to the notion of *wave-particle duality*.

So, at the atomic scale, energy can be described in terms of waves or particles, and matter can be described in terms of particles or waves. It all depends on the experimental circumstances, in other words the way in which the question is asked. The wavelength of an electron turns out to be intimately related to the uncertainty in the electron's position as a particle: the less certain of its position as a particle we are, the more the electron's probability wave is spread out in space.

The centuries-old deterministic picture of the universe now lay in ruins. Only later was it realised that what scientists had actually done was to trade in a physical theory about the universe *itself* for one that dealt with *what could be known about the universe*. In other words, human experience, knowledge, and its limitations have to be factored into fundamental

theories about the universe. It is as if our thoughts, our very consciousnesses are somehow directly entangled with the quantum physical representation of the world. The problem then is how?

Interpretation of quantum mechanics

Introduction

Quantum theory can be seen as a response to experimental facts from the microscopic world that classical physics could not explain. However, scientists built the mathematical edifice of quantum mechanics without fully comprehending what it all meant physically, and it is an area that still causes controversy.

That part of the theory that provides meaning is called the interpretation and it is only legitimate if it remains true to the formal mathematics. In this respect, there are several interpretations with no general consensus as to which should be used. Two will be mentioned here, but the reason for this lack of consensus is because, whatever the interpretation, apparent paradoxes seem unavoidable. Essentially, these revolve around whether quantum mechanics is considered to operate locally or non-locally.

Locality and non-locality

Locality is a world view that combines 'common sense' with the speed of light. The latter is the upper limit at which interactions between different locations in the universe can take place (thus light takes just over 8 min to reach us from the sun). The 'common sense' is that the physical world has a real existence independent of whoever is observing it.

Until the advent of quantum mechanics, all physical laws were predicated on this local reality assumption, even Einstein's Special Theory of Relativity. Actually, there is now much compelling experimental evidence, backed by theoretical prediction (eg, the statistical significance of the Aspect experiment¹⁴ and violation of Bell's inequality¹⁵), to suggest that at the atomic level at least, the physical world does *not* adhere to this notion of a local reality. The problem then is to decide which part of the world view has to be relinquished in order to preserve quantum reality. Either we:

- keep the speed of light and throw out common sense. This means interactions between different locations in the universe are light-speed limited (ie, they are local), but the universe *now* exists in some fuzzy indeterminate state *until we observe it*. In other words, in this so-called positivist view, *reality is in part created by the observer* (ie, the price of knowledge is the loss of an underlying physical reality),¹⁶ and is the basis of the Copenhagen Interpretation of quantum mechanics.

- or keep common sense and throw out the limitation of the speed of light. In other words, there *is* an objective world out there independent of whether we observe it or not, but that the elements of any quantum system within it are somehow connected *non-locally*, ie, *instantaneously* (faster than light) with each other across *any* distance. This is called entanglement, the implication of this choice being that the universe is fundamentally holistic and is the assumption behind the Transactional Interpretation of quantum mechanics. It will inform our metaphor for homeopathy.

Non-locality has been defined as ‘the mysterious ability of Nature to enforce correlations between separated but entangled parts of a quantum system that are out of speed-of-light contact; to reach instantaneously across vast spatial distances or even across time itself, to ensure that the parts of a quantum system are made to match.’¹⁷

This is sometimes known as Einstein–Rosen–Podolsky or EPR entanglement after a famous paper by these scientists¹⁸ in which they tried to demonstrate the incompleteness of quantum mechanics. Essentially, they argued against the second option above by saying that nothing in the universe travels faster than light, so that two parts of an entangled quantum system could not possibly be instantaneously connected. Einstein famously called this ‘spooky action at a distance’. Thirty years later, the conditions for two parts of a system to be independent were discovered (known as Bell’s inequality),¹⁵ which made it possible to test experimentally whether the parts of a quantum system were entangled as predicted by quantum mechanics. If Bell’s inequality is violated, then non-locality has to be accepted. This has now been experimentally verified many times, most famously by statistical results obtained by Aspect *et al.*¹⁴ Therefore, non-locality or EPR entanglement at the quantum level is a fact. We shall examine later whether or not it can be generalised to everyday life.

