The Presentiment Effect Points to an Occurrence of a von Neumann's Collapse[1]

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Abstract: Although small and embedded in strong noise, the surprisingly confirmed presentiment effect is deemed among the more reliable "psi" effects, although such an effect cannot reflect prediction in real-time. Rather, the effect reflects correlations found only in the historical past as a result of the end conditions represented by the participant's psychological responses to the stimuli. That is, the effect does appear, but in retrospect only. The current paper *mathematically* explains this suggestion through an orthodox interpretation of quantum mechanics whose ontology is outlined. The explanation is based on von Neumann's idea that the system's quantum state collapses when the participant's mind perceives an observation. The argument takes decoherence considerations into account. The presentiment effect's existence and its presented reasonable quantum explanation seem to support von Neumann's idea.

Keywords: tendencies, collapse, actual past, effective past, decoherent histories, consciousness, presentiment, predictive anticipatory activities

Highlights

- This paper provides an orthodox quantum mechanical mathematical model for the appearance of the presentiment effect with some empirical support for it. The framework used is "decoherent histories."
- The paper suggests that the empirically confirmed existence of this effect indicates that the orthodox interpretation of quantum mechanics, with its emphasis on primary mind and perceptions, is the correct one.

Even though according to orthodox physics one cannot sense an undetermined future event before the occurrence of the event, during several decades what seem to be successful presentiment experiments (PSEXs) have been carried out and replicated (Duggan & Tressoldi, 2018). In such experiments, physiological measures of participants, such as skin conductance, heart rate, and electroencephalography (EEG) are monitored and recorded for several seconds by computers. The records are taken *before* randomly presented stimuli designed to evoke either a significant or a nonsignificant psychological post-stimulus response. After averaging the results for any specific pre-stimulus time over many trials, a significant difference emerges between the pre-stimulus response to stimuli that evoked a significant post-stimulus response and those that did not. Although the effect is small and embedded in strong noise (i.e., an estimated effect size of 0.28 with a 95% confidence interval of 0.18 - 0.38; Duggan & Tressoldi, 2018) the averaging improves the signal to noise ratio. This improvement allows the difference to become statistically significant; over 6 standard deviations or sigmas.

Various potential mechanisms to explain the surprising effect as an artifact have been discussed and examined over the years and rejected. The aforementioned meta-analysis (Duggan & Tressoldi, 2018), as well as Mossbridge and Radin (2018), concluded therefore that the presentiment effect (PSE) seems to be confirmed and can be considered among the more reliable psi effects. Due to its basic third person approach and its straightforward design, the PSE seems (at least to me) to be the simplest psi effect. As noted in Mossbridge and Radin (2018), sometimes such effects are called Predictive Anticipatory Activities (PAA). One can read a concise review of the PSEXs in Radin (2016).

Working within orthodox quantum theory, Levin (2020) justified the existence of this effect by contemporary Quantum Mechanics (QM) ideas described, for example, in Stapp (2017a). Levin (2020) repeated a well-known QM calculation that proves that an efficient real-time prediction of an unpredictable future sentiment is impossible. By using the QM's idea of a difference between an actual past and an effective past (or historical past), he then argued that the PSE is merely a quantum delusion that appears, but in retrospect only. He also suggested that "modified PSEXs" in which either the measurement apparatus or the recording device are intentionally disconnected from the participant just before a stimulus is shown to the participant (or the pre-stimulus records consciously read-up

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before the stimulus is shown to the participant) may indicate the crucial role played by a conscious act. Based on the aforementioned repeated proof of the impossibility of a real-time prediction of an unpredictable future sentiment or sensation, Levin (2020) predicted the disappearance of the PSEs for these modified PSEXs.

The proper interpretation of QM is highly controversial. The main question under dispute is how to resolve the infamous "measurement problem" (exactly when and how a superposition of many possible values described by the Schrödinger equation becomes a single measured value). Many interpretations have been suggested, and given the lack of a clear-cut evidence for any of them the debate concerning the proper interpretation continues (e.g., Kastrup et al., 2018; Ananthaswamy, 2018).

