Exploration

An Inquiry into the Frontiers of Physics: Implications for the Problem of Consciousness

Gavin W. Rowland*

Monash University, Melbourne, Australia

Abstract

Consciousness and quantum mechanics both involve phenomena suggestive of nonlocal, or faster-than-light information transmission. This is a contradiction with relativity, which states that no information can travel faster than the speed of light. A nonmaterial message need not be subject to such constraints. It is proposed that, when approaching nonlocal phenomena, we should consider the possible role of dark energy, a nonmaterial substance that appears to occupy all space. Through an analysis of the Big Bang, a model of dark energy is developed in which two energies exist with opposing dimensional effects. The most important of these is a bivalent constructive-destructive effect. The predicted features of these dark energies correlate well with positive and negative affect. A new model of the mind, and of mental illness, is proposed in which the mind is comprised of two nonmaterial energies.

Keywords: Consciousness, quantum mechanics, nonlocal, information transmission, dark energy.

1. Introduction

Within cosmology, it is generally accepted that only five per cent of the energy budget of the universe is made of visible matter. A further 27 per cent is comprised of dark matter, and the remaining 68 per cent is dark energy, which is not matter at all. *Dark matter* is unlikely to be of significance to consciousness studies, as it appears to interact with ordinary matter via gravity alone.

Dark energy is poorly understood, but may be of interest. Firstly, large scale surveys indicate that dark energy is operating in all space, expanding the universe apart at an accelerating rate. This means that dark energy is everywhere, and given that atomic matter is greater than 99 per cent empty space, it is also presumably present within material structures such as brains.
Dark energy is only weakly expansive, and therefore does not threaten to overpower forces such as gravity or electromagnetism here on Earth. Dark energy is invisible and non-material. In fact, it is the only nonmaterial substance in our universe, so if we come across evidence of nonmaterial phenomena, we should consider looking to dark energy for an explanation.

Apart from invisibility, what special properties could a nonmaterial substance have? Material substances can be accelerated to no more than the speed of light. Thus a message carried by a

* Correspondence: Gavin W. Rowland, M.D, Monash University, Melbourne, Australia. Email: gwrowland72@gmail.com

material medium (such as electrons or pulses of light) cannot propagate to or from a location outside of a sphere of influence dictated by the finite speed of light. This is called the principle of locality. A message, or information, which appears to propagate at faster than the speed of light is termed *nonlocal*, or is said to display evidence of *nonlocality*. A nonmaterial substance such as dark energy need not be restricted to the speed of light, and may therefore be capable of nonlocal behaviour.

There are several theoretical consequences of nonlocal behaviour at infinite speed. Firstly, and most obviously, a nonmaterial message could jump instantaneously between two spatially separated locations. Secondly, the finite speed of light is what gives space-time its structure, so removing that restriction means that a nonmaterial message can jump forwards or backwards in time. Thirdly, a nonmaterial 'bit' of information may be able to oscillate at infinite speed between two (or more) alternate possibilities, such as 0 and 1, thus effectively occupying both states at once.

What evidence is there of nonlocal messaging in our reality? Most famously, nonlocality is a recognised feature of quantum mechanics. Secondly, I will argue that consciousness is likely to have nonlocal properties. We will first discuss the quantum realm.

2. Quantum Nonlocality

Quantum mechanics, also known as quantum physics, is the study of matter at the most fundamental known level. Here we see all three of the nonlocal behaviours mentioned above. Quantum experiments have shown that a piece of quantum information, known as a qubit, will simultaneously occupy multiple mutually exclusive values. This is termed superposition. Quantum experiments usually involve extracting a piece of information, say 0 or 1, from the quantum state. A careful analysis of events indicates that the information was held in superposition right up to the point of measurement. The superposition state can be expressed mathematically as a probability wave, and quantum particles are said to have wave-particle duality, as some experiments derive evidence of this inherent 'waviness' whilst others focus on the defined features of measured particles. The point at which the probability wave, or *wavefunction*, is called to account by measurement is termed the wavefunction collapse. This is because the range of quantum-level possibilities collapses from multiple to single.

Wavefunction collapse may include not only mutually exclusive properties, but spatially separated properties. Thus in the famous double slit experiment the pattern of the particles detected indicates that each particle is spread out prior to measurement. Feynman's *path integral* approach (on which rests a large part of quantum theory) suggests that the particle is in fact spread out everywhere - potentially over the whole universe - and the waviness of our results is because the probabilities of the fairly direct paths between the slits and screen tend to interfere. No matter how spatially separated the parts of the wavefunction, the act of measurement appears to collapse its information instantaneously to one point on the screen.

