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ESSAY

Some Chemical Mechanisms Involved in the Formation of Anomalous Pigmented Birthmarks in Cases of the Reincarnation Type

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HIGHLIGHTS

Ian Stevenson is known for his work studying young children who claim to remember past lives. A common feature of the cases he studied was the presence of birthmarks on the children that seemed to correspond to wounds (often fatal wounds) sustained in the previous lives they claimed to remember. Here, we enumerate some chemical mechanisms likely involved in the formation of these anomalous birthmarks based on a contemporary understanding of micro-PK (consciousness's ability to influence the outcome of probabilistic quantum mechanical events) and relevant aspects of developmental biology. We suggest two experiments that can be conducted to understand better how consciousness can influence the formation of pigmented birthmarks.

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ABSTRACT

In Ian Stevenson's time, little was known about the formation of pigmented birthmarks. Today, this is no longer true due in part to advances made to understand better and combat melanoma, an aggressive form of skin cancer that forms from melanocyte cells (which give the skin pigment and form pigmented birthmarks). Here, we summarize what is now known about the circumstances surrounding the formation of pigmented birthmarks during fetal development and some relevant work on micro-PK and its role in biology. We then enumerate some chemical mechanisms that are likely involved in the formation of anomalous pigmented birthmarks in cases of the reincarnation type. These mechanisms include the radical-pair mechanism, which has been the focus of much attention in quantum biology, as well as potential quantum computations occurring in various cytoskeletal filaments. All of the mechanisms enumerated here potentially alter the motion of migrating melanocyte and melanocyte precursor cells during pigmented birthmark formation based on the results of many simultaneous probabilistic quantum mechanical events. We theorize that micro-PK should be able to act on these probabilistic quantum events and thus exert influence on the motion of the migrating cells. We propose two experiments to further investigate the effects of consciousness on the motion of migrating melanocyte and melanocyte precursor cells.

KEYWORDS

cases of the reincarnation type, radical-pair mechanism, quantum biology, consciousness, survival.

INTRODUCTION

Ian Stevenson is known for his work studying children who claim to remember past lives. A noteworthy feature of many of the cases that he studied is the presence of birthmarks and birth defects on the children corresponding to injuries (often fatal injuries) sustained, allegedly, by their previous personalities (Tucker, 2008). A common type of reincarnation-related birthmark is hyperpigmented nevi (Stevenson, 1993), which is of the pigmented[1] variety (McLaughlin et al., 2008). From a theory development standpoint, these birthmarks are of considerable interest. If actual reincarnation occurs in these cases– if a human consciousness leaves a body to reattach later to a developing fetus– then these birthmarks are a clear example of consciousness directly affecting a biological process.[2] Understanding the mechanisms enabling this, which are better at detecting micro-PK influences than any instrument developed by science so far, will likely lead to a better overall understanding of micro-PK and its role in biological processes, including but not limited to cognitive control and cognition.

In a 1993 paper, Ian Stevenson wrote that "almost nothing is known about why pigmented birthmarks (moles or nevi) occur in particular locations of the skin" (Stevenson, 1993, p. 403). At the time, this statement was true. In Stevenson's day, a general lack of scientific understanding of the mechanisms involved in the formation of pigmented birthmarks precluded attempts by theorists to render a reductionist description of how anomalous birthmarks in cases of the reincarnation type might arise. In the ensuing decades, relevant areas of science have advanced considerably, and this is no longer the case today. Here, we discuss some chemical mechanisms that are likely involved in the formation of anomalous pigmented birthmarks in cases of the reincarnation type: the radical-pair mechanism and quantum processes occurring inside various cytoskeletal filaments.

While our analysis here focuses on pigmented birthmarks exclusively, vascular birthmarks are common in the literature (Stevenson, 1997a). It should be noted that the birthmarks that appear in cases of the reincarnation type are quite different than birthmarks that appear on members of the general population. In Stevenson's words, the birthmarks tend to be "hairless areas of puckered, scar like tissue, often raised above surrounding tissues or depressed below them; a few are areas of decreased pigmentation. [...] Those that resemble nevi and moles in appearance are often larger than "ordinary" nevi and also often occur in unusual locations" (Stevenson, 1997b, p. 3). The analysis undertaken here applies contemporary parapsychological theory to developmental biology to explain how melanocyte cells in anomalous birthmarks with pigmented components come to reside at their final location.