Because the physics and maths give no indication as to which of the above ‘options’ to choose, we arrive at different but mathematically equivalent interpretations of quantum mechanics. On the one hand, there are interpretations that preserve the speed of light limit on interactions between different locations, but an independent reality (eg, the Copenhagen Interpretation); on the other, there are those that preserve an independent reality but invoke faster-than-light non-locality, ie, EPR entanglement (the Transactional Interpretation). Ultimately, the choice of interpretation is essentially one of taste. I choose to use the Transactional Interpretation¹⁹ because, in my view, it best resonates metaphorically with the experience of homeopathy.

The transactional interpretation

This is the interpretation that will be used throughout the rest of this paper. To summarise, the beauty of it is that it takes the ‘bull’ of non-locality firmly by the horns by proposing that every particle, like an electron for example, has to be considered not in isolation but as part of a holistic electromagnetic and/or matter/energy network filling the universe. This underlying connectivity between quantum entities means that every particle is instantaneously ‘aware’ of (ie, affects and is affected by) what is happening to every other particle, regardless of their spatial and temporal separation in the universe.

The reason is that the solutions to the equations that describe electromagnetic radiation (called Maxwell’s equations), and the probability waves of matter (known as Schrödinger’s equation) are time symmetric. This means that they are applicable regardless of whether we consider them going forwards or backwards in time. These equations were originally developed in a non-quantum classical context so time symmetry was simply ignored as backwards-running time (and its complement, negative energy) had no real meaning at the ‘normal’ classical level. But at the quantum level there is no escaping this time symmetry of Maxwell’s and Schrödinger’s equations and its implications: when particles emit electromagnetic radiation, or when their probability waves propagate through space–time, they do so into the future and into the past simultaneously. The transactional interpretation of quantum mechanics makes use of this time independence to deal with non-locality.

Where forward-in-time waves (called retarded or ‘offer’ waves) from one particle overlap and interact with backward-in-time waves (called advanced or ‘confirmation’ waves) from another, they do so instantaneously and only between themselves—everywhere and every when else, the retarded (‘offer’) and advanced (‘confirmation’) waves from both particles cancel out. This results in what is called a ‘handshake’ across space–time, which is the observed interaction between the two particles (Figure 1).

The process appears to have a temporal sequence—the first particle emits an ‘offer’ wave which travels to the absorber; this returns a ‘confirmation’ wave to the emitter down the same pathway and the transaction is completed by the ‘handshake—but this is illusory. It is a semantic device that places one ‘outside time’, as it were, so that it can be discussed using ordinary language. Actually, ‘offer’, ‘confirmation’, and ‘handshake’ are atemporal: they happen simultaneously.

Quantum behaviour in everyday life?

Quantum mechanics, its interpretations, and EPR entanglement are thought only to apply to microscopic quantum systems; the assumption made by most physicists has always been that they cannot be

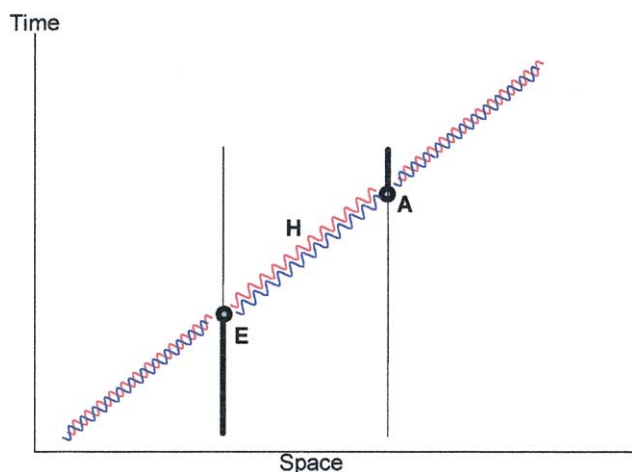


Figure 1 Transactional Interpretation. The emitter quantum entity (E) sends out an 'offer' wave into the future (in red), while the absorber quantum entity (A) sends out a 'confirmation' wave into the past (in blue). Where they overlap and reinforce, a 'handshake' (H) occurs. Every when and every where else they cancel each other out.

generalised to macroscopic everyday life. The boundary between the microscopic quantum world and the macroscopic classical world is known, and is dependent on the kind of mechanics (classical or quantum) that best describes a particular system. Nevertheless, some physicists have speculated on a possible role for EPR correlations in systems usually thought to belong to the world of the macroscopic.^{10b}

