Generalized Entanglement – A Nonreductive Option for a Phenomenologically Dualist and Ontologically Monist View of Consciousness

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Abstract The conundrum with current models of consciousness is that they either deny consciousness its own causal role, defying everyday experience and phenomenology, or they concede consciousness its own causal activity, without explaining a potential interaction. While the first, physicalist, option is very much in line with most current reasoning within neuroscience it faces serious theoretical problems and has to exclude a range of phenomena in order to be convincing. The second, dualist model, is phenomenologically more satisfying, but cannot explain how such an interaction might work. This problem has beset philosophy since Descartes. We propose here a model that is ontologically monist, in line with the general intuition of the natural sciences, and at the same time phenomenologically dualist, true to our subjective experience. This is possible if we follow the track laid out by Generalized or Weak Quantum Theory. Such a model predicts generalized entanglement. This can be seen as a coordinating notion aligning two systems through a generalized non-local correlation. Using this model one can easily conceive of the mind-body relationship as a form of generalized entanglement correlating two systems with each other. In an extension, the same mechanism can be used to redefine spirituality as a coordination of single individuals with one Whole.

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Introduction: The Mainstream View and Its Problem

The Standard Physicalist View and Arguments in Favour

An implicit consensus within the neuroscience research community is that consciousness is produced by the brain (Damasio 1999; Metzinger 2000). The arguments for this assumption seem to be quite strong:

1. We know, from a long history of neuropsychology and neuropathology, that damage to certain brain areas leads to circumscribed and reproducible deficits (Damasio 2000). If the whole brain is damaged or if anesthesia interrupts neural transmission consciousness breaks down. The accumulated data make it plausible to postulate that brain activity of a certain kind is a necessary condition for consciousness. Note that brain activity alone is not sufficient. We have strong brain activity each night and yet fall unconscious during sleep. Also, in comatose patients brain activity can be recorded and yet they are unconscious. However, under normal circumstances brain activity is strongly associated with consciousness (Alkire et al. 2008).
2. We know that if certain areas of the brain are damaged, the thalamus for instance or areas of the brainstem, consciousness is irreversibly lost (Tononi 2004).
3. So far, nobody has observed conscious activity without brain activity. A few anomalies are around (see the chapter by Pim van Lommel in this book), but by and large, the correlation between brain activity and consciousness is very strong.
4. If we follow the useful physiological heuristic that every organ has a specific function and that the anatomy and physiology of an organ support this function, then it makes sense to assume that the brain is the organ whose function it is, among others, to produce some kind of consciousness. This is in strict analogy to other observations, for instance that it is the function of the lungs to exchange gas between the blood and the environment (and not to produce thoughts), and that it is the function of the gut to absorb nutrients and water and excrete waste products (and not to generate mathematical reasoning). In that sense it seems reasonable to assume that one major function of the brain, among others, is to produce cognition and as a consequence consciousness.
5. If we look at the correlation between brain anatomy, brain size and the evolutionary record it seems plausible to assume that an increase in brain complexity and size relative to the rest of the body is the driving force behind the success of the human race in evolutionary terms and that this success is paired with an increase in conscious activity (see Rossano in this book).
6. We can build technical equipment that mimics some aspects of brain architecture, for instance its strong connectivity, and implement some elements of learning as physiologically seen in single neurons, such as strengthening and weakening of synaptic connections. Such neuronal networks can simulate some cognitive activity such as learning and pattern recognition, or decision between complex alternatives in expert systems.

7. If we study the elements of brain activity, neurons and their physiology, we can see that their activity gives rise to the modifications correlated at least partially with changes in cognitive performance, emotional valence and bodily activity.
8. The concept of emergent properties can make it plausible how a system, by the virtue of its structure and complexity, can give rise to completely new properties (Metzinger 2003). For instance, a system of amino-acids in a certain structure and environment can suddenly give rise to properties that the single amino-acids did not have, namely the capability to sustain their own environment, or to reproduce or to move, or other phenomena generally associated with life (Maturana 1980). In the same vein, a complex neuronal system that is strongly interconnected, might give rise to a completely new property hitherto unknown, such as consciousness. There is nothing in the elements of the system, and nothing in previous kinds of systems that would predict the occurrence or the nature of the property to emerge. Hence, such complex emerging properties, such as consciousness are completely new, completely unexpected and wholly dependent on the physical organization of the system and its substrate, the brain (Baianu and Poli 2009; Kronz and Tiehen 2002; van Gulick 2001). Although once emerged the new property, consciousness, might have a strong causal influence on its substrate, it still cannot exist without it.