Within quantum-level behaviour, there are numerous other examples of instantaneous action across distance, or 'damned quantum jumps' as Erwin Schrodinger called them. Nonlocal

behaviour is in fact essential to the stability of the atom. Our most explicit examples of nonlocality, however, come from quantum entanglement experiments. In these experiments two particles are set up with the same superposition, say of 0 and 1, and they are also 'entangled' such that if one is measured as 0 the other must measure 1. They can be sent off in different directions to distant locations and measured almost simultaneously. Experiments indicate that the particles 'communicate' (whatever that means) in an instantaneous or near-instantaneous manner, much faster than would be possible with any kind of material (local) message. Whilst it was argued for many years that there must be a material explanation, the work of John Bell has demonstrated mathematically that any messaging must be nonlocal, and recent experimental demonstrations appears to have closed all of the loopholes for a local explanation.[1]

Quantum information also appears to be able to jump across time. In John Wheeler's delayed choice experiment, a variation on the double slit experiment, a camera is trained on one of the slits, but not until after the subject particle has passed through the slits. The standard double slit experiment tells us that the particle passes through both slits, creating the famous interference pattern, but in Wheeler's variation there is no interference pattern, indicating that the particle only passed through one slit. The key here is that the intervention (replacing the usual measuring screen with a camera) occurs *after* the particle has passed through the slits, and yet it only passes through *one* slit - as if it had advance notice of the plan to impose a camera.

Given this evidence, physicists are increasingly accepting that quantum information behaves nonlocally. However, there is no accepted mechanism by which this could occur. Among those who lean towards material explanations, 'many worlds' explanations are popular, as the wavefunction collapse is said to never occur. However in many cases the act of quantum measurement has the potential to spawn an infinite number of alternate universes, grossly violating the law of conservation of energy. Rather than pursuing this option, I think it stands to reason that we should consider dark energy. Given that our quantum experiments are presumably occurring on a background of dark energy, any nonlocal messaging may be taking place within the nonmaterial background. This said, there is nothing in our current understanding of dark energy to suggest that it should have information carrying capacity. That question I will return to later in this paper.

3. Consciousness

There are multiple features of consciousness that suggest the nonmaterial and nonlocal. Firstly, conscious experience is not visible to material instruments, be they our five senses, our radiological techniques or direct examination of the brain. Our conscious thoughts and feelings thus remain private, personal experiences. They have peculiar features that are seemingly unique to consciousness; for example there is no such thing as the conscious experience of the colour red in material physics.

Secondly, it remains difficult to see how the brain can possess free will. The finite speed of action and reaction in the brain binds us to a deterministic chain of cause and effect, leading some to argue that, because brains are minds, free will is an illusion.

Rather than ruling out free will because of its conflict with biological determinism, it is perhaps best to consider the possibilities offered by a nonmaterial substance. As we have seen, nonlocality may permit information to flow backwards and forwards in time. So information could go from 'now' to 'then'. Similarly there is no obstacle for nonlocal information to go from 'now' to 'now', essentially allowing for self-causing activity such as decision-making and creativity. And a nonmaterial consciousness may be able to hold multiple possibilities in a superposition-like state before deciding to enact one option.

The unity of conscious experience, or binding problem, poses another problem to the material approach. Essentially the problem is that the information from our five senses is carried to a variety of centres in our brains. Visual stimulus alone will go to anatomically distinct centres responsible for (among others) face, object, colour and motion recognition. Along with one's thoughts and emotions, these various strands of information all become integrated into the seamless whole of subjective experience. The mechanism of this integration remains unclear. Were this multimodal information being 'uploaded' to a nonmaterial consciousness, the spatial separation of various brain events would no longer be an obstacle.

It is interesting to note that phenomena such as the cutaneous rabbit and colour phi[2] suggest that the mind is 'filling in' the subjective experience using information which is not yet available in a local framework. In this regard, psi phenomena are also of interest.

It is then but a further step to say that the local-nonlocal duality of information seen in both quantum mechanics and consciousness are part and parcel of the same thing. Many involved in the study of consciousness are interested in this direction. For example, the Penrose-Hameroff OrchOR theory of consciousness holds that subconscious states are held in quantum superposition, and that collapse of that superposition is the act of conscious decision-making.[3] Henry Stapp's view is similar.[4] In support of such views, a new field of quantum biology is emerging. The old arguments that living things are too 'warm, wet and noisy' for quantum effects are being silenced by new findings of finely tuned quantum coherence in light harvesting antenna and microtubules.