Subsequently, it has been demonstrated that size is not necessarily a prerequisite for EPR entanglement.²⁰ What is important is whether the elements of the system behave coherently (ie, act as one indivisible whole) and whether its processes can be described by what is known as a 'non-commutative algebra of observable'. In fact, such non-commutative observables are also a criterion of a non-algebraic formulation of quantum theory. This is another way of saying that when two operations are performed in a sequential manner, the result depends on the sequence. Making bread, for example, is non-commutative in this sense, for the order of mixing and baking the ingredients determines whether we obtain a crusty loaf or an inedible abomination. From this point of view, it could be said that EPR-type correlations might be operating in what are usually thought of as non-quantum systems and processes, which can be described in terms of a non-commutative algebra.

Most recently, a version of quantum theory (called weak quantum theory) has been developed that explicitly allows its application beyond the narrow confines of particle physics, into such areas as philosophy, psychology, and information dynamics.¹⁴ Weak quantum theory does this by stepwise relaxation of some of the restricting conditions that keep quantum theory bound to the microscopic.

Quantum theory and homeopathy

Introduction

The stage is therefore set to develop a quantum mechanical metaphor for homeopathy. But homeopathy is practised on living beings not electrons, atoms, and molecules. It might therefore seem perverse to attempt a description of homeopathy in terms of quantum theory. In the previous sections, I have attempted to demonstrate that not only does quantum theory involve non-locality, complementarity, and entanglement at the microscopic level of atoms and molecules, but that via the weak interpretation of quantum theory¹² these concepts could operate at the level of macroscopic phenomena. The following discussion outlines some ideas that could link homeopathy to quantum theory and suggests the shape and possible direction such an interpretation might take.

The patient, the practitioner, and the remedy

The major task for homeopaths is to find the correct medicine, or medicines, that match the patient's particular pattern of symptoms. This appears to be echoed in the way homeopathy is taught with its emphases on materia medica and repertorisation. This tends to confirm the view that it is the medicine that is solely responsible for cure. Such a view is strengthened by research work highlighting certain coherent properties of water, eg, 'memory' effects, that have fueled renewed interest in the therapeutic action of the potentised medicine.⁴⁻⁹

It is worth noting, however, that even in conventional medicine some advocate a reassessment of the relationship between patient, practitioner, and pharmacological agent. Anthropologically speaking, this is now beginning to be understood in terms of a triadic relationship between all the three.²¹ We do not have to look far to find a similar relationship being advocated in homeopathy.

Kent noted that a remedy is homeopathic when it cures the case.²² Kent was therefore implying that a medicine is only homeopathic when the patient and the practitioner are included or, to use quantum mechanics terminology, entangled. In other words, an unprescribed bottle, say, of *Belladonna* 30c sitting on a shelf could not be considered a homeopathic medicine. We could therefore rephrase Kent's dictum in quantum mechanical terms as follows; *remedies can be considered homeopathic when their locality, as defined by preparation and potency, becomes by prescription entangled with the non-local therapeutic interaction between patient and practitioner; the triadic totality curing the case.* We shall call this patient-practitioner-remedy or PPR entanglement, by direct analogy with EPR entanglement of quantum mechanics.

Let us analyse this statement in a little more detail. As in all therapeutic situations, the process of

homeopathy might be considered to be non-commutative. Thus:

- (1) a patient (Px) experiences symptoms, which results in the search for a health practitioner (Pr),
- (2) the Pr takes the case and, on this basis,
- (3) decides on the prescription of a medicine (Rx)/ course of treatment.

Any other ordering of these 'steps' in the process must give either no result or a different one to that intended. Insofar as this process *is* non-commutative, there is the possibility of a non-local (PPR) entanglement.

Walach³ has described this entanglement in terms of semiotics and synchronicity so that within this interpretation, a triadic relationship between patient, practitioner, and medicine could be envisaged as in Figure 2.

A corresponding and equivalent representation can be developed using the transactional interpretation of quantum mechanics. Thus, in terms of the three-step non-commutative process above, the patient's experience of symptoms and search for a practitioner constitutes the 'offer', the practitioner taking the case constitutes the 'confirmation', while the 'handshake' corresponds to understanding and prescribing of the medicine (Figure 3).

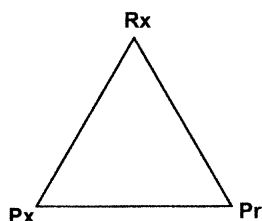


Figure 2 PPR entanglement, where Px represents the patient, Pr the practitioner, and Rx the remedy.