We will begin by discussing how micro-PK might produce effects in biological systems, specifically in the brain, where probabilistic quantum events in microtubules (Hameroff, 2022) can exert a quantifiably large influence on network-level neural activity.[3] (Hendel, 2023). We provisionally examine micro-PK effects in biological systems through the lens of Lucadou's correlation matrix method experiments (Walach et al., 2020). Next, we summarize key findings relating to the role and methods of melanocyte migration in the formation of pigmented birthmarks (Bonaventure et al., 2013). Based on these findings, as well as an understanding of how micro-PK interacts with biological systems, we then enumerate some chemical mechanisms by which probabilistic quantum processes can potentially exert a large influence over the behavior of migrating melanocyte cells during pigmented birthmark formation. We argue that these mechanisms must be at least partially implicated in the formation of anomalous pigmented birthmarks in cases of the reincarnation type, even if micro-PK influences over them alone cannot totally account for anomalous birthmark formation. Lastly, we describe two experiments that can be performed to explore the sensitivity of migrating melanocyte cells to conscious intention. The line of reasoning we use here was anticipated, conceptually, by Matlock (2019), who came to similar conclusions regarding the role of PK in the formation of anomalous birthmarks in cases of the reincarnation type.

MICRO-PK AND BIOLOGY

At face value, Ian Stevenson's work suggests that human consciousness can exist separately from the brain and fundamentally is not an emergent property of interconnected neurons. Other categories of anomalous observations made by parapsychology suggest this too, such as clinical cases in which patients experiencing cardiac-arrest-induced out-of-body experiences can accurately perceive facts about their environment that they would be unable to perceive even if they were healthy and awake (Rivas et al., 2016). If consciousness is fundamentally separate from the brain, this fact severely constrains how the brain can operate. Since human behavior is driven by network-level neural activity, there must be something in the brain that consciousness can directly affect via

mind-matter interaction that ultimately converts its will into network-level neural activity.

A plausible candidate for such a consciousness-brain connection mechanism is quantum events occurring inside microtubules, which are thought to exert influence over the firing time of pyramidal neurons (Hameroff, 2022). So-called "noise" emanating from pyramidal neurons is known to play a role in many consciousness-related neural networks (Rolls & Deco, 2012). The sensitivity of a specific neural network to changes in the noise it consumes can be quantified using the "moments method", which is a standard technique in neuroscience for describing the average dynamics of stochastic neural networks (Hendel, 2023). It has been shown that the neural networks that make binary decisions in the brain can be especially sensitive to small changes in the noise that they consume under biologically realistic conditions.

Parapsychology has amassed a large amount of evidence suggesting that conscious attention and intention can influence the outcome of probabilistic quantum events entirely independently of efforts to demonstrate that such events are involved in consciousness in the brain. A significant portion of the text *Parapsychology: A Handbook for the 21st Century* (Cardeña et al., 2015) is devoted to chronicling these experimental efforts. While experiments on this subject are historically fraught with reproducibility issues (Stokes, 2015), a contemporary string of experiments utilizing Walter von Lucadou's "correlation matrix method" seems promising and might offer insight into the specific kinds of effects that consciousness can have on the outcome of random quantum events. In these experiments, Lucadou put volunteers in front of a computer screen displaying a ribbon whose motion is controlled by a random number generator and asked them to attempt to exert control over the direction of the ribbon using their minds (Walach et al., 2020). They were instructed to press the computer's "shift" keys repeatedly, which were programmed to trigger a random sampling of a quantum random number generator and use the result of the sampling to move the ribbon horizontally. Their goal was to carry out on-screen movement instructions to cause the ribbon to either move to the right, move to the left, or remain in the same position.