Quantum experiments involve a two-way communication between the local parameters imposed by the experimenter, and the nonlocal quantum state. David Bohm expressed this as an "unfolding" and "enfolding" of information at the quantum level.[5] The quantum brain may therefore also act as a bidirectional gateway of information between the mind and brain.

Dark energy is present in the background to both quantum and conscious phenomena. I therefore suggest that the nonlocal principles of consciousness and quantum physics may be occurring within this dark energy. Whilst not illogical, this would be very difficult to prove. My theory at this stage makes no testable predictions. But let us pursue this line of inquiry a little further, by attempting to characterise dark energy in more detail. This I will attempt through an analysis of cosmology, and particularly the Big Bang.

4. The Big Bang

Approximately 13.7 billion years ago the universe began in the fiery explosion of the Big Bang. There is no evidence of anything pre-existing this explosion. Rather counter-intuitively, the universe did not originate from a point location, but appears to have originated from everywhere, so that all points are now expanding uniformly away from each other, rather than in relation to a single point of origin. From our galaxy it appears as if everything is moving away from us, but it is the same in every other galaxy too. Whatever that primordial 'everywhere' is, it would seem to be the seed from which the universe as we know it was created.

The universe is immense. Within our visual horizon, as imposed by the finite speed of light, it is populated by more than five hundred billion galaxies. Our galaxy alone contains roughly a hundred billion stars. There is no reason to believe that the universe is anything less than infinite in extent. In itself, this is evidence that the universe began as nothingness, as true nothingness cannot have any kind of boundary or limit, or else it would be something rather than nothing.

A universe from nothing is the central idea of a recent book from prominent physicist Lawrence Krauss.[6] He goes on to speculate, in the same vein as others[7,8] that the universe began as a quantum fluctuation. But this requires the pre-existence of quantum conditions, rather than true nothingness. As I see it, true nothingness is the best place to start, for then the beginning of our story needs no further explanation. Beginning with nothing, it is then logical to say that the universe came with the means of its own creation, for there was nothing else present to create it.

In the interests of brevity I am going to jump in and propose a model by which the universe can be self-creating and then match it up with the observed features of our reality. For a lengthier version in which I review the evidence in greater detail and construct the model piece by piece I refer the reader to my book.[9]

Existence, in our universe, can be summarised at bare minimum as a what, a where and a when. Thus, a little more descriptively as time, three dimensional space, and complex forms that exist through a scale beginning at the simplest subatomic particles, through to incredibly complex arrangements such as the human brain. So I propose here that the universe, because it began as nothing and exists, has to have a means of creating time, space and complexity. Think of time as what we measure with a clock (or any reliable form of motion), and space as what we measure with a ruler (albeit in three dimensions). Thus the universe will need to be able to speed clock time, expand things apart spatially and be constructive in terms of complexity. But in order to generate all of this from nothing and at the same time obey conservation of energy, I would argue it should also possess opposite actions that slow time to zero, contract things to a point and are destructive with regard to complexity.

Let us call these two sets of action the universal increaser and universal decreaser. If they are superimposed they likely cancel out, so we need a second pair of actions, again energy neutral in sum, one of which separates our positive arrows from the negative, the other attracting them together (fig. 1). Taking this a step forward, we end up with three entities, one of which has a positive and negative polarity bound together into one. The other two have single polarities (fig. 2). I propose the separating force to be inflation, a mysterious force which expanded the universe

by a factor of about 10^{28} in the very first second of the Big Bang. Let us now concentrate on the right hand side of figure 2.

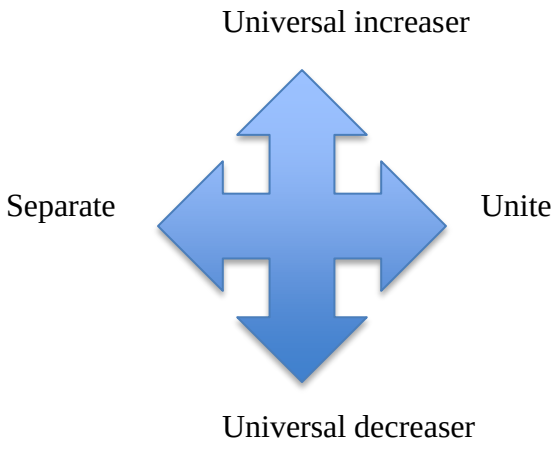

Figure 1. Nothingness breaks into symmetrical pairs.