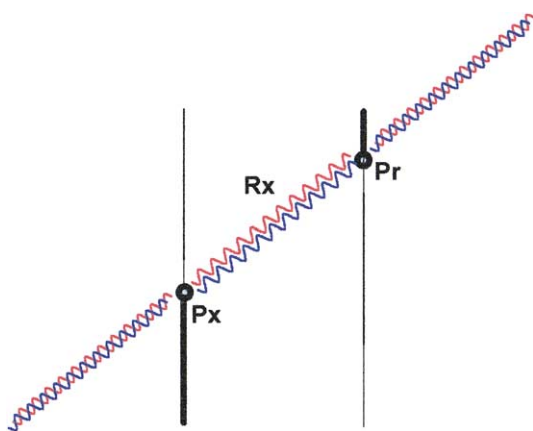


Figure 3. PPR entanglement. Here, the patient (Px) suffers symptoms and seeks help ('offer' wave), the practitioner (Pr) responds by taking the case ('confirmation' wave), and the 'handshake' corresponds to understanding and prescription of the medicine, Rx. Outside the remedial 'handshake', 'offer' and 'confirmation' waves cancel out.

Even though the terminology is requisitioned directly from quantum mechanics, it is still compelling within the therapeutic context, and immediately raises some profound issues.

First, assuming this transactional metaphor is valid for homeopathy, the importance of the medicine now has to be understood not only in terms of its preparation and potency (which arguably equates with its local properties that could be adequately dealt with in terms of water memory effects,⁴⁻⁸ decoherence,⁹ etc), but also within a PPR entangled therapeutic context. The latter unavoidably implies ascribing importance to the intentionality and states of mind of both the practitioner and the patient. In this regard, the quantum mechanical metaphor developed here is equivalent to Walach's approach based on semiotics and synchronicity.³

Secondly, the above could be seen to imply a certain kind of complementarity (in the quantum mechanical sense) between the medicine and the intentionality and states of mind of the patient and the practitioner: the more one concentrates on one, the more uncertain becomes the other. This could certainly describe the situation where a practitioner's concerns about 'getting the right medicine' could prejudice the ability to therapeutically 'entangle' with the patient, thus realising those concerns. Conversely, a practitioner's concerns about fully engaging with the patient could conceivably lead to vital clues (eg from body language, physical symptoms, etc) being missed that could point to the medicine. However, this complementarity could have a deeper significance for (and in agreement with) Walach's prediction;³ the more the homeopathic medicine is concentrated upon as the sole therapeutic causal agent, the less likelihood of finding confirmation in purely clinically-based randomised double-blind placebo-controlled trials.

Finally, as has previously been stated, within the transactional interpretation itself, 'offer', 'confirmation', and 'handshake' are non-local, ie they occur simultaneously and are atemporal. The therapeutic context is most definitely temporal, so there could appear to be a contradiction in the application of this model. I shall return to this point later.

Aggravation

For full PPR entanglement (and presumably cure) to occur, the 'offer' wave from the patient and the 'confirmation' wave from the practitioner must reinforce each other between the patient and practitioner. Every when and everywhere else, they cancel out. Ideally, there is no aggravation. What happens when the patient receives only a partial cure or no cure at all but simply aggravation of the symptoms? This may be explained in terms of the degree of PPR entanglement, which again can be envisaged in terms of the transactional interpretation.

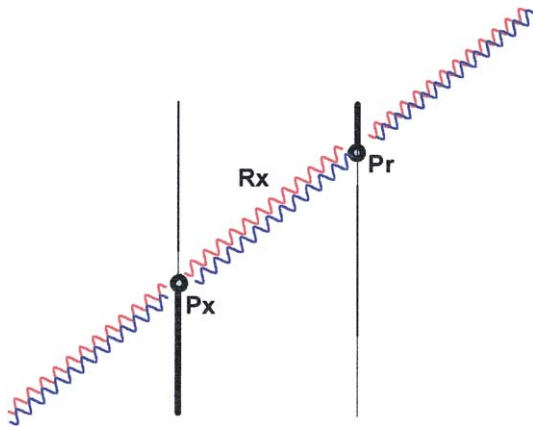


Figure 4 Partial PPR entanglement leading to some improvement and some aggravation depending on the degree of overlap between ‘offer’ and ‘confirmation’ waves between Px and Pr, and production of ‘noise’ every when and everywhere else. Note how overlap between Px and Pr (ie, understanding and prescription), and cancellation of ‘offer’ and ‘confirmation’ waves outside the Px–Pr interaction is not perfect.