While the volunteers were attempting to do this, Lucadou recorded several "physical variables" related to the output of the random number generator (things like mean voltage output) and "psychological variables" related to volunteer performance (things like the number of "left" and "right" shift-key presses). At the end of each volunteer's experimental run, the same battery of tests was executed by a presumably non-conscious computer program to serve as a control dataset. For each data set, a "correlation matrix" tabulating correlations between each of the physical variables and each of the psychological variables was populated using Spearman's correlation formula. At the end of the experiment, the number of correlations exceeding an arbitrary but predefined significance threshold in each data set for each volunteer was counted. A nonparametric permutation test was then performed to determine if the total number of significant correlations in the experimental dataset was meaningfully greater than the total number of correlations in the control dataset. In a 2019 replication of this experiment involving 134 participants, it was found that the number of correlations in the experimental data set was greater, with a p-value of .0177. This is the fifth successful replication of this experiment (Walach et al., 2020), although some difficulty has been reported during other reproduction attempts (Walach et al., 2022).

Lucadou's "correlation matrix method" experiments paint micro-PK not as a causal force but as a force that induces correlations between the outcomes of random quantum processes and events occurring on a classical scale that are meaningful to humans (Walach et al., 2020). Never in Lucadou's experiments are the laws of quantum mechanics broken or bent. Every quantum process behaves in accordance with the probability distributions specified by the Schrödinger equation. Consciousness creates harmony among the independent random quantum processes in the experiment without necessarily inducing a correlation between them. Thus, the interaction of consciousness with physical systems requires no more or less energy than the system would consume in the absence of consciousness.

Lucadou's work is predated by theoretical work done by physicist Jean Burns, who rigorously investigated the possibility of explaining PK effects in terms of "reordering" the outcomes of random quantum events "within the limits of the uncertainty principle" (Burns, 2006). Burns hypothesized that micro-PK simply imposes order on the outcome of random quantum events within the bounds of the uncertainty principle. The reordering is constrained by the laws of quantum mechanics, and the "interaction" of consciousness with physical systems does not require consciousness to possess or impart any energy. Burns' work is markedly more mathematically rigorous than Lucadou's and will likely be useful in the future for formulating

mathematically precise models of the effects of micro-PK on biological systems.

Given the evidence that quantum events inside microtubules influence conscious behavior, the evidence that consciousness itself can influence the outcome of random quantum events, and various case studies that seem to show that consciousness can exist and function independently of the brain, a clear picture of the relationship between consciousness and the brain starts to emerge. It looks like consciousness exists separately from the brain and causes the brain to carry out its will by affecting the outcome of random quantum events occurring inside of it, which eventually sets network-level neural activity in motion. This idea can be traced back to the work of Eccles (1986) and Stapp (1993). A natural question to ask is: can consciousness influence other classical processes outside of the brain if quantum processes influence those processes' dynamics? Why is whatever seems to be going on in the brain special? Should not any classical process with dynamics dependent closely enough on the outcome of many random quantum events be susceptible to direct manipulation by consciousness? As we will later see, the dynamics of the pigmented birthmark formation process are driven to some extent by the outcome of random quantum events. This, we hypothesize, is why the anomalous pigmented birthmarks observed by Ian Stevenson can exist in the first place.

MECHANISMS OF PIGMENTED BIRTHMARK FORMATION

While no specific cause of the formation of pigmented birthmarks has been determined, a lot is known about the circumstances surrounding their formation. A prominent feature of young human fetuses is the neural tube, which eventually develops into the brain and spinal cord. A temporary structure of stem cells called the "neural crest" forms around the neural tube and houses cells that will eventually become melanocytes, cells that give the skin pigment. These cells, called "melanoblasts" in their pre-melanocyte state, migrate from the neural crest into the fetus's skin between weeks 6 and 8 of fetal development (Cichorek et al., 2013). Pigmented birthmarks present at the time of birth form as a result of anomalies in this migration process[4] (Cichorek et al., 2013; McLaughlin et al., 2008).