The so called "orthodox" interpretation is one of the oldest. A psychophysical approach was originally suggested by von Neumann (1932). He argued that the quantum state "collapses" (i.e., a multitude of possibilities reduces to the observed actuality) when an observer's mind perceives it. This was tentatively supported by Wigner (1967, p. 172) who wrote "it was not possible to formulate the laws of QM in a fully consistent way without reference to the consciousness. All that QM purports to provide are probability connections between subsequent impressions (also called "apperceptions") of the consciousness." However, as described by Esfeld (1999), Wigner later (apparently too hastily) abandoned it. The psychophysical approach is supported by H. P. Stapp and is common in his writing (e.g., Stapp, 2017b).

Even if one accepts that the quantum state collapses when an observer's mind gets the perception, there remains a mystery concerning who (and how) selects that specific perception. This gap in the quantum theory is reflected in Einstein's famous statement (American Institute of Physics, 2022) "God does not play dice" and Bohr's rebuttal "Einstein, stop telling God what to do!" It clearly seems that both realized that to close this gap one needs some immaterial powerful entity. They merely disputed what this entity reasonably does. Since then, the undisputable success of quantum theory has convinced all but a handful of contemporary physicists that that abstract entity does indeed determine the perception in each specific observation. In standard orthodox QM, the Born (1926) statistical rule is unbiasedly obeyed. However, though up to now successful in physical and chemical experiments, one must remember that this rule was empirically inducted. Therefore, whether this statistical rule is strictly unbiasedly held in *all* situations can be considered a yet unanswered question. In an attempt to explain some positive precognition results, Stapp (2017a) hypothesized that under some conditions the statistic may be slightly biased. In this paper I discuss PSE rather than precognition, and aim to explain it within standard orthodox QM. Hence, the current article assumes the standard Born rule. However, in order not to conceptually exclude such hypothetical biases, I henceforth prefer the vaguer term 'Deus-ex-Machina' (a term coined from the conventions of ancient Greek theater which means 'God out of the machine') over (what statistically appears as) Einstein's merely "playing dice" immaterial God.

With this terminology one can sum the orthodox interpretation of nonrelativistic QM in the following theo-psychophysical way. Reality consists of an interplay of six *abstract* factors:

- a stage - associated with space and time
- res potentia - associated with the coexistence of objective tendencies to generate "agents' conscious observations"
- a default temporal evolution rule - a rule that governs the default temporal evolution of the tendencies whenever there are no interventions (i.e., the unitary evolution via the Schrödinger equation, sometimes called Process 2)
- res cogitans - associated with agents' egos, minds, curiosities, abilities to freely choose and pose questions to nature, etc.
- Deus-ex-Machina - associated with the entity that, while statistically keeping the so-called Born (1926) rule, freely chooses which possibility will survive the eradication

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of the possibilities in any specific intervention originated by an agent's mind, a mere *name* for this entity (other names that science cannot disallow: Nature, a cosmic MIND, Allah, God, etc.) (Wheeler, 1981)

• res extensa - now associated with "agents' conscious observations" that witness Deus-ex-Machina's choices under the measurement circumstances arranged by the agents, i. e., with the perceptions of minds.

In this most parsimonious description, an appropriate projection of the current world-representing ray (a whole class of normalized state vectors that differ from one another only by phase factors, that is by numerical factors with modulus entity) represents in the Hilbert space (a vector space equipped with an inner product that defines a distance function for which the space is a complete metric space, e.g., the space of square-integrable functions) the agent's mental event by itself. The projection is onto the ray that describes the new situation consciously felt by the agent. It is as if at the appropriate moment the currently existing ray "collapses" to a new ray compatible with the observation consciously collected by the agent. The collapse eliminates from the state of the universe all parts incompatible with the occurrence of that chosen by the Deus-ex-machina experience. Previous yet unobserved by any agent possibilities are among these eradicated incompatible parts. Physically, the change from the current tendencies to the new ones that the collapse in the Hilbert space represents describes the "actualization" of certain current tendencies. This forward-in-time process leaves a single consistent history.

