

# Concentric and Diametric Spatial Structures of Relation: Exploring a Neutral Bridge Language between Quantum Physics and Neuropsychology

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## ABSTRACT

Pauli (1949) postulated a neutral bridge language between the physical and psychological world but left this idea underdeveloped. This article proposes a candidate neutral bridge language between quantum physics and neuropsychology in terms of specific contrasting spaces, concentric and diametric spaces. Concentric and diametric spaces are explored in terms of symmetry, assumed connection and separation, as well as relatively open and closed systems of foreground-background interaction. Structural commonalities are highlighted between these concentric and diametric spaces and aspects of quantum physics, such as Pauli's Exclusion Principle and antiparticles, as well as in neuropsychology, for mirror neurons. Such structural commonalities are not to reduce this proposed spatial-phenomenological bridge language to either the quantum physical or neuropsychological level.

**Key Words:** concentric space, diametric space, symmetry, quantum physics, Pauli exclusion principle, antiparticle, mirror neurons

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## A Neutral Bridge Language and Space

Nobel Prize winning physicist Wolfgang Pauli's (1949) correspondence with Carl Jung postulated a neutral bridge language between the physical and psychological world. This language was not available to him. Despite drawing upon a possible language of archetypes, parables or in subsequent correspondence of Pauli (1953) with Jung, where he proposed mathematics as this neutral language, this issue remained no more than a promissory note in Pauli's thought.

Without making explicit the need for a neutral bridging language to mediate the domains of quantum physics and biology, Limar's (2011) review of the relation between these domains seeks to adopt a Jungian framework of acausal order, namely, synchronicity. This argument rests at a highly tentative stage. Building on the work of Michael Hyland (2004), Limar (2011) interrogates what physiological mechanism may be responsible for the existence of quantum entanglement between cells of the same and different human bodies. The possible role of

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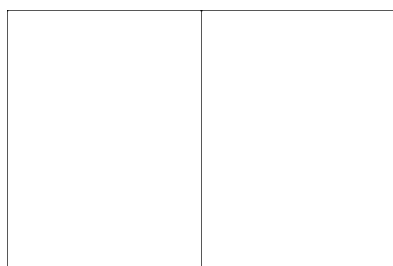
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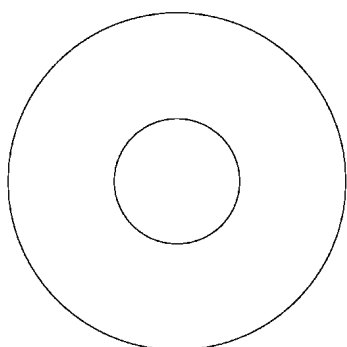


quantum entanglement in meiosis processes at DNA level within the same body is considered by Limar (2011), while recognising the need for a wider framework for quantum entanglement across different people, given that during meiosis, genetic materials may be transferred to descendants only.

This article seeks to propose a spatial neutral language as a candidate framework for relating quantum wave-particle duality and neuropsychology. This spatial discourse has previously been adopted for understanding Jung's proposed central archetype of the collective unconscious, the mandala structure (Downes 2003; 2011; 2012), purportedly more fundamental than all other experiential structures (Jung 1943). Though underemphasised by Jung, the mandala structure can be understood not only in spatial terms but also in a dynamic spatial way as a representation of an interplay (Downes, 2012). This interplay is between two contrasting fundamental spaces, concentric and diametric structures.



**Fig. 1** Diametric Dualism



**Fig. 2** Concentric Dualism

A diametric spatial structure is one where a circle is split in half by a line which is its diameter, or where a square or rectangle is similarly divided into two equal halves (Figure 1). In a concentric spatial structure, one circle is inscribed in another larger circle (or square); in pure form, the circles share a common central

point (Figure 2). These offer different models of distinction, relation and division.

While acknowledging that direct observation of effects related to quantum entanglement at the level of macroscopic objects is highly questionable, Limar (2011) treats Jung's conception of an acausal ordering of synchronicity as a bridging concept to relate quantum non-locality to molecular biology. Yet this acausal ordering of synchronicity can also be understood in the spatial terms of this proposed neutral language between concentric and diametric spaces. Before developing this argument, it is important to emphasise that this proposed spatial bridge language between the quantum realm and neuropsychology is not one that reduces these concentric and diametric spaces either to the quantum physical or neuropsychological level.

