Quantum qRules: The Parallel Principle

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8 December 2007

The evolution of a psycho-physical parallelism in a species requires a interaction between subjectivity and physiology. For the selection process of evolution to establish a parallelism, these two things must be able to influence one another at every stage of development. This interdependence is illustrated in the case of the conscious experience of 'pain' and the physiological response to pain. A mechanism is proposed that would allow consciousness to affect a physical system in the desired way. An experimental test of this hypothesis is outlined here, and is described more fully elsewhere.

Introduction

I assume that there is a rough correspondence, or at least a working relationship, between the subjective life of any creature and the objective world in which it is a part. John von Neumann calls this a *psycho-physical parallelism*, according to which the images of the creature's psychic experience mirror the objects in its physical environment [1]. This connection is presumably initiated in infancy. We are genetically programmed from birth to construct subjective images of tables and chairs and connect these with our physical encounter with tables and chairs. This construction gives us our experience of common sense reality. For something like this to happen, our species must have initiated an elementary psycho-physical dualism at a very early stage of our evolution and brought it to fruition over time. It is possible that most vertebrates participated to some extent in this development.

By *consciousness* I mean all that is contained in the subjective or psychic life of an individual. Consciousness is different from the physical processes that gives rise to it, for although it is a by-product of physical processes it is not itself 'physical'. These two things, the psycho and the physical, are entirely different kinds of things. They are apples and oranges that make no obvious point of contact within in our present understanding.

In particular we note that consciousness plays no role in contemporary physics, for it does not appear in the Hamiltonian of any physical system.

For this reason consciousness is widely believed to be *epiphenomenal,* which means that it is created and choreographed by a physical body but it cannot, conversely, influence the behavior of that body. However, if that were the case in any species including our own, then a lasting a psycho-physical parallelism would be unlikely. If conscious experience played no role in directing the evolution of our species, then it would either *atrophy* over time, or it would become completely *irrelevant*. With no possible physical influence, it would not matter to anything at all. It would be an expendable *fluff* that would probably not survive for many generations because it would serve no purpose. Indeed, there is no evolutionary reason why something so fluffy should appear in the first place.

Contemporary physics is mechanically autonomous. It provides no mechanism that would allow consciousness to influence the behavior of a physical body. Therefore, barring the acceptance of the miraculous principle of *Pre-Established Harmony* proclaimed by Leibnitz, there is no reason to believe that consciousness would exist and mirror the physical world in which we live. The subjective life of a conscious being would certainly not be rational in these circumstances, because the appearance of rational thinking that parallels the objective world would then be enormously improbable. So *given the present scientific understanding*, a psycho-physical parallelism would exist only if there were an amazing and inexplicable harmony in nature of the kind suggested by Leibnitz. My impression is that most physicists accept this idea, although they would not call it pre-established harmony. They would probably call it (pre-established) illusion.

I do not accept a pre-established ‘anything at all’. I believe that consciousness is a natural phenomenon that arises within the objective world in a way that results in a reciprocal psycho-physical parallelism; and that we can reasonably speculate as to the mechanism of this development. However, in order to do so we will have to be willing to consider amendments to physics that give consciousness an avenue of influence.

The Parallel Principle

The parallel principle states that:

physiology and psychology evolve together in any conscious species,
where each guides the evolution of the other onto a parallel track.

A psycho-physical parallelism requires some degree of mutual monitoring between the two worlds in order to keep them together on parallel tracks. This means that subjectivity must feed information back to the underlying physiological system, completing the cycle of influence so the two can evolve together in a complementary way. If there were no feedback, there would be no way for evolution to select against a species that mutates in the direction of inappropriate (i.e., non-parallel) conscious experiences.

To my knowledge the idea that mind and body must have evolved interactively was first discussed by William James, who believed that the evolution of "appropriate" subjective feelings would be incomprehensible if feelings were biologically redundant [2].

This paper will focus on how this parallelism might have first emerged in a primitive species. We will then consider an amendment to physics that satisfies the parallel principle in early organisms.