According to this interpretation, QM tells us that there is no matter in the classical sense. The entities clasically conceived by people as tiny pieces of matter (often loosely called "elementary particles") are mere appearances of quantum excitations of extended tentative fields of various types. They are figments. As apparent quantum excitations of tentative fields, these entities may (and indeed do) exhibit what classically appear as imaginary features. Furthermore, in QM one interprets objects that people classically conceive as hard matter (e.g., atoms, molecules, crystals, rocks) as bound states formed out by entangling tendencies to observe various elementary quanta.

Wigner (1967, p. 173) explains the phrase "something exists" by writing: "The statement that it "exists" means only that: (a) it can be measured, hence uniquely defined, and (b) that its knowledge is useful for understanding past phenomena and in helping to foresee further events. It can be made part of the *Weltbild*." Indeed, a tendency enjoys a "softer" rather than the "hard existence" one usually attributes to classical matter. However, under various circumstances, tendencies may become very strong. In such cases, for all practical purposes, the soft existence almost cannot be discernible from a hard one. Practically speaking, when one kicks what seems to be a rock, there is little difference between a classical existing rock and just a probability of, say, .999999 to feel the rock. The orthodox interpretation claims that under such conditions one practically retrieves the feeling of classical confident existence. Actually, most of the inanimate situations encountered daily are of this type. When some test astonishingly results in a "Sword in a Stone observation," one usually calls it a miracle (Carroll, 2001; Bartoloni, 2002).

Notice that, whereas this orthodox interpretation dethrones the existence of "matter" in favor of the existence of the more abstract concept of "tendencies to feel existence" it considers minds primary as well. This reflects the undeniable fact that all our scientific knowledge is the result of our minds' curiosity and inquiry. Also, it takes seriously the equally undeniable fact that the inputs that feed this scientific learning process are in the last resort conscious perceptions. Therefore, one can say that the orthodox interpretation is the most natural interpretation. Moreover, nowadays, as Tressoldi and Facco (2022) argue, there seems to be accumulated epistemological and scientific evidence that consciousness is primary.

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Decoherence arguments (e.g., Di Biagio & Rovelli, 2021; Gell-Mann & Hartle, 1989; Joos et al., 2003; Zurek, 1991, 2003) suggest a metaphoric ladder from this idea-like reality down to our mundane view of the world. Decoherence refers to the process through which the evolving quantum state loses coherence (i.e., the ability to interfere). The basic idea is that the environment almost constantly interacts with the studied system. The parts of the Hamiltonian (i.e., the quantum mechanical operator that corresponds to the total energy of the system) that describe these interactions determine at almost every moment some effective partition of the Hilbert space. The interaction entangles the environment with the system. Because one cannot follow the implications of such an interaction on the environment, one averages over them. This averaging leaves us at each moment with several decohered possibilities in the generated pertinent Hilbert space's partition. Since these are mere possibilities, they can logically coexist. In the orthodox interpretation of QM, every agent's posed-to-nature question and the (consequent) Deus-ex-Machina's answer cut this coexistence of multiple possible decoherent histories. The pertinent question-answer stage of this so-called Process-1 eradicates all the up-to-then coexisted possible decoherent histories that would have been incompatible with the Deus-ex-Machina's selected answer to the pertinent question. The sequence of such surviving decoherent pieces of history (approximately) appears to us as a classical physics history.

Arguably, the generalization of the theory to be compatible with relativity does *not* change this insight concerning reality in an essential way. Indeed, the "stage" becomes relativistic ("spacetime") and relativistic temporal evolution equations replace the nonrelativistic Schrödinger equation. Nevertheless, despite that, the critical point is that the *default* temporal evolution is still *unitary* (Weinberg, 1995). Being unitary, this default temporal evolution merely shuffles tendencies around without losing any of them. Thus, the full temporal unfolding of a *unique* reality remains a result of the interplay of *all* six abstract entities (including res cogitans and Deus-ex-Machina).