One could imagine ‘offer’ and ‘confirmation’ waves not fully reinforcing between patient and practitioner, and beginning to appear non-coherently and randomly outside of this interaction (see Figure 4).

This could result in aggravation of symptoms, perhaps followed by partial cure or no improvement at all, depending on the degree of understanding and medicine prescription (ie, reinforcement of ‘handshake’) occurring between patient and practitioner. There may well be some degree of complementarity between degree of cure and degree of aggravation, which this model suggests.

Homeopathy, animals, and entanglement

It is often claimed that one of the main ‘proofs’ homeopathy ‘works’ and is not a placebo effect, is the observation of the benefit animals gain from properly prescribed remedies²³.

Within the therapeutic context, it has to be recalled that although animals do not partake in the case-taking process, their owners do speak on their behalf. This situation can easily be accounted for in terms of PPR entanglement by considering the ‘patient’ in this triad to consist of the animal and its owner as a previously entangled entity. Under these circumstances, it might be interesting to explore this hypothesis further by seeing what would happen were remedies to be given not only to the animal but also to the owner, and perhaps to the owner only.

Action at a distance

At the end of his paper, Walach proposes that a generalisation of EPR correlatedness could help understand homeopathy as a special case of acausal synchronicity.³ This implies non-locality in the homeopathic process (ie, it is atemporal and involves entanglement), even though that process clearly exists

within time. An alternative way of describing the homeopathic process might include ‘coherence’ between the intentionality/mental states of the patient and practitioner, so that in transactional interpretative terms, ‘offer’ (ie, patient’s experience of symptoms and search for a practitioner) and ‘confirmation’ (practitioner taking the case) are accepted and therapeutic ‘handshake’ (understanding the case and prescribing the medicine) occurs. Thus, ‘prescription’ of the medicine could be said to include the practitioner ‘fully understanding’ the case, ie, when the patient, the practitioner, and the medicine become fully PPR-entangled.

Anecdotal reports exist of patients reporting improvement in their symptoms *before* they have received the potentised medicine.²⁴ When patients began to feel better, this has been claimed to coincide with the moment the practitioner had ‘understood’ the case and decided on the appropriate medicine (ie, the ‘moment’ of PPR entanglement). There are also reports (again, anecdotal) of homeopaths ‘prescribing’ by writing down the name of a medicine and placing over it a glass of water.²⁵ The patient drinking the water has been reported to lead to their symptoms improving. These are clearly highly contentious areas, both for science (which is highly suspicious of anything that smacks of ‘magic’)³ and homeopathy (which might be thought of as sitting uncomfortably between the opposing worlds of science and ‘magic’). It has to be said that highly respected homeopaths like George Vithoulkas have fiercely denounced such ‘magical’ acausal ideas being introduced into homeopathy, especially at a time when ‘the scientific world might be starting to take homeopathy seriously’,²⁶ especially as a result of the work of Benveniste and others.^{4–9}

One cannot help sympathising with these concerns for the future of homeopathy, so that such putative ‘magical’ effects require urgent and serious investigation, if only to refute them. However, acausality is an increasingly accepted feature of a quantum view of the world. Consequently, were these putative ‘magical’ effects of homeopathy to be confirmed, they could be describable in terms of a strongly entangled state being established between the patient, practitioner, and medicine. This entangled triad could be regarded as a coherent quantum-type system, operating non-locally, and perhaps adequately modelled using the transactional interpretation of quantum mechanics.

Healing across time: a quantum mechanical interpretation of miasms

The quantum mechanical metaphor for homeopathy using the transactional interpretation allows an understanding of the concept of miasms and the action of miasmatic remedies. Thus, quantum mechanics tells us that from the perspective of anything moving at the speed of light, like a photon or a quantum probability wave, time and space have no meaning: everything that

ever was or ever will be simply *is*.^{13a,b} So from this speed-of-light perspective, 'here' includes all of space and 'now' includes all of time. In other words, one could say that near and far are all **HERE**, while past, present and future are all **NOW**.