All these data seem to suggest with overwhelming plausibility that brain activity and conscious activity are so strongly dependent on each other that a causation of conscious activity through brain activity is a plausible, if not inescapable conclusion.

Problems with the Standard Physicalist View

However, although currently espoused in one version or another by the majority of neuroscientists and a large number of active philosophers of mind, such a standard physicalist viewpoint has also attracted criticism that has not been alleviated by arguments from the mainstream camp as yet. A few arguments that speak against the plausibility of the mainstream view are the following:

1. Although the correlation between brain activity and conscious activity are very strong they are none the less only correlations. For instance, there are empirical instances of conscious activity seemingly without accompanying brain activity (see Pim van Lommel's chapter in this book). Similar types of brain activity can be associated with quite different types of conscious states. For instance strong delta and theta waves are characteristic both for certain sleep states, epileptic states (Petsche and Brazier 1972), and states of deep meditative absorption (Aftanas and Golocheikine 2001, 2002). Thus, similar physiological patterns are associated with different brain activities and diverse phenomenological states.
2. There is no theory as yet that really transforms the correlational hypothesis of neuroscience into a truly causative theory demonstrating convincingly that brain activity must be the cause of consciousness. There is no argument that shows that

the brain is not only a necessary but also sufficient condition for consciousness. To use a blunt example: The increased usage of refrigerators is strongly correlated with the decline of births in Western countries. However, no one would claim that using refrigerators decreases birth rates. The explanation is more complex and has to be sought in the social conditions where technical progress, social change, affluence and the changing role models for women are brought into the picture.

3. While the language of the brain is comparatively monotonous, conscious experience is extremely rich. In the brain, there is a pattern of electrical discharges and conductivity between neurons, mediated by different types of neurotransmitters and a rich variety of receptors. But the result of all this complex machinery is always the same: neurons either depolarize or don't. The only difference that can be observed from the outside is a change in rhythmicity and spiking of activity of certain neurons. But the language of the brain is always electric discharges, while the language of conscious experience is that of different qualities. Qualia, the subjective feel of certain experiences, can nowhere be found in the brain itself (Chalmers 1996). To jump from a physical description into a mental description without a mediating model is to make a category mistake (Hoche 2008).
4. Although we can build machinery that mimics certain aspect of brain activity there is no evidence whatsoever that this also produces consciousness (Searle 1992).
5. A physicalist view of the world is against all odds of our phenomenal experience. Here we have the clear subjective experience that we are agents operating through our body but not that our body and our brain processes determine what we do. Although in many instances there is a clear traceable consequence from neuronal processes to experience, and although some of these experiences are so compelling that we hardly can escape them – think of hunger, thirst, sexual desire, other forms of passion – nevertheless in nearly all instances there are examples how individuals, out of their free will, decided to not act on such impulses (Libet 1999), defying such physicalist causation.
6. The worldview that underlies a physicalist view of the world is predicated on an obsolete Newtonian physics (Schwartz et al. 2005). Although most of the time and for large scale objects Newtonian physics are a valid and good approximation, when it comes to the basic theoretical understanding of the relationship between mind and matter this is not good enough. A true physicalist picture of the world has to use the best and most fundamental theory of matter. This is quantum mechanics. But quantum mechanics, at least as a fundamental theory, only works if we presuppose conscious activity that takes into account the measurement result. This is one way of reminding us of the strong self-referentiality. And many authors, starting with Gödel, have pointed to the fact that as a consequence of such strong self-referentiality an essential incompleteness arises in the following sense: There are always statements whose truth cannot be decided by means internal to the system. One always has to make use of a reference frame outside the system, whose explanation or understanding is sought. If this is true for the framework of natural numbers already, as shown by Gödel, it is even true more so for the whole framework of a physicalist theory of consciousness.

7. We all operate and experience as covert dualists. Although we might be wrong here, as we were with the idea that the sun is turning around the earth, it seems to be very difficult to produce a plausible theory that would allow us to understand how immaterial events such as thoughts, or decisions, might impact on material events (Bieri 1989). To just say that the alleged immaterial events do not really exist is rhetoric, not science.
8. The physicalist view can only be maintained at the prize of excluding many phenomena that have been well documented, are relevant to many people (Ross and Joshi 1992), yet are neglected by mainstream science, such as experiences of telepathy (Schmidt et al. 2004), precognition (Utts 1996), mystical experiences [AU2] (Walach 20[illegible]) or similar ones. These phenomena are, as one common denominator, experiences of non-locality, where conscious experience seems to have access to information that is not available through known physical channels of information transfer and interaction (see also Pim van Lommel's chapter in this book). As a consequence, there needs to be a different theoretical framework for treating these phenomena, if they are to be taken seriously. We maintain that there is good reason to do so (Walach and Schmidt 2005).