Neuroscience research on the limits of conscious perception provides fresh evidence for non-conscious processes and the large influence of it in our daily life (Berlin, 2011). A further step taken by Limar's (2011) framework is to engage with the hypothesis that molecular orbitals (electron shells) of molecules, biologically active during meiosis and mitosis are in some way material carriers of consciousness. Again here he draws not only on synchronicity but on interpretations of it as a phenomenological dimension based on Jung's analytical psychology (Limar 2011, p.317). He also draws on the hypotheses of Denis (2010) and Taric et al. (2010) that genetic material can be a tangible medium of consciousness. Without going as far as this and without reducing phenomenology to simple subjective consciousness, nevertheless, a distinctive spatial phenomenological level as a possible bridge between the quantum physics realm and the neuropsychological requires amplification with regard to Pauli's neutral bridge language between physics and psyche. In other words, a spatial-phenomenological level of concentric and diametric spaces is being proposed as a candidate neutral bridge language between quantum physics and neuropsychology. To develop this argument, at least in initial exploratory terms, key features of concentric and diametric spaces will be related to aspects of quantum physics, neuropsychology and to synchronicity as acausal orderedness to examine their structural commonalities. The phenomenological features of concentric and diametric spaces have been described elsewhere

for von Uexkull's perception in biology (Downes, 2010b), early childhood experience of attachment and transitional objects (Downes, 2003; 2012), precognitive frames for belief systems (Downes, 2015), psychoanalysis regarding repression (Downes, 2012; 2013) and social systems in education (Downes, 2015a).

While space has been analysed in cognitive psychology to some degree, regarding both perception (Piaget & Inhelder, 1956; Neisser, 1967; Nisbett *et al.*, 2001) and cognition (e.g., Newell & Simon's 1972 problem-space model; Simon, 1996), the proposed neutral bridge language of space through concentric and diametric spaces is a phenomenological level that is to be distinguished from a cognitive level, whether cognition is interpreted as a dimension of folk psychology (von Eckhardt, 1993) and culture (Nisbett *et al.*, 2001), or otherwise. The static, noninteractive features of 'empty' spatial assumptions in cognitive science have been analysed elsewhere (Downes, 2006; 2010a; 2010c; 2012). This proposed bridging discourse of diametric and concentric spatial complementarity is a phenomenology through space not of space (Downes, 2012). The projection of these spatial structures operates at a different level, prior to the cognitive (Downes, 2015).

### **Setting Out the Proposed Neutral Language of Diametric and Concentric Spaces of Relation in Relation: The Dimension of Symmetry**

A key distinguishing feature of concentric and diametric spatial structures, found by structural anthropologist Claude Lévi-Strauss (1973), is that they are observed to co-exist in complementary functional relation and not simply in isolation. They are structures of relation as part of a system of relations. Being mutually interactive, at least potentially, they are observed as structures of relation but also structures in relation. Lévi-Strauss recognizes that they are fundamentally interlinked, so that an increase in one is compensated for by decrease in the other. Meaning is relational in their contrasting relative differences, rather than in either space considered in isolated, absolute or atomistic terms. Lévi-Strauss (1962; 1963; 1973) examined a wide range of cross-cultural examples of concentric and diametric spatial structures, observed by a range of anthropologists, for social structures and myths. However, he did not

analyse the scope of concentric and diametric spatial systems of relation to be relevant to other contexts.

For current purposes, three entailments of the relative differences between concentric and diametric spaces can be described:

- i) Diametric space as mirror image symmetry: Concentric space as symmetrical unity
- ii) Diametric space as assumed separation: Concentric space as assumed connection
- iii) Diametric space as relative closure and noninteraction with background: Concentric space as a relatively open system in interaction with background

### **i) Diametric space as mirror image symmetry: Concentric space as symmetrical unity**

Lévi-Strauss (1973) explicitly relates diametric structures to mirror image inversions between both diametric poles. He describes 'symmetrical inversions' (p. 247) in Mandan and Hidatsa myths:

"[...] these myths are diametrically opposed ... In the Mandan version ... two earth women who are not sisters go to heaven to become sisters-in-law by marrying celestial brothers. One who belongs to the Mandan tribe, separates from an ogre, Sun, with the help of a string which enables her to come back down to her village. In revenge, Sun places his legitimate son at the head of the enemies of the Mandan, upon whom he declares war. In the Hidatsa version ... everything is exactly reversed. Two celestial brothers come down to earth to be conceived by human beings and born as children. Sun's sister, an ogress, is joined with an earthborn character by means of a string. She makes him her adopted son and puts him at the head of the enemies of the Hidatsa". (Lévi-Strauss, 1973; p.250)

A mirror image is not an identical one but a left-right inversion. Strictly speaking, a mirror image is plane symmetry rather than the line (or point) symmetry of diametric space. Nevertheless, plane, line and point symmetry all accommodate a view of symmetry as reversal or inversion, as in diametric space. Concentric structures of relation are not a symmetry as



inversion. Rather they offer a different symmetry as unity, where the line or axis of symmetry brings the same pole rather than a mirror image pole in diametric structures (Downes, 2012).

It is notable that Pauli (1957), in his later letters to Jung, did begin to conceptualise the relation between the psychological and quantum physical world in implicitly spatial terms, as being a mirror image relation. An active spatial organizing principle between the psychological and physical would be a direct challenge to a Cartesian split between mind and body, a challenge to a Cartesian split that is consistent with evidence in neuropsychology (Damasio, 1994). Moreover, it would also challenge a Cartesian conception of space; Descartes (1954) referred to 'empty space, which almost everyone is convinced is mere nonentity' (p.200). Nobel prize winning physicist Steven Weinberg (1996) rejects a dialogue between physics and the social sciences in general. However, he views some notable exceptions to this, specifically regarding space, time and matter, where suggests that the insights of physics on these dimensions may have implications for the social sciences.

### Antiparticles and isospin mirrors as expressions of diametric structures of relation

Inverted symmetry expressing diametric modes of relation occurs in quantum field theory which is a 'partial' (Penrose, 1990; p.374) union of ideas from quantum mechanics and special relativity. In quantum field theory, each kind of particle has its anti-particle. Sometimes such as with photons, this is the same as the original particle. A massive particle and its anti-particle can annihilate to form energy; this pair can also be created out of energy. Particles and anti-particles are in a diametric structure of relation.

Peat (1988) gives the following accounts of the mirror image relation between the proton and neutron with regard to spin:

"Heisenberg guessed that if the electromagnetic field could be switched off, then the proton could not be distinguished from the neutron...they could be thought of as a single particle

having a basic two-valuedness...Spin up would signify a proton and spin down a neutron. With the electromagnetic field switched off, there would be a mirror symmetry between an identical particle with two opposite spins. Switching the field back on breaks the symmetry and picks out the proton from the neutron. This new form of spin was called isospin." (p.76-77)

The spin of an electron can have only one of two possible values – up or down. A lone spinor is the simplest possible quantum object which can have one of two values. It is a single bit of quantum space, as a binary object. Thus, it can be concluded that diametric space is an underlying structure of relation as a supporting precondition with regard to the dimension of spin for fundamental aspects of the quantum world, namely, protons, neutrons and electrons.<sup>2</sup>

### *Commutativity and the inverted symmetry of diametric space: Non-commutativity in quantum mechanics as a move away from diametric modes of relation*

A key inference from the relative differences of concentric and diametric spaces is that the concentric poles are not mirror images of each other, whereas the diametric poles are. This resonates with the mathematics relevant to quantum theory (and also the Riemannian geometry of general relativity which challenges Euclidean space). The relation is to non-commutativity (AB does not equal BA) in contrast to the more traditional mathematical commutativity (AB equals BA) which does provide a mirror image. This feature of non-commutativity operates for Heisenberg's matrix mechanics in quantum mechanics. Normally in multiplication, two times three is the same as three times two. However, Matrix A multiplied by Matrix B does not equal matrix B multiplied by matrix A. Depending simply on the order in which measurements are carried out the microscopic world yields different results.

Bohm (1980) observes that although there are several alternative formulations of quantum theory (due to Heisenberg, Schrodinger,

<sup>2</sup> See also Pauli's reference to his and other physicists' 'shock' ('Letter to Jung', 1957, p.163) at the violation of the principle of conservation of parity in weak nuclear interactions. The principle of parity states that two sets of phenomena, one of which is an exact mirror of the other, behave in an identical fashion except for the inverted

symmetry of the mirror image effect. Pauli accepts that his concern with 'the mathematics of mirror images' was influenced by psychological factors and that he had a 'mirror complex' ('Letter to Jung', 1957, pp.162-63).