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Timing the collapse to the moment a mind perceives the observation is inconvenient for an experimental physicist. This is because such timing interfaces with psychological variables that are less directly accessible. However, one can study science that interfaces both physics and psychology, namely physiology, and hope for advance. The PSE is such a physiological phenomenon. The cognition of the participant is bypassed. The participant is not asked to describe his subjective emotions or express out his predictions. Instead, his testifying physiological reactions are being directly measured. Just like classical experiments in physics, chemistry and biology, a PSEX fully uses a third person view. Most PSEXs use truly random number generators to select the future stimuli. Therefore, it seems certain that no one knows what stimulus is about to appear. This simplicity of the structure of the experiment, combined with its repeatability, increases its reliability. Hence this paper describes a mathematical-physical model for this effect.

A Mathematical-Physical Model for the PSE

Since a PSEX involves macroscopic systems such as an electrodermal activity measuring apparatus and a computer, decoherence is unavoidable. However, decoherence theory alone does not solve the "problem of outcomes"; without the collapse postulate, it is not clear in this theory how definite outcomes are to be explained. It was mentioned previously that in orthodox QM a Deus-ex-Machina's answer cuts the coexistence of multiple tentative decoherent histories. This collapse of the quantum state generates a specific end condition and solves the problem of outcomes. In orthodox QM (Stapp, 1994; Wigner, 1967), a collapse is associated with an agent's mental event. Various mental events, such as those generated by observing wild pictures and those generated by observing mild pictures, supply various end conditions to the prior Process-2 stages. The variety of these end conditions generates a corresponding variety in their effective (or historical) pasts. This variety in the effective pasts is the cause of the PSE. That is, the tentative records from the time *before* observing a wild picture that survived the eventual

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collapse (associated with the, say, eventual wild mental event) partially reflect (are correlated with) the nature of this eventual, say, wild mental feeling.

An appropriate theory to describe such situations is the “decoherent histories theory,” which is compatible with orthodox QM. (Notice that I distinguish between Gell-Mann and Hartle's (1989) decoherent histories theory and Griffith's (2002) consistent quantum theory, which is further away from orthodox QM.) It assumes that time "flows" strictly forward. However, according to Gell-Mann and Hartle (1989), the probability of the history that is composed of the sequence of decoherent alternatives $\alpha_n(t_n)$, $\alpha_{n-1}(t_{n-1})$, ..., $\alpha_1(t_1)$ is given by the trace of a multiplication of operators. That is,

$$p[\alpha_n(t_n), \alpha_{n-1}(t_{n-1}), \ldots, \alpha_1(t_1)] = Tr[P^n_{\alpha n}(t_n) \ldots P^1_{\alpha 1}(t_1)\ \rho\ P^1_{\alpha 1}(t_1) \ldots P^n_{\alpha n}(t_n)]. \qquad \text{Eq. 1}$$

Here, the trace operation is denoted by the Tr[] symbol. (This trace sums over the diagonal elements of the operator inside the square brackets.) The $P^n_{\alpha n}(t_n)$ is the Heisenberg n-th projection operator in Hilbert space on the α_n alternative for the time t_n. In terms of Schrödinger's picture projection operator $P_{Sh}{}^n{}_{\alpha n}$ and the unitary time evolution operator from t_0 to t_n it is given by $P^n_{\alpha n}(t_n) = U(t_0, t_n)\ P_{Sh}{}^n{}_{\alpha n}\ U(t_n, t_0)$. The ρ symbol denotes the initial density operator (a positive semi-definite, Hermitian operator of trace one acting on the system's Hilbert space and completely characterizing the system's statistical properties). Because one may circularly shift the operators in a trace operation and because the time evolution operator is unitary, one may omit the leftmost projection operator in the aforementioned trace. When treating decoherent histories one can adopt the usual rules of the classical probability theory.