A General Model & Hypothesis

An automaton operates on the basis of a simple stimulus/response sequence that is this sole variable in the evolutionary struggle. But suppose as a result of mutation a sequence appears in the form stimulus/consciousness/response. The conscious experience in this sequence does not have to be the sole determinant of the response, but we will allow that it is influential; that is, it will increase or decrease the likelihood of one response or another. If the response favored by the newly introduced consciousness is wrong (i.e., if it encourages an unfortunate response), then the species will not survive; but if the favored response is right, then the species will be more likely to survive. In the end, a successful species will have an appropriate conscious experience that is associated with a successful stimulus/response sequence, and this is the signature of a psycho-physical parallelism.

A Fanciful Example

An example that I use in previous papers is more specific [3]. It involves the experience of "pain" that is assumed to *decrease* the probability of any response to which it is associated. In the interest of concreteness, an ancient fish is assumed to brush against the toxic tentacles of a jellyfish. This contact provides a nicoceptive stimulus that gives rise to two possible responses of the fish: W-withdraw or C-continued contact.

A mutation is assumed in Fig. 1 to introduce the conscious experience of pain associated with one or the other of these responses. The sequence W(pain) or C(no pain) therefore presents itself as a possibility together with the sequence C(pain) or W(no pain). In the first case, W(pain) is repressed inasmuch as we require that pain always represses the response with which it occurs. The fish therefore maintains contact with the tentacles C(no pain) thereby doing harm to the fish and promoting its extinction. In the second case C(pain) is repressed. The fish therefore withdraws from the tentacles which is a healthy response W(no pain), thereby promoting its survival.

The result is the emergence of a species of fish that instinctively withdraws from jellyfish tentacles, and at the same time experiences a release from pain. The fate of the fish is clearly decided in Fig. 1, assuming that the experience of pain (or no pain) does not simultaneously attach to both W and C, and that the effect is strong enough to override or at least mediate any purely neurological response.

We therefore see the beginnings of a psycho-physical parallelism in which pain is coupled with a dangerous behavior. When I speak of "pain" in this example I do not

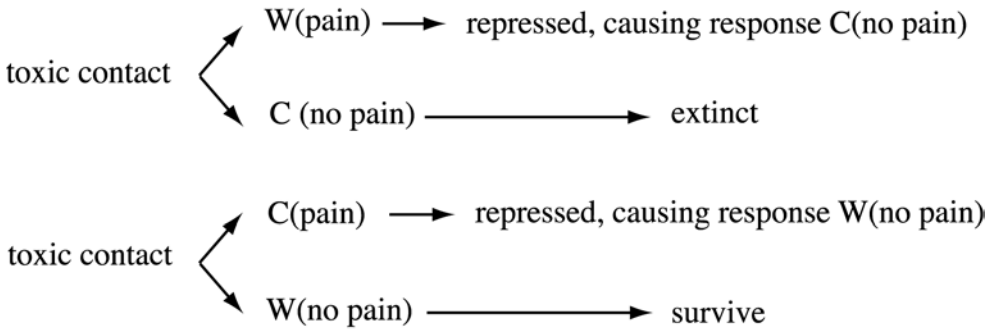

Figure 1: Pain/no pain model

necessarily refer to the painful experience known to humans. Different creatures might experience pain differently. What is important about pain is that it is associated with the repression of responses.

This example illustrates the fundamental thesis of this paper that: *The psycho-physical parallelism **requires** the parallel principle, and the parallel principle **requires** that consciousness causally influences physical systems in which the parallelism occurs*, unless one is willing to accept some form of Pre-Established Harmony.

We assume in the above example that the fish has first learned to avoid the jellyfish tentacles without the help of consciousness. The fish already has a nervous system that favors withdrawal from this toxic contact, otherwise it would not have survived to this point. There is controversy here. Some say that consciousness must be present in any creature that has developed such a sensitive "human-like" stimulus/response system. I do not agree. The nervous system of a fish is very primitive compared with humans. It is dominated by brainstem components that lack a neocortex, and its cortical sensory responses appear to be non-existent since the sensory behavior of a fish is not affected by cortical damage [4]. It is therefore easy to believe that fish are very robot-like creatures in spite of their frequent human-like responses. It is for this reason that I choose a fish to illustrate the possible starting point of conscious intervention.