Dirac, von Neumann and Bohr), one of their common basic assumptions includes the non-commutation of many operators such as position and momentum. The concentric relation expresses a resistance to inversion of its poles in a common structural fashion to non-commutative mathematics, whereas the reverse symmetry of diametric space allows for an inversion as commutative mathematics does. While inverted symmetry exemplifies a diametric relation, this is by no means not to equate every resistance to inverted symmetry with a concentric relation.

Pais (1982) noted Bohr's preoccupation with the role of language in the appropriate interpretation of quantum mechanics, so that terms such as disturbance of phenomena by observation needed to distinguish words like 'phenomena' and 'observation' from common usage to avoid confusion. The argument for common structural regularities between concentric and diametric spaces, on the one hand, and quantum waves and particles, on the other hand, seeks to go beyond words to *structural* parallels between a diametric and concentric spaces and quantum physics. In other words, concentric and diametric spatio-temporal relations are being investigated as providing a neutral bridge *structural* language between the psychological and the physical – a structural language of spatio-temporal relation that is reliant on structures and structural patterns of relation more than the slipperiness of words susceptible to distortion across different contexts. In this sense, the neutrality of the language is to be found in its role as a *structural* discourse of relations and patterns common to both domains.

This concern with spatial structures prior to language raises issues of the ambiguity of meaning in understandings of mirror neurons in neuropsychology. A mirror neuron is a term used to describe when a neuron fires, both when an animal acts and when the animal observes the same action performed by another (Keysers, 2010). This is also an observable inference for humans, where brain activity consistent with mirror neurons has been found in the premotor cortex, the supplementary motor area, the primary somatosensory cortex and the inferior parietal cortex (Molenberghs *et al.*, 2009). The neuron is interpreted as mirroring the behaviour of the other, as though the observer were itself acting. However, it is important to emphasise that these mirror neurons are not

mirror image inversions, where left and right are reverse symmetries. Rather they offer a direct matching between an action observation and an action execution (Rizzolatto & Craighero, 2004).

Initially observed in area F5 of the ventral premotor cortex of macaque monkeys, such mirror neurons are activated both when the monkey executes goal-related hand or mouth actions, such as taking an object, and also when observing other monkeys or humans performing the same actions (Di Pellegrino *et al.*, 1992). Direct matching offers a structural commonality with the symmetry as unity of concentric relational spaces and not the mirror image inverted symmetries of diametric spaces. Thus, the term *mirror* neuron is to some extent a misnomer as an inversion is not taking place in the direct matching. It is arguable that *neuron symmetry* is a more apt term.

### **Setting Out the Proposed Neutral Language of Diametric and Concentric Spaces of Relation in Relation: The Dimension of Assumed Separation and Assumed Connection**

#### *ii) Diametric space as assumed separation: Concentric space as assumed connection*

Though Lévi-Strauss did not explicitly highlight this difference, it is evident that the inner and outer poles of concentric structures are more fundamentally attached to each other than diametric structures. Both concentric poles coexist in the same space so that the outer circle overlaps the space of the inner one. The outer circle surrounds and contains the inner circle. The opposite that is within the outer circle or shape cannot detach itself from being within this outer shape. And though the outer circle or shape can move in the direction of greater detachment from the inner circle, it cannot fully detach itself from the inner circle (even if the inner circle becomes an increasingly smaller proportion of the outer). Full detachment could conceivably occur only by destroying the very concentric structure of the whole opposition itself. In contrast, diametric oppositional realms are both basically detached and can be further smoothly detached from the other. A concentric relation assumes connection between its parts and any separation is on the basis of assumed connection, whereas diametric opposition assumes separation and any connection between the parts is on the basis of this assumed separation



(Downes, 2003; 2012). A concentric spatial relation is a structure of inclusion compared to a diametric spatial structure of exclusion.