The Problem

The problem, thus, seems to be twofold: The standard physicalist view of the world and of consciousness in particular, does not really account well for consciousness as a non-material phenomenological reality. If we think of pink elephants, smell the smell of aged Pinot Noir, taste white truffles, experience the pang of being in love, then we do not have elephants, wine, truffles or love in our brains but always electrical activity. Exactly how this comparatively similar event is translated into quite a different and rich language of phenomenology no physicalist theory has made plausible as yet. On the other hand, the same problem ensues: quite how an immaterial event such as a decision to not follow the impulse to smoke or drink alcohol, for instance, that lies at the heart of breaking addictions impacts on the physiology of the brain and on its whole architecture, is difficult to understand. Bieri has aptly described the conundrum as a trilemma (Bieri 1995). This consists of three sentences that each taken for itself is plausible, but together produce a contradiction: (1) The world of material events is causally closed. (2) Mental events are not physical events. (3) Mental events are causally effective. We can subscribe to two of the three sentences and produce a contradiction with the third.

The fact that most people seem to opt for a physicalist solution, at least – and mostly only – in theory, does not make the contradiction go away.

Hence, there is scope for an alternative approach. This approach should fulfill several requirements:

1. It should be true to the strongest theory of matter we have, quantum mechanics.
2. It should not be reductionist in the sense that it should allow for conscious experience both as partially autonomous of and in some way causative for material events.

3. At the same time it should account for the strong correlation observed between brain events and conscious events.
4. It should allow for phenomenological duality. At the same time it should, if possible, conform to the basic intuition of unity and monism that inspires science.

How is this at all possible? In the chapter by Römer and Walach in this book we assumed that physical or physiological and mental or phenomenal properties pertain to one and the same system (see also Römer (2004)). Loosely speaking, they are two sides of the same medal. Moreover, we argued that physiological and phenomenal observables are complementary in the sense of a Generalized Quantum Theory. This implies a correlation between the measured values of physiological observables on the one hand and phenomenal observables on the other hand, although, due to their complementarity, it is in general impossible to attribute sharp and definite values to both of them simultaneously. In what follows, we are going to develop a somewhat different description, which keeps mind and brain somewhat further apart. This time, they are associated with different subsystems of a larger system containing both of them. This is similar to an approach by H. Primas (2003) with the important difference that Primas considers a partition of an "unus mundus" into one mental and one material domain, whereas we assume many minds and brains. This alternative framework, seems to be particularly appropriate, if mind is considered as "soul", for problems of free will, for transpersonal phenomena or near death experiences (see van Lommel in this book). In such a model, the relationship between mind and matter is given by generalized entanglement correlations to be described in the next section. We will be drawing on a generalized formalism of quantum mechanics. This allows us to derive a non-local coordinating principle, generalized entanglement. Such a postulated mechanism would be exactly the coordinating principle we are seeking: it coordinates two tightly correlated systems, allowing for a phenomenological duality.

Weak Quantum Theory and Generalized Entanglement

Predecessor Ideas: Leibniz

Leibniz was the first prominent author to query a strong physicalist hypothesis in the discussions following Descartes. Locke and Boyle had, following physicalist tendencies, developed ideas that made conscious experience secondary to physical events. Leibniz countered this argument by his well known thought experiment (Bieri 1995): if we imagine the brain as a big machine which we could enter and inspect, walking through all paths and channels, we would never encounter a thought or another conscious activity, only physical activities. Thus, he conceived of physical and mental systems as two parallel systems, like two clocks running in perfect harmony. He coined the phrase "pre-established harmony" for this. In his essay

"Betrachtungen über die Lebensprinzipien und die plastischen Naturen – Contemplation on the Principles of Life and the Plastic Natures" he wrote:

> Souls follow their own laws,…, while bodies follow theirs, namely the rules of motion. Nevertheless, these two entities of completely different kind meet and are coordinated like two clocks, which have been perfectly set in the same way, although they may be of totally different making. It is exactly this which I call pre-established harmony. (Leibniz 1966, p. 65 f.)