Both melanocyte migration and proliferation are well understood. Cancerous melanoma cells form from melanocyte cells, and the two types of cells are presumed to use similar mechanisms to move. Much of the work in this area has been done to better understand melanoma cells, which are notoriously mobile once they appear in the body. The most common modes of motility for both melanocyte and melanoma cells are amoeboid and mesenchymal migration (Bonaventure et al., 2013). The cells switch between these modes as needed. Both methods of locomotion are ultimately carried out by the cell's actin cytoskeleton, which assembles and disassembles itself to exert the force necessary to cause movement. In both modes, the assembly and disassembly of the actin cytoskeleton are controlled by Rho GTPase signaling proteins (Bonaventure et al., 2013), which is common in mobile cells in general (Spiering & Hodgson, 2011). For a summary of what is known about the mechanisms governing the proliferation of melanocyte cells, see Hirobe's (2011) review article on the subject.

QUANTUM PROCESSES IN CELL MIGRATION

The Radical-Pair Mechanism

It is a known fact that magnetic fields can influence some organic chemical reactions. The mechanism by which this influence is imparted has been named "the radical-pair mechanism". In chemistry, a *radical* is defined as a molecule with an unpaired electron. An introductory exposition of this mechanism can be found in Hore and Mouritsen's (2016) summary paper. In magnetosensitive organic reactions, pairs of radicals form as short-lived reaction intermediates. Each radical in the pair has an unpaired electron, and the spin states of the two electrons in each pair are quantum mechanically entangled when the pair is created. There are two relevant spin states that a radical pair can be in: the "singlet" state, in which the electrons have opposite spins, and the "triplet" state, in which the electrons have the same spin. As the reaction progresses, individual radical pairs transition between these two spin states rhythmically (generally at a rate in the megahertz range) as a result of *hyperfine interactions*, the interactions of the magnetic moments of atomic nuclei with the unpaired electrons.

Generally, it is the case in these kinds of reactions that radical pairs in the singlet state, as well as in a superposition of both spin states, can potentially revert to the previous reaction step, and pairs in either spin state can potentially continue to the next reaction step (Kominis, 2015). The inability of triplet pairs to revert to their previous state is ultimately due to the Pauli Exclusion Principle. Thus, increasing the number of radical pairs in the triplet

state will make the reaction produce its product faster. External magnetic fields oscillating at the correct frequency increase the number of radical pairs in the triplet state via Zeeman interactions (Hore & Mouritsen, 2016).

There is empirical evidence that a reaction with a radical-pair mechanism intermediate step takes place during generic cell migration and that the rate of this reaction has a significant influence on the behavior of the migrating cell. In a 2023 experiment by Vecheck et al., mouse fibroblast cells were subjected to a 50 μT static magnetic field and a 1.4 MHz oscillating magnetic field with a 10 μT amplitude, while a group of control cells was subjected only to a 50 μT static magnetic field. After seven days of incubation, the cells exposed to the oscillating magnetic field had clustered more than the control cells, forming groups with an average density of 23.5×10^{-4} Cell/μm^2 compared to 4.7×10^{-4} Cell/μm^2. The explanation for this observation, posited by the authors, is that the oscillating magnetic field sped up cell respiration in the migrating cells by influencing the rates of metabolic processes that use the radical-pair mechanism to produce reactive oxygen species.

While the ratio of singlet to triplet radical pairs oscillates predictably in reactions involving large quantities of molecules (Hore & Mouritsen, 2016), the behavior of an individual radical pair in a reaction is fundamentally quantum mechanical. Radicals probabilistically slip between the singlet and triplet states, and the probabilities of these state changes can be quantified. Formally, radical pairs are treated as an open quantum system. They are modeled as being continuously "observed" by neighboring molecules with a Lindblad-type equation (Kominis, 2015, III.E.). At every instant of the system's evolution, a "response from nature" (Stapp, 2015) is rendered to determine if the system should collapse into a singlet or triplet state or continue evolving in a superposition state. Micro-PK should be able to influence when this collapse occurs and the resulting state. When cast over every radical-pair reaction occurring in a group of migrating melanocyte cells for days on end, this influence could conceivably have a large impact on the final distribution of cells.