### *Assumed separation (quantum particle) versus an inherently relational mode (quantum wave)*

The Pauli Exclusion Principle (1925), a fundamental part of modern quantum physics, states that no more than one particle of a particular kind and spin is permitted in a single quantum state. This principle is a fundamental ingredient responsible for the stability of all matter. Hawking (1988) emphasises the importance of the Exclusion Principle for real matter particles detectable by a particle detector, although observing that virtual force-carrying particles do not obey this principle. No two particles of a particular kind and spin can occupy the same location at the same time. Hence, particle A excludes particle non-A from a given location at a given time. This Exclusion Principle applies to quantum particles but not quantum waves. Similarly, in diametric space, each pole excludes the other from its given location; whereas in concentric space the outer pole is also contained within the inner pole and is in an assumed connection relation that is not that of exclusion. This is not to treat the exclusion in diametric space as equivalent with Pauli's Exclusion Principle but rather to explore Pauli's Exclusion Principle as one example of a diametric structure of relation. An exclusion principle applies to diametric space which does not apply to concentric space.

Mansfield & Spiegelman (1991-92) observe the inherently relational nature of quantum waves. Similarly, the inner circle of the concentric structure is inherently relational, as it is unable to remove itself from being encompassed within the outer realm; no matter how far the outer pole of concentric space expands, it is still in a relation of assumed connection with the inner pole. This inherently relational quality to quantum waves and concentric space is not present for quantum particles and diametric space.

With regard to simple organisms, Gash (2015) observes that the approach-avoidance of single cell organisms depends on noticing differences and that it is resonant with the account of diametric spaces in Downes (2012) that observe diametric projected spaces of

assumed separation as a dynamic process of splitting. Gash (2015) more tentatively raises the question as to the parallels between approach and concentric assumed connection in Downes (2012).

An implicit spatial understanding regarding division underpins Limar's (2011) recognition that quantum entanglement may exist not only between nuclear DNAs of different cells. Summarising issues highlighted by Hameroff (2004) and Tulub (2004), Limar observes that any cellular structures interacting both before and during mitosis and meiosis processes, and after cells have divided, ending up in different cells, may potentially represent elements related to quantum entanglement between molecules of different cells. Moreover, he refers to Hyland's (2003) suggestion that quantum effects may be responsible for morphogenesis processes, possibly as a bridge linking genotype and phenotype.

The mirror neuron system is an embodied simulation that is viewed as a motor resonance function founding human's learning capacity to imitate others' actions (Rizzolati & Craighero, 2004). This motor resonance function presupposes a concentric spatial-relational background of symmetry and also assumed connection between the goal-related action and the neurons rather than a diametric spatial split between them. In other words, concentric relational space of assumed connection and symmetry as unity, rather than reversal, offers a framework of being a key supporting precondition for direct matching processes.

This initial step towards interrogating mirror neuron systems in terms of concentric relational spaces is not to exclude diametric spatial dimensions of inverted symmetry from other aspects of such a neuron system, as well. Again it is to be emphasised that the argument for current purposes is to identify structural commonalities across the three different levels of explanation (neuropsychological, spatial-phenomenological and quantum physics) rather than seek equivalences.

**From Diametric Space Underlying Causal Explanations to Synchronicity as Acausal Connection Resonant with Concentric Space: Assumed Separation and Inverted Symmetry Inherent in the Cause-Effect Relation**

Quantum physics clearly challenges traditional conceptions of causality assumed by Newtonian physics, while similarly Jung sought to transcend mechanical causal explanations through his emphasis on final causes or teleology. Interpreting causality in terms of diametric and concentric projected structures of relation can clarify that Jung was, in effect, seeking a level of psychological explanation that went beyond diametric structured projections.

Built into the cause-effect type of explanation (at least the Newtonian billiard ball type explanation) frequently used in the social sciences is the contingent condition of an assumed separation between cause and effect. It is the action of an *external* force upon the other; externality presupposes a basic and ongoing separation prior to and during the collision between the causal force and that which it acts upon. Externality is an assumed separation which is consistent with a diametric spatial relation and contrary to the assumed connection relation of concentric space.

Jung wants to avoid a grounding for the psyche in a causally self-sufficient source, in contrast, for example, to Fodor's (1976) cognitive science which seeks 'mental states that have mental causes. It may be that we are labouring in quite a small vineyard, for all that we can't now move out of its borders (p.202). A necessary precondition for such a causal grounding is the diametric structure framing cause and effect - a diametric structure which may not be a fundamental or unmalleable ground. Movement from this diametric relation is presupposed in movement from causal structures and is implicated in a Jungian understanding of synchronicity at a level of acausal order prior to causality.