There are many theories about the starting point of consciousness. William Clifford says that all matter is accompanied by a rudimentary sentience, and that this flowers into more sophisticated forms of consciousness when matter takes on more sophisticated structural configurations [5]. Many in the AI community favor the idea that structural configuration alone gives rise to consciousness, according to which the structure of a nociceptive nervous system would somehow reverberate a feeling of 'pain' [6]. But why pain? Is that a coincidence? Why not a feeling of 'pride', or 'joy', or even 'indifference'? All these theories fail to answer the question: Why should a neurological configuration that responds negatively to a noxious 'contact' *also* give rise to a noxious 'experience' – in the claimed absence of an *inter*action between the two? These theories appear to me to be veiled versions of Leibnitz's Pre-Established Harmony. I believe the only way that the notion of Pre-Established Harmony can be avoided is to introduce consci-

ousness in the same way that any other property of an organism is introduced – by random mutations that pass the test of survival. Consciousness may not be a 'physical' quantity as we usually understand that term, but that does not mean that it is not a natural property of advanced organic systems.

Presumably mutations that introduce consciousness will modify the physiology in ways that we do not now understand because we lack sufficient neurological/testimonial data and a theory of consciousness that rationally organizes that data. However, any such modification will probably be located in the higher regions of the brain. I imagine that a psychological mutation merely 'tweaks' the affected the nervous system in the cortex or neo-cortex without affecting its neurological structure in the rest of the body. So pain is introduced by physiologically tweaking the part of the noceceptive nervous system that extends into the brain.

If an organism undergoes psychological mutations as well as physiological mutations, the evolutionary time scale would seem to be lengthened. On the other hand, if the psychological mutations are truly beneficial as we suppose, the time scale might be shortened. We do not speculate as to how this averages out. The fossil evidence is no help in this matter. It gives us the historic mutation rate and total time for the evolution of a species, but it does not tell us how long this process would take in the presence (or absence) of consciousness. The theory of evolution is also no help. It only tells us that mutations are random.

A Pycho-Physical Hypothesis

Physics will have to be amended to support the parallel principle. Applied to pain, this will take the form of a hypothesis requiring that

> *when pain consciousness is associated with one component of the quantum mechanical state of the system, it will repress that component relative to other 'painless' components.*

This feedback cannot be thought of a euphemism for a physiological activity that is 'really' the underlying cause of the influence; for barring a Leibnizian miracle, a genuine psycho-physical interaction is necessary for there to be a parallelism.

It is difficult to imagine an experiment that directly tests the ability of consciousness to influence behavior. However, if consciousness of pain has this kind of influence on an organism, then the relief from pain should have the opposite effect. It is along theses lines that an experiment suggests itself.

The *endorphins* produced by the body are migratory molecules that mediate pain by seeking out and attaching to *opiate receptors* in the brain and other parts of the body. These small molecules are peptides that function as pain suppressers when they attach to receptors. It should therefore be possible to characterize the 'pain' state of a conscious organism at a given time in terms of the number of occupied opiate receptors at that time, assuming that other input (such as the cause of the pain) remains constant.

Receptor Occupation

Let the initial state of the system be give by the qRule equation $U(t_0) = n_1\ n_2\ n_3\ldots$, where $n_1 = 0, 1$ is the first opiate receptor, $n_2 = 0, 1$ is the second opiate receptor, etc. The number 0 means that the receptor is not occupied by an endorphin molecule, and the number 1 means that it is. A system with $n_1 = 0$ is more painful than the system with $n_1 = 1$ assuming that other occupation numbers remain the same. We let

$$n = n_1 + n_2 + n_3 + \ldots$$

so if n increases in time the system will become less painful, if n decreases the system will become more painful, and if n remains the same the pain of the system will remain unchanged. The component $n_1\ n_2\ n_3\ldots$ is complete as are all qRule components [7]. It contains all the other parts of the body as well as the rest of the universe, but our focus will be on the opiate receptors and state reductions associated with them alone.