Leibniz' idea of pre-established harmony did not meet with a lot of enthusiasm at the time and was buried by mechanistic reasoning following Newton. It is only with the advent of quantum mechanics that Leibniz' philosophy can be seen as a pre-emptive imaginative leap of insight that is much more akin to the type of reasoning that manifests itself in quantum theory than in Newtonian mechanics. The reason for this is the implicit non-locality that is germane both to Leibniz and to quantum mechanics.

Nonlocality in Quantum Theory

The formalism of quantum physics describes quantum systems by a state function that defines the whole system with all potential measurement outcomes at once. If, for instance, the system is a multi-particle system then the state function of the system fixes the joint probabilities for the outcomes of measurements on all of its constituent particles. This is much more information than the probabilities of measured values for each of the particles separately. Since the system with all its elements is governed by one single function, the analysis of such a situation yields insights into a hitherto unrecognised phenomenon that Schrödinger dubbed "entanglement" (Schrödinger 1935). It means that all parts of a quantum system that are governed by one state function behave in a coordinated fashion, and only certain combinations of measurement outcomes are likely or possible. Exactly which combination will be discovered on measurement is unpredictable. But it is predictable that if one measurement outcome is observed at one part of the system, then other outcomes are more likely for the other part of the system. In other words: which outcomes will be seen is unclear, but what is clear is that only certain joint results are likely or possible. The interesting thing about this quantum correlation is the fact that it holds, theoretically, across space and time, i.e. no matter how far distant elements of a system are in space, nor in time, provided the system is isolated well enough against interactions with the environment. This gives rise to what Einstein had called "spooky actions at a distance" (Einstein et al. 1935). It appears as if elements belonging to one system behave in a coordinated fashion although there is no signal travelling between the elements of the system informing them of their "theoretically supposed" behaviour or about what measurement value the counterpart of the system has just taken. In fact, entanglement correlation cannot be used for causal
[AU4] influences or signal transfer. (See e.g. (Lucadou et al. 2007)). This global coordination

or correlation thus gives rise to what has been called quantum non-locality or quantum correlation or EPR-type correlations, named after Einstein, Podolsky and Rosen who were the first to exploit this quantum feature in order to demonstrate the potential lack of coherence of quantum theory.

As it turned out, empirical tests showed that quantum theory is quite correct and that quantum systems do have this peculiar property of behaving in a correlated, coordinated fashion no matter how widely parts of the system are separated in space or time. Nowadays, intricate tests of quantum entanglement have proven that such coherent quantum states can be maintained over many kilometres, making quantum teleportation of information or quantum encryption a technical feasibility, as well as the potential application of quantum computing (Salart et al. 2008). All these potential applications build on the reality of quantum entanglement and quantum non-locality.

However, it is very important to realise that such quantum entanglement proper is highly dependent on the fact that a quantum system can be isolated and maintained in isolation for a time period relevant enough for a measurement to be taken. In fact, each interaction of a quantum system with its environment is such a measurement, and as soon as such a measurement has taken place, quantum entanglement may be destroyed, and a classical, non-local world may ensue. The fact that quantum entanglement has been proven is only because quantum systems could be technically isolated for a long enough period of time. The challenge to engineer quantum entanglement for application purposes is associated with the technical difficulty of maintaining quantum systems in separation and preventing them from interacting with their environment. Technically this requires intricate precautions like very strong magnetic fields, ion-trappings in such fields, cooling, or optical and other devices that allow for quantum coherence.

In normal systems, such as the brain or other physiological macro-scale systems, interactions are much too numerous to maintain any trace of quantum entanglement, quantum coherence or non-locality.

Generalized Non-locality

The quantum physical formalism can be generalized and extrapolated to all kinds of systems beyond quantum physical systems proper, as we have shown (Atmanspacher et al. 200[illegible]e also the chapter by Römer and Walach in this book). We use the very same formal instruments that quantum physics uses. We then drop a couple of formal requirements and definitions. But we retain the most decisive element of quantum theory, the handling of non-commuting operations. This is intimately related to the fact, fundamental in quantum physics and assumed to be valid in its generalized form, that measurement will necessarily be related to a change of the state of the system and that the order in which different quantities are measured will in general be relevant. In the formalism of Generalized Quantum Theory this is implemented by non-commuting operators associated to observables of the system.