Gillespie's (1984) description of Hegel's insight into chains of cause-effect can be seen to reveal the inverted symmetry structure in the cause-effect relation:

"Cause is formally differentiated from effect as the original and active element, the free element from which motion arises. Substantively, however, the cause is not distinguished from the effect and in fact, is and can only be a cause in becoming an effect, just as the effect is and can only be an effect because it was a cause. The cause becomes the effect and the effect thus becomes the cause (of the next effect). Moreover, this

transformation of each into its opposite i.e., of cause into effect and of effect into cause, is necessary, for each only has meaning in relation to the other..." (pp.52-3)

This inverted symmetry, where cause is a mirror image of effect, once again highlights the diametric structure framing traditional causal explanations.

It is here that Jung's conception of synchronicity as acausal orderedness, emphasised by Limar (2011) as bridging quantum physics and biological levels, can be conceived in spatial terms. Whereas diametric space is a necessary condition for traditional causality, concentric space of assumed connection offers not only a contrast to this diametric cause-effect conception but also a structured, hence ordered, systemic organising principle which offers a connective spatial movement - an influence upon a system of diametric space to bring restructuring from this causal type of space towards a more proximate mode of interaction than simple causality. This is not to reduce the quantum wave function to concentric space or vice-versa.

### **Setting Out the Proposed Neutral Language of Diametric and Concentric Spaces of Relation in Relation: The Dimension of Foreground-Background Interaction**

*Diametric space as relative closure and noninteraction with background: Concentric space as a relatively open system in interaction with background*

Another contrast between diametric and concentric space is highlighted by Lévi-Strauss. He argues that self-sufficiency and a split relation to the outside environment is a general quality of diametric systems, 'In a diametric system ... virgin land constitutes an irrelevant element; the moieties are defined by their opposition to each other, and the apparent symmetry of their closed structure creates the illusion of a closed system' (Lévi-Strauss 1963, p. 152). While this makes sense for the immediate example given for social structures, it is not yet clear if non-self-sufficiency and orientation to the outside environment is a general quality of concentric as opposed to diametric spatial relation, as Lévi-Strauss (1963) claims:

"[In concentric relation] The system is not self-sufficient, and its frame of reference is always the environment. The opposition between cleared ground (central circle) and waste land (peripheral circle) demands a third element, brush or forest – that is, virgin land – which circumscribes the binary whole while at the same time extending it, since cleared land is to waste land as waste land is to virgin land." (p. 152)

Lévi-Strauss rejects closure for concentric structures, implying that the relation of the background to both poles is governed by the relation within the dualism itself, i.e., 'cleared land is to waste land as waste land is to [background] virgin land'. The mode of relation to the background is not extraneous to the respective modes of relation within the poles themselves. Thus, as the concentric poles are in assumed connection to each other, they are also in assumed connection to the background; this assumed connection to the background resists closure within the concentric structure. In contrast, diametric structures' relation to their own poles is one of assumed separation which then maintains an assumed separation with the background.

Whereas Lévi-Strauss is preoccupied with such diametric closure in the context of cross-cultural physical structures and societal arrangements, this systemic spatial closure is also meaningful for other contexts, including individual experience (Downes, 2012) and social systems in education (Downes, 2015b).

*Interaction or assumed connection with background field of probability (quantum wave) versus being relatively distinct from the background probability (quantum particle)*

Mansfield & Spiegelman (1991-92) note that while quantum waves are 'inherently nonlocal' (p.291), quantum 'particle measurements are well-defined, distinct and localisable events in spacetime' (p.292). Yet this description of quantum particles is accurate only for early conceptions of quantum particles and not for modern quantum mechanics. As Pais (1982)

observes, the association between the particle concept and a high degree of spatial localization is typical for the period circa 1909; it is not correct in general.

This view of Mansfield and Spiegelman (1991-92) describes a physics prior to, for example, De Broglie's (1923) incorporation of matter, and not simply light, within a view of quantum particles and wave fields of probability. As Pais (1982) comments on Einstein, one statement he made in 1909 needed revision: moving light-quanta with energy  $h\nu$  are not pointlike (p.404).