Assume that the blood and other intercellular fluids of the body deliver a rush of endorphin molecules, all potentially interacting with the opiate receptors. A capture will be irreversible and discontinuous (in the occupation numbers). Therefore after t_0, probability current will flow into any number of possible successor components giving

$$\begin{aligned} U(t \geq t_0) = n_1\ n_2\ n_3\ldots &+ (n_1 + 1)\underline{n_2} n_3\ldots + \ldots \\ &+ \underline{n_1}(n_2 + 1)n_3\ldots + \ldots \\ &+ \underline{n_1} n_2(n_3 + 1)\ldots + \ldots \\ &+ \text{all other possible } n + 1 \text{ components.} \end{aligned} \tag{1}$$

Assume for the moment that pain consciousness *does not* influence the choices that are being made.

If there is a stochastic hit at time t_{sc} on, say $\underline{n}_1(n_2 + 1)n_3\ldots$, then $n_1(n_2 + 1)n_3\ldots$ will be realized and a new batch of launch possibilities will emerge, giving

$$U(t \geq t_{sc} > t_0) = n_1(n_2 + 1)n_3\ldots + (n_1 + 1)(n_2 + 1)\underline{n}_3\ldots + \ldots \quad (2)$$
$$+ \underline{n}_1(n_2 + 2)n_3\ldots + \ldots$$
$$+ \underline{n}_1(n_2 + 1)(n_3 + 1)\ldots + \ldots$$
$$+ \text{all other possible n + 2 components.}$$

again assuming that pain consciousness does not influence the choice. Let the extent of endorphin capture be well below saturation, so n is free to increase without foreseeable limit.

After a series of collapses like this, n might increase in time from its initial value as illustrated in Fig. 2, which shows a drift in the direction of less pain as the endorphin rush takes hold. All other physiological variables are assumed to remain constant as has been said – such as the cause of the pain

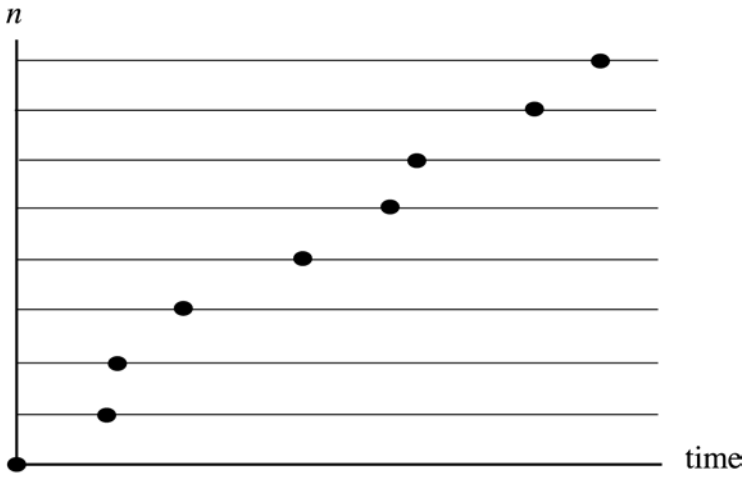

Figure 2: Drift of n for a succession of 8 captures

When the psycho-physical hypothesis *is* applied to this case, probability current will flow more rapidly into the ready components of Eqs. 1 and 2, so the behavior of n would then be a *guided drift* that is skewed upward as in Fig. 3. Consciousness increases the

efficiency of endorphin attachment. Each individual quantum jump will be sufficiently small that it will not produce a noticeable subjective change. However, after many choices it will be 'felt' as a more pleasurable experience.