According to orthodox QM, whether an emotionally significant experience occurs can be considered a "Yes" or "No" question posed to nature (Stapp, 2017a). Let us attribute a value of (+1) to a "Yes" answer and a value of (-1) to a "No" answer. This "Yes" or "No" question is a qubit of information.

A PSE is observed, for example, in an EDA (electrodermal activity) measurement. The EDA signal level is actually a function of many variables used to describe the experiment, and the temporal state of aforementioned qubit is just one of these functions. Nevertheless, the EDA temporal physiological signal indirectly depends on this qubit through the processes generated as reactions to the mental experiencing of its state (i.e., through an effective transfer function). When a stimulus is being presented the significance of this qubit strongly shows up. During a prestimulus time interval the idle participants are most probably calm. Their calm state and various wandering boring thoughts are reflected in a chaotic low amplitude EDA signal. During this period, it is reasonable to assume that the functions upon which the EDA functional signal depends indeed vary, yet smoothly and relatively slowly. When the computer`s screen is suddenly turned on, the participant’s mind is suddenly aroused as well. As a result, the gain of the EDA temporal physiological signal indirectly increases. This leads to higher poststimulus EDA signals’ amplitude levels. Since the EDA signal’s sudden change is mainly due to the change of the state of this qubit let us study the time history of this qubit.

I use the common bra and ket notation of Dirac (i.e., the usual | > and < | symbols to denote vectors in Hilbert space and its adjoint space). The Schrödinger's projection operator in Hilbert space onto the |1><1| ray in Hilbert space is represented by a 2 X 2 diagonal matrix with values of 1 and 0 along the diagonal. Likewise, the Schrödinger's projection operator onto the |-1><-1| ray is respectively represented by a 2 X 2 diagonal matrix with values of 0 and 1 along the diagonal. The inverse time evolution operator $U(t_0, t_n)$ is represented by the 2 X 2 Hermitian conjugate of the forward time evolution 2 X 2 matrix $\mathbf{U}(t_n, t_0)$. It is well known that this unitary time evolution matrix is given by $\mathbf{U}(t_n, t_0) = \exp[i\ \beta/2\ \mathbf{I} - i\ (n_1\boldsymbol{\sigma}_1 + n_2\boldsymbol{\sigma}_2 + n_3\boldsymbol{\sigma}_3)\ \omega\ (t_n - t_0)]$. Here: $i = \sqrt{(-1)}$; β is a real number; $\mathbf{I}$ is the 2 X 2 identity matrix; n_1, n_2, and n_3 are the three components of a unit vector (i.e., $n_1^2 + n_2^2 + n_3^2 = 1$); $\boldsymbol{\sigma}_1$, $\boldsymbol{\sigma}_2$, and $\boldsymbol{\sigma}_3$ are the three Pauli matrices (Schiff, 1968); and $\omega = 2\pi f$ is an angular frequency.

Let the initial state at t_0 be a state of ignorance. That is, let us represent the knowledge about the initial state by a 2 X 2 diagonal **ρ** matrix with two values of 0.5 along its diagonal.

Let t_2 be the instant at which the computer presents a stimulus to the participant and assume that ($t_2 > t_1 > t_0$). Consider first what one can expect for the pre-stimulus moment t_1. According to equation 1 the probability of getting a value of 1 at t_1 is $p[1(t_1)] = Tr[\rho P^1_1(t_1)] = 0.5$. Likewise, the probability of getting a value of (-1) at time t_1 is $p[-1(t_1)] = 0.5$. On average, one expects therefore at t_1 $\langle\alpha_1(t_1)\rangle = 0$.

Suppose now that at t_1 a macroscopic computer merely recorded the electrodermal activity of the participant. The record has been almost immediately decohered. However, assume that neither the experimenter nor any other conscious agent did inspect that decohered record yet. Thus, according to the orthodox interpretation of QM there has been *no* collapse and *all the decohered alternatives still coexist*. If nothing special occurs in the $[t_1, t_2]$ interval one can expect that the $p[1(t_2)]$ and $p[-1(t_2)]$ probabilities and the $\langle\alpha_2(t_2)\rangle$ average will remain the same as those at t_1. Unless one provides a definite end-condition these expectations should remain correct forever. *This describes the situation in a ("modified") PSEX in which the experimenter disconnected the electrodes from the recording computer just before t_2.* One does not provide a definite end condition in this case.