This is the formal expression of complementarity, which is decisive for quantum mechanics (see below). Once complementarity or non-commutativity is allowed into the formalism, we discover a strange and exciting prediction: Local elements of a system pertaining to its different parts whose descriptions are complementary to the global description of the system as a whole are non-locally correlated just as elements of a quantum system are correlated by entanglement correlations. In other words: entanglement or non-locality might not be restricted to quantum systems proper, but might be a feature of our world at large, provided systems obey the respective requirements of complementarity between local and global observables. Put still differently: what has become obvious in quantum mechanics, first formally through the theoretical description and then proven through experimentation, namely entanglement, might be a universal feature of our world. It became obvious in quantum mechanics, because the tight formalism of quantum mechanics made the conclusion inescapable and the precise theoretical description made experimental predictions possible that allowed for empirical testing.

Weak or generalized quantum theory stipulates that this feature holds true for all sorts of systems, provided global and local descriptions of the system are complementary. This is, at the moment, a theoretical stipulation that has to be confirmed by empirical evidence. In favour of it speaks some theoretical intuition that salient structural features of quantum physics are realised in a wider framework. In particular, measurement will change the state of a system under quite general circumstances. For instance, the mental state of a conscious individual will change by the very "measuring" act of becoming consciously aware. Moreover, what is a sufficiently rich description for material systems might also be useful to describe more complex systems, and the principle of analogy stipulates that what is true at one systemic level of description likely also holds at a higher level of systemic description. Generalized non-locality or generalized entanglement, thus, is, at this time, a theoretical prediction. Römer (submitted) has given many examples where generalized entanglement may be at work. Just to list a few cases:

- It can be used to reconstruct everyday phenomena that are widely known, described in all cultures and at all ages, yet defy a cogent and plausible reconstruction within the framework of local theories, such as Newtonian mechanics. Parapsychological phenomena, such as telepathy, telekinesis, remote viewing and precognition can be reconstructed as non-local correlations, without the requirement of special signals or violating accepted laws of physics (Lucadou et al. 2007).
- Generalized entanglement has been used to reconstruct certain highly contentious areas of medicine, such as homeopathy, spiritual healing, or the Chinese medical concept of Chi (Walach 2003, 2005).
- The model of generalized non-locality can be used to understand transference and counter-transference phenomena in psychotherapy and close human relationships which are empirically well described but extremely difficult to theoretically conceptualise (Walach 2007).

- Finally, the model of generalized entanglement would lend itself to a theoretically elegant description of a coordinating mechanism within the body, between bodily systems and also between the mental and the physical system, as is proposed in this chapter.

Complementarity

Before we go into detail here, we must pause to examine the formal requirement that the model stipulates as a precondition for anything to be non-locally correlated, namely complementarity. Non-locality or entanglement is just a special case of complementarity, namely complementarity between local and global descriptions of a system. Clearly, all further discussions hinge on an appropriate understanding of the notion of complementarity. Niels Bohr, one of the founding fathers of quantum mechanics who had introduced the term complementarity into physics, never defined it clearly. On closer scrutiny, one can see that he uses at least three different descriptions of the term (Fahrenberg 1992; Hoche 1990).

1. On one level, he used the two mutually exclusive set-ups of wave and particle detection of light to determine complementarity at the experimental level.
2. Then, complementarity referred to two descriptions of a particle that are mutually contradictory yet necessary to describe it, such as location and momentum. While in classical physics these descriptions could be measured independently, in quantum mechanics we have the strange situation that measuring one means giving up any definite knowledge of the other, and vice versa. This is where Heisenberg's uncertainty relationship comes into play. It is in fact a formalisation of the complementarity relationship of two descriptors, yielding an uncertainty. While in quantum theory proper this relationship is defined, with Planck's constant defining the amount of uncertainty or non-commutativity, in the case of the Weak Quantum Theory this relationship is unrestricted, hence could be much smaller or much larger.
3. Finally, Bohr used the term complementarity for an epistemological relationship, where two general approaches or concepts were incompatible with each other, yet both belonged to it. Thus, he thought that the perspective of natural sciences and religion or concepts such as conscious and unconscious are complementary.

While the usages of the term complementarity in (1) and (2) are well defined in quantum mechanics, it is this latter usage beyond the realm of quantum mechanics that poses some difficulties. It might be helpful if we used a definition that is more general than the one used in quantum mechanics proper, distilled from Bohr, but never verbally produced by him (Atmanspacher 1996; Meyer-Abich 1965): *We can call "complementary" two descriptions of one and the same entity, event or system that are maximally incompatible with each other, yet have to be applied conjointly to describe this entity, event, or system.*

We are much in line with this definition except for the fact that we request incompatibility but not maximal incompatibility.