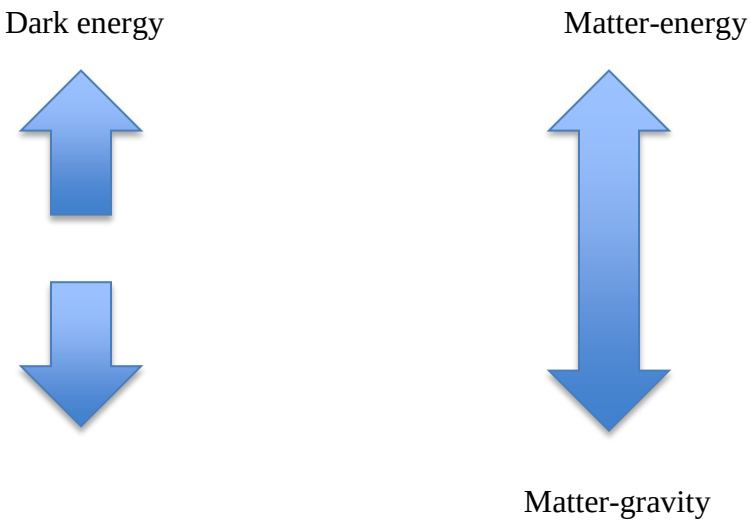

Figure 2. The universe splits into three entities - one is bipolar and the other two are unipolar.

I should point out that we don't understand why our universe contains matter, or why it has the properties of gravity and energy. I propose the right hand side of figure 2 to be matter, with its positive and negative polarities of energy and gravity respectively. Let us test the predictions of the model. Firstly, does energy speed time, expand spatially and behave constructively towards complexity? As regards time, the answer is yes. All clocks, indeed all forms of motion on Earth, are due to energy. When motion appears to be due to gravity, such as an apple falling from a tree, it is actually due to a release of potential energy. Is energy spatially expansive? Again the answer is yes – heat disperses to occupy a space as evenly as possible, as per the second law of thermodynamics. I am here following the energy dispersal interpretation of Lambert[10] and others

(see also entropysite.oxy.edu). And does energy behave constructively towards complexity? Here we encounter the fine tuning problem of the laws and constants, also known as the anthropic principle, goldilocks principle or bio-friendliness principle. All of the laws and constants that apply to energy, of which there are many, appear to be finely tuned to construct complex forms from matter. Were many of them even slightly different, the universe would be still-born with no atoms, stars or galaxies. The arrangement of these laws and constants allows for (on our planet at least) an incredible diversity of immensely complex forms. So yes, energy could be regarded as a constructive polarity of matter.

If the negative pole of the right side of figure 2 is gravity, does it slow time, contract spatially and behave destructively towards complexity? To the first two, the answer is yes – gravity is a warping of spacetime such that, unopposed, it contracts to a *singularity*, within which space contacts to a zero-dimensional point and all clocks grind to a halt. But is gravity destructive? Certainly all complexity is destroyed on the way to a singularity, within the confines of a black hole. But equally, gravity is an essential component in the creation of atoms, stars, planets and therefore life. The way I see it is this - gravity is neither constructive nor destructive. Gravity and energy, being irrevocably bound together, have only one share of complexity between them. Gravity appears to have no inherent complexity and is merely a warping of spacetime. Energy seemingly got all the say in complexity – a plethora of subatomic particles and a variety of laws and constants. In fact, in a lot of ways these particles, laws and constants appear to be *adapted to* gravity. For example, atoms have a low mass density, and a structure which is robust in the presence of Earthly levels of gravity. Further, atoms are curiously well suited to nuclear fusion within stars and supernova explosions. And without stellar fusion, we wouldn't have any elements heavier than helium.

To be true to this model, gravity and energy should balance out in conservation of energy terms. And do they? I am no expert here, but physicists often say that they do. Alan Guth, the physicist who originally proposed inflation, famously referred to this balanced nature of energy and gravity as indicating that the universe is "the ultimate free lunch".