Quantum Computations In Cytoskeletal Filaments

Actin filaments, like microtubules, are one of the three main types of cytoskeletal filaments in eukaryotic cells. In addition to physically implementing movement during cell migration (Bonaventure et al., 2013), there is strong evidence that actin networks are involved in various kinds of information processing tasks (Adamatzky et al., 2024). The possibility that actin filaments perform quantum computations like their microtubule cousins has been partially explored. Theoretically, classical F-actin networks can implement XOR, AND-NOT, and OR gates when modeled as automata (Adamatzky, 2017). When quantum mechanical effects are thrown into the mix and individual actin proteins in a strand are allowed to be in a superposition of two deliberately unspecified states, three-valued logic gates can be realized (Siccardi & Adamatzky, 2016). The networks could take advantage of the quantum superposition states of individual actin proteins if the physical realization of such states is possible. There is currently no concrete evidence that quantum computations occur in actin networks.

A curious fact that may ultimately be relevant here is the striking similarity between melanocyte cells and neurons. Both types of cells are derived from pluripotent cells in the neural crest, and both types of cells share a sensitivity to many of the same signaling molecules. The similarities are so striking that it has been suggested that melanocyte cells can be used to create toy models of brain disorders such as Alzheimer's disease (Yaar & Park, 2012). It is possible that microtubules play a bigger role in the behavior and migration of melanocyte cells than is currently known. Evidence shows that microtubules align pigments in melanophore cells (McNiven et al., 1984; Murphy & Tilney, 1974), and perhaps the microtubule scaffolding that exists for this purpose does something interesting from a quantum computing perspective. The mechanism that allows consciousness to influence the brain might be partially responsible for allowing consciousness to influence birthmark formation, although this is still only speculation.

DISCUSSION

It is possible to conclude that consciousness can exert some kind of influence over the outcome of probabilistic quantum events simply by acknowledging the existence of aforementioned consciousness-related anomalies and looking into the physical mechanisms involved in consciousness-related brain activity. Nonetheless, decades worth of micro-PK experiments suggest independently of these anomalies that consciousness can influence the outcome of probabilistic quantum events any time these events are sampled and used to create a meaningful change perceptible to the unaided human senses. Devices that record or display the outcome of random quantum events have been a staple of micro-PK research since pioneering work in the

area in the 1960s and 1970s, and many significant results have been obtained in experiments using them (Varvoglis & Bancel, 2015). It follows from this that any biological mechanism that magnifies the outcome of probabilistic quantum events into perceptible classical events should be able to be influenced by micro-PK. Furthermore, any biological process whose outcome is easily perceptible and partially influenced by random quantum processes should only be influenceable by micro-PK to the extent that the outcome of the biological process is determined by said random quantum processes. For example, network-level neural activity in the human brain is likely very sensitive to the outcome of probabilistic quantum events in microtubules (Hendel, 2023), so micro-PK should easily influence easily observable outcomes associated with brain activity, such as voluntary movement (see Figure 1a).

The chemical mechanisms discussed here influence melanocyte cell distribution based on the outcome of probabilistic quantum mechanical (QM) events (see Figure 1b). The degree to which the outcome of these probabilistic events affects the outcome of the biological process being considered, pigmented birthmark formation, is markedly less than the degree to which probabilistic quantum events affect the outcome of the biological processes associated with conscious brain activity. Moreover, the chemical mechanisms enumerated previously may not be the only such mechanisms that inject quantum randomness into the pigmented birthmark formation process. Regardless, our total knowledge of micro-PK suggests that consciousness should be able to affect the formation of pigmented birthmarks by influencing the enumerated mechanisms. Based on Lucadou's work, we should expect to see this influence manifest itself not by flippant deviations from probability distributions prescribed by quantum mechanics but rather by a series of convenient quantum coincidences that bring about the observed effects but do not violate the laws of physics.[5]

It should be possible to directly evaluate the effect of micro-PK on melanocyte migration[6] even without a complete understanding of the underlying chemistry involved. The mechanisms governing the migration of melanocyte cells and their cancerous counterparts, melanoma cells, are regarded as being so similar that research on one cell type's migration mechanisms is often interpreted as applying to the other's (Bonaventure et al., 2013). Techniques were invented for melanoma research to create three-dimensional models of human skin to examine the movement of melanoma cells in the skin under various conditions (Haridas et al., 2017). It should be straightforward to prepare such a model, seed it with living melanoma cells, and then instruct a volunteer to attempt to influence the motion of the cells with their intention. The motion of melanocyte and melanoma cells is quite slow and occurs in time frames on the order of days. Prolonged concentration by experiment participants might be necessary to observe an effect. It cannot be known *a priori* what sorts of effects volunteers should be expected to be able