Table 1 Potential and proposed examples of complementary relationships outside physics

Global	Local	Area
Freedom	Structure	Education
Holistic	Linear	Processing, thinking
Love	Hate	Relationships
Appetence	Avoidance	Motivation
Explicit, unconscious	Implicit, conscious	Memory
Mercy	Justice	Law
Unity	Separation	Development
Function	Structure	Systems description
Whole	Part	Systems theory
Community	Individual	Society, systems description
Good	Evil	Morality, ethics

Some of these pairs may not constitute truly complementary relationships, or, rather, may sometimes be complementary in the sense used here, and sometimes not. This is a consequence of the fuzziness of our everyday language and the fact that we do not really distinguish between complementarity and opposites

It is useful to pause here to ponder on the implications. For most of our cultural, philosophical and scientific heritage we have not had much dealing with such concepts. Most of our everyday world follows the bivalent logic that Aristotle famously formalised and made the cornerstone of our scientific world-view: One of two assertions which contradict each other must be true. Something either has a description or it does not. This is the principle of the excluded third. In this logic, there is no place for complementarity, where one has to use incompatible descriptions to describe something. Although not formally part of our scientific culture, complementarity or the mode of thinking derived from it has been part of our heritage nevertheless. Our everyday world ("Lebenswelt" in the sense of Husserl) is full of examples. In personal relationships we often encounter situations where we both love and hate someone. Psychology is full of conflict situations that do not obey the simple logic of bivalent relationships. The famous conflict between appetence and avoidance, that is at the base of many neurotic problems, or the relationship between implicit and explicit, holistic and algorithmic processing, emotional and rational, conscious and unconscious, extensive and lexical memory, to name but a few, are examples of how complementarity might in fact be theoretically important also for areas other than quantum mechanics proper. Table 1 gives a few examples.

The most general and perhaps most important of these pairs might be "Whole" – "Part" or "Separation" and "Unity". These are two very general descriptions that govern almost all relationships. Depending on the level of analysis every part is at some point part of a whole that unifies it into a larger whole. In this case the complementarity between individual and community comes into play. If this is the case, then we would expect, following Generalized Quantum Theory, a non-local correlation or generalized entanglement between the parts of the whole, or between all elements of the system that belong to the system.

Thus, the model would actually predict a non-local, coordinating mechanism in any system that can be separated into subsystems and has sufficient cohesion to be called a whole. The same can be said of systems that are united to form a larger system. In other words, how an ensemble is partitioned also determines, whether one observes such correlations or not. Still put differently, entanglement as a systems property might be dependent on the observer.

Generalized Entanglement

Non-local Coordinating Principle Between Body and Consciousness

We now have our elements in place to propose a different, non-reductionist viewpoint in which we can combine a phenomenological duality with an ontological monism. We may assume that the underlying reality is one, beyond the distinction between mind and matter. Atmanspacher has formally shown that it is possible to construe the two systems as derived from one underlying unity through a spontaneous breaking of time-reversal symmetries (Atmanspacher 2003). This first breaking of an underlying symmetry would yield the distinction of two phenomenologically different systems, mind and matter, or material and conscious systems. Within one human being these systems might be coordinated with each other through the "mechanism" of generalized entanglement, or in other words, these two systems might be non-locally correlated. We have put inverse commas around the term "mechanism", as we normally mean by it any local mechanism in the sense that something is affecting something else using a signal exchange process or an interaction exchanging energy. A non-local process is clearly without exchange of energy and does not use signalling; this is its very definition. We are hereby making clear that we take this process to in fact fulfil the condition of explaining the "mechanics" of something without signal exchange. As our language does not offer any term at this time, we have no other option than saying it is similar to a mechanism, yet it is not a mechanism in the classical sense of the word. The mechanism is, as it were, an anti-mechanism not functioning mechanistically through signal exchange processes or energetic interaction, but non-locally, without such interaction, yet coordinated.

In such a model, consciousness and its physical substrate, the brain, or rather the whole body, can be seen as intimately linked, as in Leibniz' example of the two clocks that are of different make yet intricately coordinated. There is, however, no coordinating "something", as this "something" is the non-local correlation between the two systems. This model would explain why we have two phenomenologically different systems that are extremely tightly correlated. Hence we have a clear phenomenological duality with an underlying unity. Observe in passing that this model is not an ad-hoc parallelism, but is formally derived from the strongest theoretical model available to us so far, from quantum theory.