But what about the other side of figure 2, where the arrows separate? I propose this is the nonmaterial side of reality, but you will notice there are two. Guth's "free lunch" statement was made well before the discovery of dark energy, which is approximately two thirds of the energy budget of the universe - albeit a different type of energy from the ones we are used to. If two thirds of the energy budget of the universe is spatially expansive, then we may have a conservation of energy problem within our 'something from nothing' scenario, and Guth's ultimate free lunch statement is in question. But is it possible that there is a second type of dark energy, thus far undetected by science, which results in contraction of space?

So let's look at a scenario in which the Big Bang produces not only a spatially positive dark energy but a spatially negative one as well, and in which the two types of dark energy separate from each other with an inflationary force. The kind of configuration that would emerge from this model would be eternally contracting pools of space within a sea of expanding space. This new model of dark energy may be testable (now or in the future) against a number of outstanding questions in cosmology. Firstly, detailed mapping of the expansion history of the universe may help distinguish between a model in which there is only one type of dark energy, expanding at a

constant rate (termed the 'cosmological constant'), and other models such as mine. It has been known for some years that dark energy expansion only kicked in about five billion years ago, the question being - can this delay be explained in entirety by the gravitational attraction of visible and dark matter or do we need an additional force? The Planck satellite has provided a single early, and accurate measure of expansion. The data for the subsequent expansion of the universe, has until now only imposed loose constraints on models. However at the time of writing this article, new more refined data of the mature universe has just been published[11,12]. As I understand it, if we try to connect the dots between the very early Planck measure and these new measurements, we no longer get a fit to the cosmological constant. It now appears as if something has held back the dark energy expansion force – possibly a second, negative type of dark energy that is causing pools of space to contract. These pools would gradually grow smaller as time went on, leading to a runaway expansion, as we have seen, of the positive dark energy.

Another emerging question in cosmology is what we might call the *primordial black hole problem*. Black holes are traditionally thought to form via the gravitational collapse of massive stars. Recent advances in astronomy have been generating substantial evidence to the effect that, in the early universe, black holes grew too early and too fast to be caused by the collapse of stars.[13] A scenario in which the Big Bang itself creates seed black holes may be the answer. This model's configuration of two dark energies which separate (inflate) from each other might leave clumps of like-type dark energy uninflated. The matter associated with these clumps would also be uninflated. These could be the seeds of primordial black holes. Regardless what creates the seeds of the first black holes, their growth may be accelerated when they occur within pools of the contracting dark energy. If the contracting-type dark energy has a time-slowing effect, then this would also promote their growth.

Within cosmology, it may be difficult to find evidence of a dark energy constructive-destructive dimension. But if dark energy is the substance of mind and therefore creativity, it may be that the initial choosing of the laws and constants can be attributed to it. Given these laws are constructive, perhaps the constructive-type dark energy is responsible for the choosing. I have discussed this question in more detail elsewhere.[9]

If dark energy has a constructive-destructive dimensionality with respect to complexity, then it should possess its own intrinsic complexity, albeit invisible to us. Hence by this logic, dark energy should have information-carrying capacity, as I suggested was necessary to the quantum experiments.

Thus from analysis of cosmology, and particularly the Big Bang, we have arrived at a model in which there are two types of dark energy; one which speeds time, is spatially expansive and is constructive; the other slows time, is spatially contracting and is destructive. But what of consciousness? Since I have proposed that dark energy could be mind-stuff, interacting quantum mechanically with the material brain, we now need to see if these two types of 'mind-stuff' or 'head-space' correspond to features of the mental landscape.

5. Affect

The biological underpinnings of affect, or emotion, remain poorly understood. Likewise, the biological causes of mental illness (which are largely dysfunctions of emotions) continue to elude medical science. Mental illness continues to be diagnosed through checklists such as the DSM V, which rely almost entirely on subjective report and observation of the patient's behaviour.

The proposed actions of these two dark energies correlate well with the features of positive and negative affect. Positive affect has been shown to speed subjective perceptions of time flow.[14] Negative affect slows subjective passage of time, and effects are more pronounced when the subject is under extreme stress.[15]

Similarly, in spatial terms, negative affect causes a narrowing of the scope of conscious awareness. A wealth of research going back to the 1950s indicates that stress and negative affect cause narrow attentional focus.[16] Thus, when subjects under stress are given a visual task they tend to notice the central details and neglect the peripheral details. The same is true when subjects are asked to remember upsetting events - these are called *tunnel memories*, as only central details are recalled.[17]

The converse is true of positive affect. A more global picture of happy events is recalled, much richer in peripheral details. Similarly in visual tasks, the happy subject is more likely to notice the global picture and peripheral cues. This theme also extends to other, more abstract internal representations. Thus positive people are more likely to make more novel or remote internal associations – such as *elevator*, *camel* and *feet* for the root word *vehicle*[18] – and are more likely to synthesise an accurate global perspective in complex situations.