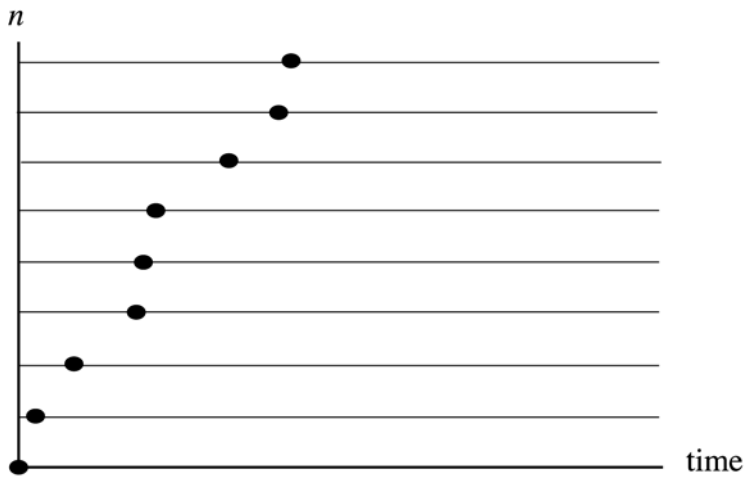

Figure 3: Guided drift of *n* for a succession of 8 captures

Connection to Behavior

The hypothesis applied in this way seems to say nothing about overt behavior, so it appears to make no contribution to evolutionary survival. By itself, it only enhances the affinity of endorphins to their receptors. The same will appear to be true of other opiates such as codeine, morphine, and heroin that also alleviate pain and/or give pleasure by attaching to opiate receptors [8].

However, an increase in *n* is physiologically connected with positive behaviors such as putting a smile on one's face. We would normally say that an opiate increases the value of *n* and that that 'causes' both good feelings and a smile on the face. We now put this differently. We say, as before, that the increase in *n* and a smile on the face are correlated physiologically, but now we say that both taken together represent a response to the good feeling. Just as pain represses certain responses, so pleasure enhances other responses – in this case it increases the value of *n* and puts a smile on the face. So the influence of consciousness not only guides the value of *n* in Fig. 4, but it guides all other causally connected behaviors as well. And because consciousness represses or enhances

complete qRule components in Eqs. 1 and 2, its influence conserves energy and momentum as well as all the other normally conserved quantities.

Cause of Influence

The question is: Which part of physics is violated to make room for the influence of consciousness? For consciousness to have the claimed guided influence, a greater number of endorphin molecules must be available for capture in Fig. 3 than are available in Fig. 2; so the molecular density must be increased by consciousness in the vicinity of the opiate receptors. This means that consciousness must have the ability to decrease entropy in violation of the second law of thermodynamics.

Classically speaking that is impossible. When two particles in a gas or liquid collide their resulting trajectories are exactly determined, and the resulting statistics is immutable. Entropy cannot be tampered with classically. However, quantum mechanical collisions produce a wide distribution of possible results reflecting the Heisenberg uncertainties. In principle, these microscopic probabilities can be guided in such a way as to violate the second law, while preserving the conservation principles – energy, momentum, etc. Therefore, one possible way in which consciousness can be influential is by micromanaging quantum mechanical probabilities in such a way as to decrease entropy on the macroscopic level. *It guides macroscopic probabilities (entropy) by managing microscopic probabilities*. Macroscopic does not just mean a large number of changes in the value of *n* in Fig. 3, but includes the correlated 'smile on the face'.

It is certainly a stretch to imagine that consciousness has an influence of this kind. But if we are to accept the parallel principle, and at the same time reject the notion of Pre-established Harmony in all its forms, then consciousness *must* have some kind of influence on physiology that has survival consequences for the species. An ability to manipulate changes of entropy through quantum micromanagement seems to be the least disruptive way of going about it.

Experimental Test

A test of this thesis is proposed by the author in another paper where two experiments are suggested: (1) a PET scan (Position Emission Topography) of a human

subject experiencing pain, and (2) an autoradiography of a rat experiencing pain [9]. I will briefly describe the PET experiment.

Agonist molecules (i.e., opiates) attach to opiate receptors and stimulate a response that is recognized by the subject as euphoria and/or anesthesia. *Antagonist molecules* also attach to these receptors, but their effect is to block the attachment of agonist molecules. In this experiment a subject experiencing pain is injected with a certain ratio of opiate agonist to antagonist molecules, where one or the other is radioactively labeled. The extent of positron emission is then measured in parts of the brain where there are high densities of opiate receptors. There are four separate scans.

(a) the agonist is labeled and the dose is pharmacological.

(b) the antagonist is labeled and the dose is pharmacological.