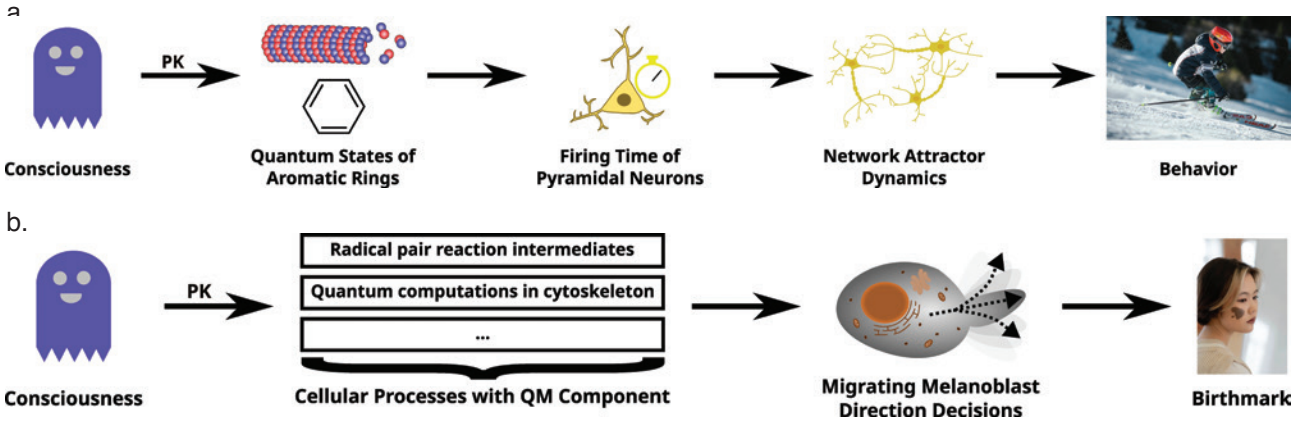

Figure 1. Causal Chains Involving Micro-PK. (a.) A plausible causal chain in which micro-PK effects are magnified by the brain to produce desired behavior. Micro-PK affects the states of electrons in the aromatic rings in the microtubules of pyramidal neurons, which in turn influences their firing times. When a micro-PK influence is cast over many pyramidal neurons simultaneously, the resulting effect on the state of behavior-related attractor networks can be approximated using the moments method (Hendel, 2023). (b.) A plausible causal chain in which micro-PK effects are magnified by quantum mechanical (QM) processes inside migrating melanoblast cells to influence their motion and final destination.

to produce in this kind of experiment. It might turn out, for example, that volunteers are only able to influence the distribution of cells and have little or no influence on their average direction of travel. Many different kinds of effects should be searched for.

Additionally, subjecting migrating melanoma cells in a three-dimensional model to an appropriate oscillating magnetic field could provide insight into what kinds of effects manipulating the spin states of electrons in radical pair reaction intermediates inside the cells might have on the cells' motion. Techniques similar to those used by Vecheck et al. (2023) could be used. In Vecheck's experiment, the target cells, fibroblasts, clustered more as a result of magnetic field exposure. This fact can't necessarily be used to make statements about melanoma cells, which might behave differently when their radical-pair reaction intermediates are tampered with. The effects of magnetic fields on cells, which change spin states *en masse*, are much different (and certainly much more dramatic) than the effects of micro-PK on cells. Micro-PK likely cannot alter the global numbers of singlet and triplet electron pairs in a given cell over a long period of time, as this would violate the laws of quantum mechanics. We can likely expect micro-PK to induce "happy coincidences" in which individual radical pairs just so happen to be in the right spin state at the right time (and behave totally probabilistically otherwise) to contribute to some larger effect ultimately brought about by an ensemble of micro-PK interactions throughout the entire collection of melanoma cells.