As regards constructive-destructive effects, it is important to understand the evidence for *mood-congruent* effects in psychology. Mood congruence refers to the way in which our moods or emotions tend to guide us, largely subconsciously, towards information that matches our mood state. Thus, for example, there is a large literature to show that when people are anxious, they are subconsciously biased towards threatening information. This includes not only selectively attending to external information, but preferentially engaging in internal elaborations of threatening information (i.e. worrying). Depressives will similarly attend to, or ruminate over, negative information. The opposite effect is seen in positive affective states, where people will preferentially attend to positive or rewarding information. Positively biased attention tends to lead people to experience the positive side of situations – whether it being seeing humour in adversity, or noticing the positive features of others, or taking a more pro-active and adaptive approach to problems.

When studying mood congruent effects, a common approach is to take a group of people and induce them into different emotional states. Hence, for example, subjects may be given a list of information to learn, some positive and some negative. Those who are induced into a sad mood recall more of the negative and those induced to be happy recall more of the positive.[19] In one study, subjects were videotaped during a social interaction. The following day, after being induced into a positive or negative mood, they were asked to evaluate their behaviour. The

positive subjects noticed more positive social behaviours while the negative subjects noticed themselves exhibiting more negative and antisocial behaviours.[20] In another study, this time longitudinal in design, a group of depressed people were asked to remember things about their childhood. They recalled their parents as being rejecting and unloving, but when they had later recovered from depression, the same people recalled their parents as more loving and nurturing.[21]

The beneficial effects of sustained positive affect (and therefore sustained positive mood-congruent attention) have been demonstrated in numerous studies. Happy people tend to have better outcomes in relationships, in education, in employment, and have better health habits. Psychologist Barbara Fredrickson notes that when positive emotions flourish in people's lives, they trigger "upward spirals" of positive feedback to even greater emotional wellbeing. Fredrickson has developed the widely respected "broaden and build" theory of positive emotion.[22] She argues that positive emotions serve a global constructive function leading to an increase in enduring resources - be they material, social or personal.

Sustained negative affect has the opposite effect. Particularly when severe, negative affect is associated with negative, destructive outcomes. Sustained negative attention leads the mind towards negative perceptions of others, in turn leading to disrespect, hostility and the perpetration of abuse on one hand, or fear, withdrawal and paranoia on the other. Internal representations of self, where present, are similarly negative, resulting in critical self-talk, low self-esteem and social anxiety. In many cases, social aggression can be seen as an attempt to boost self-esteem. It is also well recognised that, from childhood onwards, a common coping style is one of *externalising*, i.e. deflecting externally one's emotionally driven tendency to think negatively. Hence, negative affect tends to promote addictions, and antisocial behaviours such as bullying, vandalism and crime. Whether the predominant trajectory of negative affect is along internalising lines (anxiety, depression) or externalising (substance abuse, antisocial personality disorder) or a mixture, the outcomes are generally destructive – towards friends, family and workplace relationships, and also towards one's physical and mental wellbeing.

Evolutionary psychologists will often argue that negative emotions are actually positive and constructive in lots of ways. Thus anger is important for resolving disputes. The vigilance of anxiety is an important means of avoiding harm, and the withdrawal characteristic of depression may be useful when one is trying to adjust to bad news, such as the death of a loved one. The key point here is that evolutionary psychologists are inclined to point out behaviours that are characteristic of people who have an underlying tendency to *positive* affect. Thus the positive person *will* behave in the above constructive ways when faced with adversity.

But what of those who experience generally negative affect, when faced with adversity? Here we see crippling anxiety, unreasonable aggression and so forth. It is common for the chronic depressive, when faced with the unexpected death of a loved one, to respond with an all-consuming grief from which they never fully recover. These types of situations are a much truer representation of negative affect in pure form, and are plainly destructive. It is also common for evolutionary psychologists to point to the biological consequences of negative emotional states. For example there are the responses to threat, such as increased heart rate and blood flow to the muscles – so-called 'fight or flight'. But these responses are biological, and therefore evolved,

and so *should* be constructive. The physiological, constructive response should not be confused, however, with the mental aspects of emotion.