Next, consider what one can say after the t_2 moment of stimulus presentation. Suppose that a stimulus presentation at t_2 resulted in a "Yes" answer (that is, an emotionally significant experience occurred). According to equation 1, the conditional probability that the record from t_1 shows a value of 1, given the fact that $\alpha_2(t_2) = 1$, is (by direct calculation)

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$$P[\alpha_1(t_1)=1 \mid \alpha_2(t_2)=1] = Tr[P^1_1(t_1)\ \rho\ P^1_1(t_1)\ P^2_1(t_2)] \ /\ Tr[\rho\ P^2_1(t_2)]$$
$$= 1 - (1 - n_3^2)\ \sin^2[\omega\ (t_2 - t_1)]. \qquad \text{Eq. 2}$$

Of course, since at t_1 there are only two possibilities, the conditional probability $P[\alpha_1(t_1)=-1 \mid \alpha_2(t_2)=1]$ that the record from t_1 shows a value of (-1), given the fact that $\alpha_2(t_2) = 1$, must be $(1 - n_3^2)\ \sin^2[\omega\ (t_2 - t_1)]$. Notice that the value of the record from t_1 is not unique. It is constant, of course, in each trial. However, it fluctuates from test to test according to these conditional probabilities. One cannot accurately retrodict what had happened in the past. Moreover, its average, $\langle\alpha_1(t_1) \mid \alpha_2(t_2)=1\rangle$, does not necessarily vanish.

This shows what happens in a continuously connected (i.e., usual) PSEX. That is, after the perception of the emotionally significant stimuli by the participant the pre-stimuli records still fluctuate from test to test. *In retrospect*, however, the effect on the participant that the subsequent stimuli made had fabricated a corresponding non-vanishing average of the pre-stimuli records.

By direct calculation it follows that the retrospective difference between the average at t_1 due to an emotionally significant stimulus at t_2 and the average at t_1 due to an emotionally insignificant stimulus at t_2 is

$$\langle\alpha_1(t_1) \mid \alpha_2(t_2)=1\rangle - \langle\alpha_1(t_1) \mid \alpha_2(t_2)=-1\rangle = 2 - 4\ (1 - n_3^2)\ \sin^2[\omega\ (t_2 - t_1)]. \qquad \text{Eq. 3}$$

This last difference describes the difference that one gets in a usual PSEX. Obviously, in the general case, it must *not* be null: For one, for $n_3^2 \approx 1$ or $t_2 - t_1 \ll 1/\omega$ the second term on the right of this equation becomes very small leaving us with a difference of about $2 \neq 0$. For another, because the $\sin[\omega\ (t_2 - t_1)]$ oscillates as a function of $(t_2 - t_1)$, even if $n_3^2 \approx 0$ the second term on the right of this equation cannot always cancel the first term on the right of this equation (that is the 2). Such a cancelation occurs only at the discrete special times when $\sin^2[\omega\ (t_2 - t_1)] = 0.5 / (1 - n_3^2)$.

Since, as was argued above, the EDA signal depends on the state of this qubit of information, the retrospective prestimulus EDA signals reflect the retrospective prestimulus states of the qubit as well. Non retrospectively (that is, during real time), even with the decoherence mechanism, unless observed, just like the prestimulus states of the qubit the samples of the prestimulus EDA signal are merely possible values. It is the answer of the Deus-ex-machina emotionally experienced by the (inquiring and) observing participant that serves as an end condition and retrospectively modifies the prestimulus tentative actual past to an effective past that matches this end condition. This is the explanation of the usual PSE.