The background relation to diametric space has been seen to be much more distinct from the two poles of diametric space than in concentric space. There is an assumed separation from the background in diametric space, so that diametric space is more well-defined, discrete and distinguishable from its background than concentric space; whereas for concentric space the relation between background and the concentric poles themselves leaves the poles and background in assumed connection. Diametric space's quality of discreteness is shared by quantum particles, not so much in the sense of spatial localization, but in the sense that the quantum particle emerges relatively distinct from the background field of probability or probability density, as the wave function collapses. This assumes the orthodox Copenhagen interpretation that probability is not an actual event, in contrast to, for example, Everett's (1957) more unorthodox 'many worlds' interpretation of the probabilities (see also e.g., Coveney and Highfield, 1991, p.129; Barrow & Tipler, 1986; Wallace, 2003). In contrast, both concentric space and quantum waves remain in assumed connection with their respective backgrounds - the quantum wave probability is part of a background field of probabilities of encountering objects in a particular place or state of motion, if a measurement is made<sup>3</sup>.

**Complementarity between Concentric and Diametric Spaces: Parallels with Complementarity at the Quantum Physics Level**

<sup>3</sup> The linearity of Schrodinger's deterministic wave equation is emphasised by Weinberg (1993): 'If we change one value of the wave function at any one time and plot a graph of any value of the wave function at any later time against the value that has been changed, eISSN 1303-5150

then, all other things being equal, the graph is a straight line...quantum systems cannot exhibit chaos; a small change in the initial conditions produces only a small change in the values of the wave function at any later time' (p.68).





Following Jung (1948), Mansfield & Spiegelman (1991-92) observe the reciprocal complementarity between quantum particles and waves, and parallel this with the complementary interaction between the conscious and unconscious. In physics, this refers to Bohr's (1927) principle that space-time coordination and causality of classical physics are complementary to, but exclusive of, features of quantum wave fields of probability. Niels Bohr emphasised a particular feature of quantum mechanics that he called complementarity<sup>4</sup>, where knowledge of one aspect of a system precludes knowledge of certain other aspects of the system. Heisenberg's uncertainty principle is one example of complementarity, where knowledge of a particle's position (or momentum) precludes knowledge of the particle's momentum (or position).

Simply put, Heisenberg's Uncertainty Principle (1927) observes that the precise position and momentum of a given electron at a given time cannot be known, as the more precise the position of the electron the more indeterminate is its momentum and vice-versa. This limitation on description is not due to distortions brought about by measurement of either the position or momentum but is a quality of the events themselves<sup>5</sup>. Bohm (1980) describes this complementarity in relation to the non-commutativity of Heisenberg's Uncertainty Principle:

"The impossibility of theoretically defining two non-commuting observables by a single wave function is matched exactly, and in full detail, by the impossibility of the operation together of two overall set-ups that would permit the simultaneous experimental determination of these two variables. This suggests that the non-commutativity of two operators is to be interpreted as a mathematical representation of the incompatibility of the arrangements of apparatus needed to define the corresponding quantities experimentally." (p.74)

A similarly complementary relationship exists between diametric and concentric spatial structures of experience, in that they interact, and increase in one is at the expense of the other (i.e., increased assumed connection challenges an increase in assumed separation). There is to some extent a mutual exclusion between diametric and concentric structures of experience.

### Cautionary Notes for Interpreting Commonalities between Diametric and Concentric Spaces and Quantum Physics

These contrasting relations of diametric and concentric space are explored as sharing a common structural domain of relevance with central concepts in quantum physics, namely, Pauli's Exclusion Principle, the non-commutative mathematics in quantum theory generally, dimensions of spin for protons, neutrons and electrons, as well as Bohr's principle of complementarity. They have also been explored in initial terms regarding mirror neurons. It is important, however, to distinguish the framework of concentric and diametric structures of relation viewed as projections, from the subjectivity of what Jean Bricmont (1996) rejects for physics as a highly common error, namely, the 'Mind Projection Fallacy', described by E. T. Jaynes, which supposes that the creations of one's own imagination are the real properties of nature. The projections of concentric and diametric structures of spatio-temporal relation are clearly distinct from subjective projections. As transpersonal spatio-temporal structures of relation, concentric and diametric projections are at a different level of description from the kind of subjectivity described by Bricmont & Sokal (2001, p.4), 'in the sense that their meaning would be significantly influenced by extra-scientific factors (such as the personality of the individual scientist or the social characteristics of the group to which she belongs)'. The existence of concentric and diametric spatio-temporal relation is independent of the individual will – and is projection at a different level of description from subjective projections. The relation to lived human experience is through potential movement between concentric and diametric

<sup>4</sup> See Zabriskie (2001, p.xxx) on the prior role of William James regarding 'complementarity' and its relevance for psychology and physics, including his influence on the terminology employed by Bohr.