In sum, the Big Bang model proposed makes predictions of dark energy, and these predictions appear to correlate with dynamics of the mental realm. Positive affect does appear to speed subjective time, expand subjective awareness and impose a fundamentally constructive lens on perception. Negative affect does appear to slow subjective time, contract awareness and impose destructive filters on reality. I propose consciousness to be comprised of dark energy – a mixture of positive and negative types. Thus consciousness, as a consequence of the Big Bang, possesses a constructive-destructive dimensionality not seen elsewhere in nature.

6. Mental Illness

So how, within this model, do we arrive at an understanding of the origins of mental illness? Stress and adversity are commonly implicated in the causation of negative emotions and mental illness. Psychological stress can be defined as a threat to self, either real or imagined. I think it is also reasonable to equate stress with destructive information (although not in all cases, as adversity may provide opportunities as well). It is therefore fairly easy to visualise a link between an input of destructive information and mental illness. Forms of childhood adversity - such as excessive parental criticism or control, or parental neglect, sexual abuse or bullying - are particularly potent causes of mental illness. In early childhood the mind/brain is not only more malleable, but also less empowered to find solutions.

At the fundamental level of the quantum brain, it is possible to imagine the interaction between incoming information within the material brain, and a nonmaterial mind comprised of a mix of both types of 'head-space'. Let us propose, for simplicity, a very young child in which, at a particular moment, there are equal proportions of both headspaces such that there is no preferential filter on perception. If that child is exposed to information of very strong negative valence (or 'charge'), such as a threat from caregivers, then that negative information may be able to cross the quantum realm into the mind, imparting a negative valence to the mind. Essentially the headspace is now predominantly negative, and sees the world in that light. If this type of occurrence happens often enough or severely enough in childhood (particularly in the absence of protective positive information), then the child may develop a mental 'set-point' which favours a predominance of negative emotions.

Further, we can now understand why the mind develops disorders that can broadly be divided into internalising and externalising. If the mind is a pool of information, as delivered by the brain and elaborated within, then the boundaries of mental illness are only imposed by that person's conscious reality, and not by their physical body. And if the valence of that pool determines the direction in which thoughts will trend, those who are trying to cope with a relentless drive to think negative thoughts will have two broad options. They can either inflict their negative thoughts on their core self, in the form of negative self-talk and so forth, or deflect it externally in some way. External options are virtually unlimited. They might include some negative action to the bodily self, such as self-harm or substance abuse, or risk taking activity, or any form of abuse of others, or involvement in some kind of general act against society. These

types of action have a strong tendency to become habitual, as they are rewarded by a temporary sense of release from the psychological pain of internalising.

This model also proposes a more nuanced explanation of 'free will'. Most models of free will make no allowance for the important effects of the emotions. Our ability to behave in a constructive manner is markedly reduced as we approach strongly negative mental states. Dark moods seem to have the ability to twist all of our positive ideas into negative ones. Thus, the thought "I want to be a better person" might quickly dissolve into negative self-talk and despair – "Why am I such a hopeless case?" The opposite applies to those who have had a robust positive outlook from childhood. They seem to have a happy ability to get the best out of all situations, display great resilience in the face of adverse circumstances, and in fact seem to have a natural inability to perform destructive acts. This type of person would, for example, find it very difficult to inflict harm on self or another person. These features of the will can be accounted for within a model such as this, in which the mind possesses its own dynamic destructive/constructive valence.

One further mental illness we should consider is mania. Manic states exist almost exclusively in the context of a bipolar manic-depressive illness. Whilst these people often spend much of their time depressed, they can swing to irrational highs of emotion. In a fully blown manic state, the subjective outlook seemingly has no concept of negative outcomes. Floridly manic patients are oblivious to possible failure of their grand financial plans, relatively insensitive to the hurt their actions cause to others and unperturbed by any risk of loss of social status. This is in sharp contrast to the features of natural healthy positive affect, in which positive moods seem to moderate themselves in order to remain mindful of risks. Mania is interesting because, while I have proposed that positive emotions are constructive, excessive levels of positive emotion can also be destructive in outcome. We must remember, after all, that we are all trying to live in the real world. While an hour of mania in a situation where we are protected from harm might be an unambiguously positive experience, being so positive that we are oblivious to all negative information can make us susceptible to adverse outcomes.