Experimental Support

Several experimental findings seem to support the above developed explanation for the PSE:

1. The aforementioned (commonsensical) prediction that during real time one can expect at any prestimulus t_1 moment only $\langle \alpha_1(t_1) \rangle = 0$ (that is, that one cannot efficiently predict the unpredictable incoming event) can explain the results found by Duma et al. (2017) that indicate a participants' inability to efficiently predict unpredictable events in real time (and actively react accordingly) in spite of the existence of recorded indications for PSE in their body.

2. I developed above a general functional form that the temporal behavior of the PSE may be expected to follow. One should be aware, of course, that since we are dealing with complicated (psychological) evaluations of very complicated macroscopic systems various modifications of the functional form may occur in practice. Even the values of the parameters n_3 and ω were not fixed by the aforementioned general theory. In principle, one may hope to determine these parameters by fits to measurements. Consider, for instance, figure 4 in Radin (2004; reproduced as Fig. 1 in Radin, 2011, as well), which shows the presentiment effect over the last eight seconds before the application of the randomly selected stimulus. Assuming, for example, that $n_3=\sqrt{(1/2)}$, the temporal behavior of the difference between the two shown presentiment average skin conductance level curves suggests that under the used experimental conditions f≈1/28Hz. Of course, these parameters' values merely represent one possibility. They are not unique. Earlier presentiment data are needed to better determine both n_3 and ω. The surprising existence of the PSE and its (most probably wrong) interpretation as a real time "hunch" (or a subconscious effect) apparently misled most of the experimenters to restrict their studies to the last few seconds before the stimuli. However, unless attenuated by some other factors, our reached retrospective temporal behavior exhibits fluctuations over longer perstimulus periods.

3. This predicted retrospective PSE over longer prestimulus periods may find experimental support by the results of the experiment on precognition with planarian worms described in Alvarez (2016, p. 222) who found that "Frequencies of Head Movements behavior during the two observation periods (one min before and immediately before stimulation) for the experimental planarians more than doubled that of values during the corresponding observation periods for the control subjects (Table 1)."

Conclusion

Roughly speaking, it can be said that in spite of an experimentally verified violations of Bell type inequalities and proven theorems such as the Bell-Kochen-Specker one, many current mainstream scientists prefer some sort of physicalism over idealism. Following a Galilean attitude they dismiss minds, consciousness, and feelings as mere secondary. The conceptual problems that current mainstream physics has in sticking to an "objective particles worldview" can be clearly seen in Passon (2019) and Passon et al. (2019). Wallace (2019, p. 309) describes a bewildering situation by writing; "Quantum mechanics, as actually practiced in mainstream physics, makes no use of the eigenstate-eigenvector link, nor of the collapse postulate. Its dynamics are unitary; the

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unitarily evolving quantum state is interpreted inchoately, as describing physical goings-on in regimes where interference is important and as describing probabilities in regimes where it can be neglected. On pain of failure to account for interference, we cannot (it seems) consistently treat the state as probabilistic; on pain of failure to account for the probability rule, and more generally of failing to make contact with observation, we cannot (it seems) consistently treat the state as representational." Furthermore, this approach, adopted by mainstream physics, leads to an incurable tear in science; physics on one side and psychology on the other side. It leaves the "hard problem" of consciousness unsolvable. It also gives no explanation for any paranormal phenomenon. No matter how statistically well such phenomena are established, mainstream physics simply disregards it or even denies it. Arguably, this approach ignores the most mysterious and most important issue for us as human beings.

Concerning the consciousness-physics mutual influence, Wigner (1967, p. 181) almost desperately claimed; "we cannot help but feel somewhat helpless as we ask the much more difficult question: how could the two theses be verified experimentally?" He then suggested (p. 182): "discovering phenomena postulated by the second thesis, in which the consciousness modifies the usual laws of physics." Concerning the previous lack of success of such search, Wigner retorted (p. 182); "However, every phenomenon is unexpected and most unlikely until it has been discovered - and some of them remain unreasonable for a long time after they have been discovered. Hence, lack of success in the past need not discourage."