(c) the agonist is labeled and the dose is subpharmacological.

(d) the antagonist is labeled and the dose is subpharmacological.

Let r be the ratio of positron emissions between (a) and (b), where this is to be compared with the ratio r of emission activity between (c) and (d). The variable r in each case is equivalent to the number of receptors that are occupied by agonist molecules compared with the number of receptors that are occupied by antagonist molecules. On purely physiological grounds this ratio ought to be the same in both cases (a/b and c/d) because the difference has only to do with dose, and that can be held well below saturation even in the pharmacological case. The physical state of the subject is otherwise unchanged throughout the four scans. However, the subject is conscious of the effects of the injection in the first case (i.e., the pharmacological dose) but not in the second case (i.e., the subpharmacological dose). If the hypothesis is correct, then consciousness should alter the result in the first case by increasing the number of agonist molecules relative to the number of antagonist molecules. We should therefore measure

$$r \text{ (between a and b)} > r \text{ (between c and d)}$$

thereby validating this narrow application of the hypothesis. Validation depends on a change in r that cannot be accounted for on purely physiological grounds.

Other Cases

There must be similar effects that involve other conscious experiences (e.g., anger, fear, love, etc.) that may or may not be initiated by a discontinuous quantum jump like a sudden attachment to a receptor. Pain receptors call for discontinuous stochastic events as we have seen, but that is not required by our hypothesis. It *does not matter* if the response of a sensitive microscopic variable is microscopically continuous or discontinuous. A violation of the second law is possible either way in a quantum mechanical system.

It may help to briefly discuss how other conscious experiences might be introduced. The initial introduction of a basic emotion must be a purely supportive or repressive influence. Pain as we've seen began by repressing any behavior with which it was associated. The same would have been true of the emotion fear. Love and anger would have begun in much the same way but as attractive influences. That being the case, one might ask how it is possible that pain and fear feel so different from one another? Or love and anger for that matter?

Pain and fear feel different because they are associated with different parts of the nervous system. They evolved separately and so they evolved differently in their qualitative aspect, even though they both began as a simple repressive influence. Presumably they each took on different shades of feeling as the organism developed a more nuanced nervous system – resulting in subtle varieties of pain and fear.

It is possible to imagine that the two feelings might have been reversed. It is possible that the conscious experience that attached to the noceceptive nervous system might have felt like fear instead of pain. And it is possible that the conscious experience that attached to the flight mechanism of the brain might have felt like pain instead of fear. The same would be true of the different qualities that we associate with sensations, inasmuch as they originated in different parts of the nervous system. Sensations and emotions need not always be qualitatively different when they arise in different parts of the nervous system. But there is no reason why they should be the same; and in any case, sameness would be confusing and would have a negative survival value.

How far might something like that go? Is it possible that an emotion like love could become attached to the noceceptive nervous system instead of pain? It seems a stretch,

but I would say yes. If love had been built into our species from the beginning in place of pain, then long behavioral and consequential association would cause us to find it as repugnant as we now find pain. Accordingly, evolution arbitrarily assigns subjective experiences such as love, taste, anger, smell, etc., to different parts of the nervous system. It is possible that a species like ours might evolve on another planet such that all of the sensations and emotions of an individual of that species are arbitrarily switched around compared to our own assignments. That person would still be able to function in the world without any more difficulty than ourselves, so if we encountered such an individual we would not notice a difference. Of course all humans share a common ancestor, so I assume that we all have the same subjective experiences associated with the same part of the nervous system. But the qualitative aspect of any one of these experiences does not matter to the smooth functioning of the organism [10].

What *does matter*, however, is whether the conscious experience assigned to some part of the nervous system supports or opposes the physiological function of that system. If consciousness has the power to decrease entropy in a part of the body, it might do so (for a given mutation) in a way that either supports or defeats the associated physiology. To the extent that consciousness supports physiology it will contribute to survival in the evolutionary struggle; and to the extent that it does not, it will contribute to extinction. The net result of this evolution will be a conscious creature whose experience mirrors the world in a supportive and complementary way. It will experience a psycho-physical parallelism.

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