Finally, biological factors should not be excluded. A wealth of evidence is emerging of genetic and other biological influences on mental health and illness. Psychoactive medications, for example, do often have a beneficial effect. It is well-recognised that lead exposure has a damaging effect on impulse control, such that children exposed to high levels of environmental lead have much higher rates of violent crime.[23] It is also well known that looking after one's physical health, with a nutritious diet and exercise, can improve mental health. These biological influences do not, however, tell us whether the mind *is* the brain or whether the two are closely associated. There are many features of the mind, and mental illness, which separate them from the biological sciences. Thus psychiatry remains a distinctly different field to neurology. We should not blind ourselves to these differences in an attempt to accommodate the mental within our current scientific understanding.

References

1. Hensen, B. et al. (2015) Loophole-free Bell inequality violation using electron spin separated by 1.3 kilometres. *Nature*, 526, pp. 682-686.
2. Hameroff, S. (2010) Consciousness, Neurobiology and Quantum Mechanics: The Case for a Connection. In Tuszynski, J. A. (ed.) *The Emerging Physics of Consciousness.* Berlin: Springer.
3. Hameroff, S., Penrose, R. (1996) Orchestrated reduction of quantum coherence in brain microtubules: A model for consciousness. *Mathematics and Computers in Simulation*, 40, pp. 453-480.
4. Stapp, H. (2011). *Mindful Universe: Quantum Mechanics and the Participating Observer*. Berlin: Springer.
5. Bohm, D. (1980). *Wholeness and the Implicate Order.* Abingdon: Routledge Classics.
6. Krauss, L. M. (2012) *A Universe From Nothing: Why there is something rather than nothing.* New York: Free Press.
7. Tryon, E. P. (1973) Is the Universe a Vacuum Fluctuation? *Nature*, 246, pp. 396–397.
8. Vilenkin, A. (1983). Birth of inflationary universes. *Physical Review D* **27** (12): pp. 2848–2855.
9. Rowland, G. W. (2015) *Mind Beyond Matter: How the non-material self can explain the phenomenon of consciousness and complete our understanding of reality.* Melbourne: Burdock Books.
10. Lambert, F. L. (2002) Disorder: a cracked crutch for supporting entropy discussions. *Journal of Chemical Education*, 79, pp. 187–92.
11. Reiss, A. G. et al. (2016) A 2.4% Determination of the Local Value of the Hubble Constant. *The Astrophysical Journal.* (In press) arXiv: 1604:01424
12. hubblesite.org/newscenter/archive/releases/2016/17/full/ [accessed 8/6/2016]
13. Pelupessy, F. I., di Matteo, T. and Ciardi, B. (2007) How rapidly do supermassive black hole "seeds" grow at early times? *Astrophysics Journal*, 665, pp. 107–19.
14. Campbell, L. A. and Bryant, R. A. (2007) How time flies: a study of novice skydivers. *Behavioral Research and Therapy*, 45, pp. 1389–92.
15. Hancock, P. A. and Weaver, J. L. (2005) On time distortion under stress. *Theoretical Issues in Ergonomic Science*, 6, pp. 193–211.
16. Easterbrook, J. A. (1959) The effect of emotion on cue utilization and the organization of behaviour. *Psychological Review*, 66(3), pp. 183-201.
17. Berntsen D. (2002) Tunnel memories for autobiographical events: central details are remembered more frequently from shocking than from happy experiences. *Memory & Cognition*, 30, pp. 1010–20.
18. Isen, A. M., Johnson, M. M. S., Mertz, E. and Robinson, G. F. (1985) The influence of positive affect on the unusualness of word associations. *Journal of Personality and Social Psychology*, 48, pp. 1413–26.
19. Watkins, T., Mathews, A. M., Williamson, D. A. and Fuller, R. (1992) Mood congruent memory in depression: Emotional priming or elaboration. *Journal of Abnormal Psychology*, 101, pp. 581–86.
20. Forgas, J. P., Bower, G. H. and Krantz, S. (1984) The influence of mood on perceptions of social interactions. *Journal of Experimental Social Psychology*, 20, pp. 497–513.
21. Lewinsohn, P. M. And Rosenbaum, M. (1987) Recall of parental behaviour by acute depressives, remitted depressives and nondepressives. *Journal of Personality and Social Psychology*, 52, pp. 611–19.
22. Fredrickson, B. L. (1998) What good are positive emotions? *Review of General Psychology*, 2, pp. 300–19.
23. Wright, J. P., Dietrich, K. N., Ris, M. D., Hornung, R. W., Wessel, S. D., et al. (2008). Association of prenatal and childhood blood lead concentrations with criminal arrests in early adulthood. *PLOS Medicine*, 5, pp. 732-40.