I argue here that the PSE is such a looked-for phenomenon. As Wigner expected, the PSE remains unreasonable for a long time after being discovered. I mathematically explained how PSE can retrospectively appear. Indeed, at this stage, the huge complexity of the involved systems prevents detailed numerical predictions of the effect. As suggested by me (Levin, 2020) and proved above (recall the aforementioned $\langle\alpha_1(t_1)\rangle$ = 0.5 – 0.5 = 0 result), we only know how to prevent the effect by our intervention. However, its experimentally confirmed existence and our orthodox QM's successful mathematical (in principle) demonstration of it point to the central role held by consciousness in a proper comprehensive scientific (i.e., evidence-based) worldview.

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Der Presentimenteffekt deutet auf das Auftreten eines von Neumannschen Kollapses hin

Ephraim Y. Levin

Zusammenfassung: Obwohl er klein und in starkes Rauschen eingebettet ist, gilt der überraschenderweise bestätigte Presentimenteffekt als einer der zuverlässigeren "Psi"-Effekte, obwohl ein solcher Effekt keine Vorhersage in Echtzeit widerspiegeln kann. Vielmehr spiegelt der Effekt Korrelationen wider, die nur in der historischen Vergangenheit gefunden wurden, als Ergebnis der Endbedingungen, die durch die psychologischen Reaktionen der Teilnehmer auf die Stimuli repräsentiert werden. Das heißt, der Effekt tritt zwar auf, aber nur im Nachhinein. In der vorliegenden Arbeit wird diese Vermutung *mathematisch* durch eine orthodoxe Interpretation der Quantenmechanik erklärt, deren Ontologie skizziert wird. Die Erklärung basiert auf von Neumanns Idee, dass der Quantenzustand des Systems zusammenbricht, wenn der Geist des Teilnehmers eine Beobachtung vornimmt. Das Argument berücksichtigt Dekohärenzüberlegungen. Die Existenz des Presentimenteffekts und ihre hier vorgestellte vernünftige Quantenerklärung scheinen von Neumanns Idee zu unterstützen.

German translation: Eberhard Bauer

O Efeito Pressentimento Aponta para a Ocorrência de um Colapso de von Neumann

Ephraim Y. Levin

Resumo: Embora pequeno e envolvido em muito barulho, o surpreendentemente confirmado efeito pressentimento é considerado um dos mais confiáveis efeitos "psi", embora tal efeito não possa corresponder a previsão em tempo real. Em vez disso, o efeito reflete correlações encontradas apenas no passado histórico como resultado das condições finais representadas pelas respostas psicológicas do participante aos estímulos. Ou seja, o efeito aparece, mas apenas em retrospecto. O presente artigo explica matematicamente esta alusão através de uma interpretação ortodoxa da mecânica quântica cuja ontologia é referida. A explicação é baseada na ideia de von Neumann de que o estado quântico do sistema entra em colapso quando a mente do participante percebe uma observação. O argumento leva em consideração fatores de decoerência. A existência do efeito pressentimento e sua explicação quântica plausível apresentada parecem apoiar a ideia de von Neumann.

Portuguese translation: Antônio Lima

El Efecto de Presentimiento Sugiere la Aparición de un Colapso de von Neumann

Ephraim Y. Levin

Resumen: Aunque pequeño e inmerso en mucho ruido, el sorprendentemente confirmado efecto del presentimiento es uno de los efectos "psi" más fiables, aunque no puede reflejar la predicción en tiempo real. Más bien, el efecto refleja correlaciones encontradas sólo en el pasado histórico como resultado de las condiciones finales representadas por las respuestas psicológicas del participante a los estímulos. Es decir, el efecto aparece, pero sólo en retrospectiva. El presente artículo explica matemáticamente esta sugerencia mediante una interpretación ortodoxa de la mecánica cuántica cuya ontología se esboza. La explicación se basa en la idea de von Neumann de que el estado cuántico del sistema se colapsa cuando la mente del participante percibe una observación. El argumento tiene en cuenta consideraciones de decoherencia. La existencia del efecto presentimiento y su explicación cuántica razonable parecen apoyar la idea de von Neumann.

Spanish translation: Etzel Cardeña

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