Until quite recently, although non-locality posits instantaneous *connection* between separated elements of a quantum system, the possibility of this being utilised for some kind of signalling across vast spatial distances had been prohibited by the standard formalism of quantum mechanics. It was shown that such 'superluminal communication' (as opposed to non-local connectivity) was impossible because the mathematical operators turn out to commute (non-locality implies and requires non-commutative operators). In other words, 'Nature's superluminal (ie, faster-than-light) telegraph cannot be diverted to mundane human purposes.'¹⁷

Examination of the standard formalism of quantum mechanics reveals that the superposition of quantum waves is always taken to be linear. However, several physicists have speculated recently on what would happen if this superposition of quantum waves were to be slightly non-linear.^{27,28} This is not an unreasonable suggestion as the onset of non-linear behaviour is a common occurrence in other branches of physics, most famously in lasers (where coherent interactions between many photons produce an intense, coherent, beam of radiation). Non-linear behaviour usually occurs in a system when it is driven at high energy. It turns out that when only tiny non-linearities are permitted in the superposition of quantum waves, separated but entangled quantum entities are able to communicate faster than light. Via the transactional interpretation of quantum mechanics, this can be understood in terms of the retarded and advanced waves (that reinforce each other between the emitter and the receiver as the 'handshake') not completely cancelling each other out every when and everywhere else in space-time. Moreover, where these waves exist outside of the handshake, they would be coherent and stable, rather like a soliton.²⁹ Faster than light and backward in time communication between quantum entities then becomes a clear possibility.

Factoring these speculations about superluminal communication between quantum-entangled entities into the perspective of a PPR-entangled therapeutic relationship, it could be argued that this more 'active' coherent form of non-locality implies the possibility of being and operating in the **HERE** and **NOW**, as defined above. Insofar as we each contain the experiential, organic, and genetic consequences of past actions, our present is partly defined by the past and partly (assuming the existence of free will) defines the future. In that sense, we could be said to contain our own **HERE** and **NOW**.

Miasms could be described as propensities for disease in the present as a result of patterns of susceptibility laid down in the past and, if not PPR-

entangled, proceeding into the future. Consequently, via the PPR-entangled transactional 'handshake', and as a result of possible energetic non-linear soliton-like combinations of 'offer' and 'confirmation' waves outside of the immediate patient-practitioner interaction, a miasmatic medicine has the possibility of changing patterns of susceptibility **NOW**, ie in the past, the present, as well as the future, simultaneously.

This differs from the PPR-entangled description of aggravation in that here the non-cancellation of offer and confirmation waves outside the 'handshake' is not coherent, leading to a kind of 'noise' that could be said to generate the aggravation response.

Locality, non-locality and homeopathy

The rephrasing of Kent's definition of a medicine in quantum mechanical terms raises the question of what locality and non-locality mean in the homeopathic context.

Every quantum system is described mathematically in terms of a wave function, Ψ . These are simple for single particles like electrons but are complex for larger entities. It is even possible to consider a wave function for the whole universe.^{13b} In dealing with interactions between quantum systems, the individual wave functions are usually combined together mathematically to produce new wave functions. In this way, for example in chemistry, molecular wave functions can be generated by combinations of atomic wave functions, and so used to predict the energies, shapes, and properties of molecules from their constituent atoms.

By analogy with this formalism, the entities (ie, patient, practitioner and medicine) that each go to make up the homeopathic PPR-entangled state, could conceivably be describable individually in terms of a wave function. Thus, Ψ_{Px} would be the wave function for the patient; Ψ_{Pr} for the practitioner; and Ψ_{Rx} for the medicine (in this context, it is interesting to observe that the notion of 'water memory', as an explanation of how ultra-diluted substances could exert a therapeutic effect, is rooted in a quantum mechanical description of the coherent behaviour of large numbers of water molecules).^{4c} PPR entanglement may be envisaged as a coherent state arising out of the superposition of these individual wave functions, which could describe the non-local interaction between the patient, the practitioner, and the medicine, eg

$$\Psi_{PPR} = \alpha\Psi_{Px} + \beta\Psi_{Pr} + \gamma\Psi_{Rx}$$

where α , β , and γ are coefficients comprised of complex numbers. Bearing in mind the definition of the quantum-entangled state given in reference 20, it has to be realised that the combination of wave functions shown in the equation above is not a simple arithmetic addition, as in 2 plus 2 = 4. It is a sum of products such that none of the original individual wave functions can be factored out.³

The effect of prescribing the medicine is then possibly understandable in terms of the way in which

the individual wave functions are combined. Thus, combining the individual wave functions (in a manner analogous to the way in which individual atomic wave functions are combined to generate the wave functions of molecules; this will be explored in a later paper) could give rise to curative PPR entanglement Ψ_{PPR} as depicted in Figure 3. Here, the entanglement of wave functions occurs between the patient, practitioner, and medicine and cancels out every when and everywhere else in space-time.