Future theoretical parapsychology work could focus on performing an analysis similar to the one performed here to better understand the effects of micro-PK on the development of vascular birthmarks as well as on other relevant aspects of fetal development. While some birthmarks implicated in cases of the reincarnation type certainly have pigmented components, it is clear that more is going on in these cases than just a disruption in melanocyte cell migration. Stevenson noted that some anomalous birthmarks "are bleeding or oozing when the baby is born" (Stevenson, 1997b, p. 3). There are cases in the literature in which birth defects are present in addition to or in place of anomalous birthmarks, and the totality of the evidence suggests that significant birth defects do not occur in cases when the reincarnating consciousness is not present in the early weeks of pregnancy (Matlock, 2019, Chapter 4). This suggests, perhaps, that many of the biological processes that take place in fetal development, particularly in the early stages, can be influenced by micro-PK in the same manner that we have proposed melanocyte cell migration can be influenced by micro-PK.

IMPLICATIONS AND APPLICATIONS

Nature is better at detecting micro-PK influences than we are. Today's parapsychologists struggle to create devices that consistently respond to conscious intent in a statistically significant way. There is certainly a lot to be learned from biology, which appears to have acquired through evolution the ability to detect micro-PK influences better than we currently can. Studying events inside the brains of awake animals is usually difficult (and expensive), so it is desirable to find other biological systems outside of the brain that are also sensitive to micro-PK influences and can be more easily examined. Ian Stevenson's work shows that melanocyte cells are such a biological system, and their melanoma cell derivatives are easy to work with in an experimental setting. Studying the chemical mechanisms involved in making melanocyte cells sensitive to micro-PK influences will improve our understanding of how biological systems, including the brain, capture these influences. Beginning to enumerate candidate micro-PK reception mechanisms in melanocyte cells and their precursors is a crucial first step toward realizing this objective. Additionally, any new information that can be learned about the effects of prolonged concentration on the migration and proliferation of melanoma cells has immediate and obvious medical applications.

ENDNOTES

1 The highest levels of classification for birthmarks not caused by abnormal development are *vascular* and *pigmented* (McLaughlin et al., 2008). Vascular birthmarks are made of blood vessels, and pigmented birthmarks are made of melanocyte cells.

2 Somehow, the information contained within a reincarnating consciousness gets imprinted on a developing fetus in cases involving anomalous birthmarks. Perhaps the reincarnating consciousness is present in the womb during fetal development and is actively ruminating about its previous death. Alternatively, the imprint, while ultimately originating from the experience of the reincarnating consciousness, might be imparted by some more subtle, almost subconscious means. Regardless, these cases are still instances of consciousness directly affecting a biological system.

3 The author does not endorse (or outright reject) Orch OR theory. All references to the theory here are made

solely in regard to the empirical evidence that the theory's supporters use to justify it.

[4] Specifically, congenital melanocytic nevi are thought to be caused by anomalies in the migration of melanoblasts in the neural crest itself. Dermal melanosis (or "Mongolian spots") is caused by melanocyte cells getting trapped in the skin during migration (McLaughlin et al., 2008).

[5] It would be just as problematic for consciousness to induce correlations between theoretically independent quantum events as it would be for consciousness to bias a number of quantum events to the extent that their outcome no longer conforms to the probability distribution(s) prescribed by quantum mechanics. The "problem" of causing a macro-level effect with micro-PK is akin, in a way, to solving a large Sudoku puzzle. The effect must be realized, but unnatural correlations between any pair of quantum events cannot be induced, and the results of all wave function collapses involved must conform to their prescribed probability distributions. Thankfully, nature seems to "solve" this problem automatically, almost as if some action integral is implicitly being minimized.

[6] It would be interesting if a convincing case of the reincarnation type could be produced involving pigmented birthmarks in which the time between death and birth is less than or equal to approximately 32 weeks. Since melanoblast migration takes place between 6 and 8 weeks of fetal development (Cichorek et al., 2013), and a normal pregnancy is about 40 weeks, a pigmented birthmark in such a case could not be the result of consciousness influencing melanoblast migration. In such an instance, quantum mechanisms involved in the proliferation of melanocytes already in the epidermis would presumably be the primary micro-PK targets.

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