Theoretically, thus, the model is feasible and plausible. There is one caveat, though: at the moment our generalized or weak quantum theory is a systems theoretical description of very general scope. It can be applied. It can be used to make some predictions, such as the entanglement between a physical and mental system. It can be used to reconstruct a situation. However it is not precise enough to make more concrete predictions. And more importantly, it is nothing but a theoretical option at the moment that awaits some direct empirical verification. We hold that it has strong face validity and explanatory strength. This might recommend it and allow us to view its consequences with some confidence. If those provisions are duly taken into account we can see that the model provides us with what we have been looking for: a plausible account of a dualist phenomenological model of how a mental and a physical system might interact without postulating dualist ontology.

Spirituality: Non-local Correlation Between Whole and Individual

By the same token, we can now extrapolate the prediction. If we concede that such a non-local correlation operates between parts of a system and the whole system, then it is only a small step to accept that there is one system that can be called the Whole, comprising everything. By definition each subsystem is a part of this whole and is at the same time unified by it. Thus, the basic complementarity between part and whole also holds true here. We can now re-define spirituality as alignment of an individual with the Whole. Spiritual practice, such as meditation, prayer, contemplation, Chi Gong, Tai Chi, or Yoga, to name but the more prominent examples, can then be conceived as actions designed to increase the alignment of the individual with the Whole.[1] Thus, in the same way as elements within our body are coordinated by the organism at large, producing health, and our mental and physical life are coordinated to produce our conscious experience, we can conceive of all individual elements being coordinated and orchestrated into one Whole. This would at the same time give a very precise meaning to the common adage that all is dependent on everything else. There might indeed be a non-local reverberation of single events on other events or the whole. Thus, what Leibniz had called pre-established harmony would find a new and potentially naturalistic description in a global non-local correlatedness of all events with each other and the Whole.

References

Aftanas, L.I., & Golocheikine, S.A. (2001). Human anterior and frontal midline theta and lower alpha reflect emotionally positive state and internalized attention: High-resolution EEG investigation of meditation. *Neuroscience Letters, 310*, 57–60.

[1]Exactly what this “alignment” means would have to bet he content of another chapter, if not book. Likely means to bring tendencies of individualisation or separation in conformity or balance with the whole.

Aftanas, L.I., & Golocheikine, S.A. (2002). Non-linear dynamic complexity of the human EEG during meditation. *Neuroscience Letters, 330*, 143–146.

Alkire, M.T., Hudetz, A.G., & Tononi, G. (2008). Consciousness and anesthesia. *Science, 322*(5903), 876–880.

Atmanspacher, H. (1996). Erkenntnistheoretische Aspekte physikalischer Vorstellungen von Ganzheit. *Zeitschrift für Parapsychologie und Grenzgebiete der Psychologie, 38*, 20–45.

Atmanspacher, H. (2003). Mind and matter as asymptotically disjoint, inequivalent representations with broken time-reversal symmetry. *Biosystems, 68*, 19–30.

Atmanspacher, H., Römer, H., & Walach, H. (2002). Weak quantum theory: Complementarity and entanglement in physics and beyond. *Foundations of Physics, 32*, 379–406.

ianu, I.C., & Poli, R. (2009). From simple to super- and ultra-complex systems: A paradigm shift towards non-Abelian emergent system dynamics. In R. Poli, Healy, M., & Kameas, A. (Eds.), *TAO-Theory and Applications to Ontology* (pp. in print). Heidelberg: Springer. [AU5]

Bieri, P. (1989). Schmerz: Eine Fallstudie zum Leib-Seele-Problem. In E. Pöppel (Ed.), *Gehirn und Bewusstsein* (pp. 125–134). Weinheim: VCH.

Bieri, P. (1995). Why is consciousness puzzling? In T. Metzinger (Ed.), *Conscious experience* (pp. 45–60). Thorverton: Imprint Academic.

Chalmers, D. J. (1996). *The conscious mind. In search of a fundamental theory*. New York/Oxford: Oxford University Press.

Damasio, A.R. (1999). How the brain creates the mind. *Scientific American, 281*, 74–79.

Damasio, A. (2000). *The feeling of what happens. Body, emotion, and the making of consciousness*. London: Vintage.

Einstein, A., Podolsky, B., & Rosen, N. (1935). Can quantum-mechanical description of reality be considered complete? *Physical Review, 47*, 777–780.

Fahrenberg, J. (1992). Komplementarität in der psychophysiologischen Forschung. Grundsätze und Forschungspraxis. In E.P. Fischer, H.S. Herzka, & K.H. Reich (Eds.), *Widersprüchliche Wirklichkeit. Neues Denken in Wissenschaft und Alltag: Komplementarität und Dialogik* (pp. 43–77). München: Piper.