In terms of the effect of homeopathy on animals mentioned earlier, the wave function for the patient, Ψ_{Px} , itself can be imagined as a combination of animal and owner wave functions, i.e. $(\delta\Psi_A + \varepsilon\Psi_O)$, so the equation above representing PPR entanglement in the case of animals becomes

$$\Psi_{PPR} = \alpha(\delta\Psi_A + \varepsilon\Psi_O) + \beta\Psi_{Pr} + \gamma\Psi_{Rx},$$

where δ and ε are also coefficients comprised of complex numbers. Again, it has to be realised that this combination of wave functions is a sum of products from which none of the original wave functions can be factored out.

A non-linear combination of the individual wave functions, Ψ'_{PPR} say, on the other hand generates the situation we see in Figure 5. Combination of the individual wave functions could lead to coherent soliton-like waves existing outside of direct PPR interaction and their concomitant effect on patterns of susceptibility laid down in the past.

How the individual wave functions combine might depend on the degree of PPR entanglement. This leads to the prediction that the greater the degree of PPR entanglement, the more likely the prescription will tend to be miasmatic, i.e. the greater the depth of cure. From the idea of treating the PPR relationship in quantum mechanical terms, it may be possible to develop a rigorous non-commutative algebra for the homeopathic process. Such an endeavour could lead to

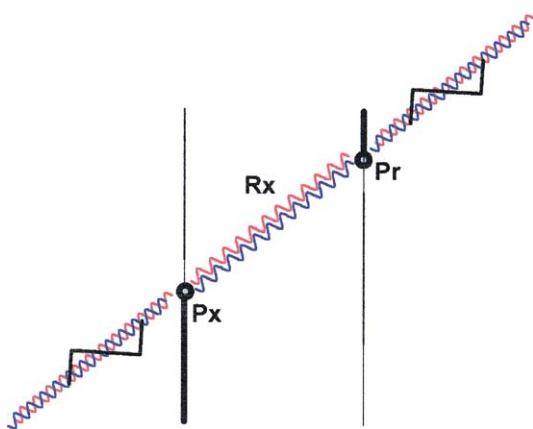


Figure 5 PPR entanglement and the miasmatic medicine (Rx). Non-linear overlap between the 'offer' (red) and 'confirmation' (blue) waves from Px and Pr, respectively, generates coherent soliton-like waves (black) every when and everywhere else that change patterns of susceptibility in the past the present and the future.

new ways of experimentally testing and verifying homeopathy.

Conclusion

In this paper, I have attempted to develop a metaphor for homeopathy based on the transactional interpretation of quantum mechanics. This could allow the medicine to be seen not only in deterministic, biomedical terms but also within the context of an entangled relationship between the patient and the practitioner. I have called this PPR entanglement by analogy with non-local EPR entanglement in quantum mechanics. By treating the patient–practitioner–remedy relationship in such a non-local context, it may be possible to develop a concept of miasms based on the action of disease and susceptibility across time. Homeopathic aggravations and the treatment of animals are also explicable using this model.

Although the justification for this approach rests primarily on the observation that the *process* of homeopathy (like quantum processes) can be imagined in terms of a set of non-commuting operations, other reasons exist for wanting to proceed down this path. Tensions exist between those wishing homeopathy to be seen purely within conventional therapeutic terms, and those advocating a more metaphysical approach.^{24,25} A quantum mechanical description of homeopathy (with its emphasis on non-locality and all that it implies in terms of acausality, synchronicity, and non-determinism) could help to bridge this developing divide.

However, it remains to be seen if such an approach could be expanded into a more formal and rigorous algebra perhaps along the lines of the weak quantum theory being developed by Atmanspacher *et al.*¹² If so, as well as being able to perhaps delineate complementarity between the medicine and the patient–practitioner relationship, it might also suggest ways of testing and verifying homeopathy beyond that of the double-blind placebo-controlled trial.

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