<sup>5</sup> Momentum was the key quality which distinguished simple light energy quanta from photons. As physicist Pais (1982) notes in his eISSN 1303-5150

acclaimed biography of Einstein, 'the full-fledged particle concept embodied in the term photon was not there all at once' (p.408). Pais (1982, p.414) describes Compton's experimental support for a radiation quantum carrying with it directed momentum as well as energy as creating a sensation among physicists of the time (1923-1924).



modes of relation bringing changes in their relative position and dominance in relation to the other pole.

Any argument for relation between a spatial-phenomenology and the quantum realm needs to acknowledge the extreme dangers of oversimplification. Hofstadter (1979) cautions against overgeneralising interaction between the observer and observed in quantum physics to other contexts, such as psychology, while Barrow & Tipler (1986) acknowledge the possibility of an extremely limited role for the observer in quantum mechanics, noting that a photographic plate would serve equally well as an observer. Similarly, Sokal and Bricmont (1999) have offered a trenchant critique of attempts in the social sciences to import concepts from modern physics, highlighting the use of oversimplified distinctions between classical Newtonian physics and modern physics which have brought misunderstanding to terms such as linearity, determinism and subjectivity/objectivity<sup>6</sup>. Moreover, although Pais (1982, p.456) acknowledges that objective reality is incompatible with the assumption that quantum mechanics is complete, this does not mean, as Sokal and Bricmont (1999) also emphasise, that this provides a *carte blanche* for subjectivity. Penrose (1995) also notes that it is too simplistic to suggest that a conscious act of will could influence the result of a quantum-mechanical experiment. Pauli further highlights that individual characteristics of the observer are not found in physics at the quantum level and the measurements results cannot be influenced by the observer, once the observer has selected the experimental set up (Letter to Jung 1953, pp.120-121).

Sokal & Bricmont (1999, p.4) criticise Lacan and others for 'importing concepts from

the natural sciences into the humanities or social sciences without giving the slightest conceptual or empirical justification'. The current argument does not seek the 'importing' of concepts from physics into the framework being developed for concentric and diametric structures of relation. Rather, having developed a conceptual and empirical justification for this framework within the social sciences (of anthropology and psychology mainly, Lévi-Strauss 1962; 1963; 1973; Downes, 2003; 2010; 2012; 2013; 2015a; 2015b), a framework for dialogue is being sought between this framework and that of quantum physics and neuropsychology, to examine their potential relations with concentric and diametric spaces of relation. It is important to reiterate that the interaction between levels, within this attempted framework for dialogue, is to examine if there can be a dynamic interactive relation between these levels, rather than an argument for identity between the levels.

This examination is not a justification *a priori* that there is a relation; it is an attempt to examine their structural commonalities to establish the basis for a bridging neutral language of relation between them, resonant with Pauli's, reference to 'the gradual discovery of a new ('neutral') psycho-physical standard language, whose function is symbolically to describe an invisible, potential form of reality that is only indirectly inferable through its effects' (Letter to Jung, 1952, p.82). Through their relational contrasts regarding assumed separation/connection, symmetry, relative openness and closure of foreground-background interaction, concentric and diametric spatial structures of relation provide progressive steps towards a neutral language of relation between quantum physics and neuropsychology.

<sup>6</sup>Some accounts of modern physics which resist oversimplified distinctions between Newtonian and modern physics include the following: Coveney & Highfield (1990) highlight similarities between Newtonian and modern physics, namely that Newtonian mechanics, Einstein's relativity and the quantum mechanics of Heisenberg and

Schrodinger are fundamentally neutral with regard to the direction of time, and appear to work equally well with time running in reverse. See also e.g., Weinberg (1993) on the linearity of quantum physics and Bricmont (1996) on serious confusion between determinism and predictability.



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