Hoche, H.-U. (1990). *Einführung in das sprachanalytische Philosophieren*. Darmstadt: Wissenschaftliche Buchgesellschaft.

Hoche, H.-U. (2008). *Anthropological complementarism. Linguistic, logical, and phenomenological studies in support of a third way beyond dualism and monism*. Paderborn: Mentis Verlag.

Kronz, F.M., & Tiehen, J.T. (2002). Emergence and quantum mechanics. *Philosophy of Science, 69*, 324–347.

Leibniz, G. W. (1966). Betrachtungen über die Lebensprinzipien und über die plastischen Naturen. In E.Cassirer (Ed.), *Hauptschriften zur Grundlegung der Philosophie* (pp. 63–73). Hamburg: Meiner.

Libet, B. (1999). Do we have free will? *Journal of Consciousness Studies, 6*, 47–57.

Lucadou, Wv, Römer, H., & Walach, H. (2007). Synchronistic phenomena as entanglement correlations in generalized quantum theory. *Journal of Consciousness Studies, 14*, 50–74.

Maturana, H.R. (1980). Autopoiesis: Reproduction, heredity, and evolution. In M. Zeleny (Ed.), *Autopoiesis, dissipative structures and spontaneous social order* (pp. 45–79). Boulder: Westview.

Metzinger, T. (2000). *Neural correlates of consciousness: Empirical and conceptual questions*. Cambridge: MIT Press.

Metzinger, T. (2003). *Being no one: The self-model theory of subjectivity*. Cambridge: MIT Press.

Meyer-Abich, K.M. (1965). *Korrespondenz, Individualität und Komplementarität*. Wiesbaden: Steiner.

Petsche, H., & Brazier, M.A.B. (Eds.). (1972). *Synchronization of EEG activity in epilepsies*. Wien: Springer.

Primas, H. (2003). Time-entanglement between mind and matter. *Mind and Matter, 1*, 81–121.

Römer, H. (2004). Weak quantum theory and the emergence of time. *Mind and Matter, 2*(2), 105–125.

[AU6] Römer, H. (submitted). Verschränkung. In M. Knaup (Ed.) (pp.) Post-Physikalismus.

Ross, C.A., & Joshi, S. (1992). Paranormal experiences in the general population. *The Journal of Nervous and Mental Disease, 180*, 357–361.

Salart, D., Baas, A., Branciard, C., Gisin, N., & Zbinden, H. (2008). Testing spooky actions at a distance. *Nature, 454*, 861–864.

Schmidt, S., Schneider, R., Utts, J., & Walach, H. (2004). Remote intention on electrodermal activity – Two meta-analyses. *British Journal of Psychology, 95*, 235–247.

Schrödinger, E. (1935). Discussion of probability relations between separated systems. *Proceedings of the Cambridge Philosophical Society, 31*, 555–563.

Schwartz, J.M., Stapp, H.P., & Beauregard, M. (2005). Quantum physics in neuroscience and psychology: A neurophysiological model of mind-brain interaction. *Philosophical Transactions of the Royal Society B: Biological Sciences, 1458*, 1309–1328.

Searle, J.R. (1992). *The rediscovery of the mind*. Cambridge: Massachusetts Institute of Technology Press.

Tononi, G. (2004). An information integration theory of consciousness. *BMC Neuroscience, 5*, 42.

Utts, J. (1996). An assessment of the evidence for psychic functioning. *Journal of Scientific Exploration, 10*, 3–39.

van Gulick, R. (2001). Reduction, emergence and other recent options on the mind/body problem. A philosophical overview. *Journal of Consciousness Studies, 8*, 1–34.

Walach, H. (2003). Entanglement model of homeopathy as an example of generalizsed entanglement predicted by weak quantum theory. *Forschende Komplementärmedizin und Klassische Naturheilkunde, 10*, 192–200.

Walach, H. (2005). Generalized entanglement: A new theoretical model for understanding the effects of complementary and alternative medicine. *Journal of Alternative and Complementary Medicine, 11*, 549–559.

Walach, H. (2007a). Generalisierte Verschränkung – Ein theoretisches Modell zum Verständnis von Übertragungsphänomenen. *Zeitschrift für Psychotraumatologie, Psychotherapiewissenschaft, Psychologische Medizin, 5*, 9–23.

Walach, H. (2007b). Mind – body – spirituality. *Mind and Matter, 5*, 215–240.

Walach, H., & Schmidt, S. (2005). Repairing Plato's life boat with Ockham's razor: The important function of research in anomalies for mainstream science. *Journal of Consciousness Studies, 12*(2), 52–70.

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