Benevolent Universe ?

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Chapter 1: Introduction

Does Nature care about how you feel? Do her actions spring from any concern for your joys and sorrows? Prevailing scientific theory says 'No', but recent high-profile experiments suggest that contemporary science may be wrong on this particular point. Extensive new data indicate that certain choices that play a central role in contemporary physical theory, and that are asserted to be completely random, are in fact not random. Under certain conditions they appear to be biased in a way that favors the occurrence of positive emotions in the minds of certain human observers, and disfavors the occurrence of negative emotions. The existence of an effect of this kind could increase the capacity of your thoughts to influence the unfolding of physical reality.

Prior to the rise of modern science it was widely believed that nature, while often acting in ways disastrous to human welfare, occasionally responded positively to our thoughts and emotions. Then, early in the eighteenth century, scientists, building on the ideas of Isaac Newton, proclaimed nature to be a purely mechanical process that grinds out our destinies with utter disregard for all mental processes.

This mechanistic conception of nature grew out of an idea promoted by the French philosopher and mathematician René Descartes. He argued, in effect, that reality is divided into two different kinds of things: "physical things" and "mental things". Physical things can be described by ascribing mathematical properties to points in space at instants of time, whereas the mental things include your thoughts, ideas, and feelings. A possible physical reality is the location of a tiny particle in three-dimensional space at a particular instant of time, whereas two typical mental realities are your feeling of pain when you touch a hot stove, and your experience of the color "red" when looking at a red-painted fire engine.

Descartes believed that the mental events occurring in a person's stream of consciousness are associated with physical events occurring in that person's brain. But he maintained that these mental realities are fundamentally different in kind from the corresponding activities in the brain. This difference is the famous Cartesian separation between mind and body.

Isaac Newton, building on this Cartesian division of nature into these two parts, focused his attention on the physical aspects. He formulated mathematical "laws of motion" that accounted in a detailed way for the motions of the planets in the solar system, for the orbit of the moon around earth, for the rising tides and falling apples, and for a host of other observed features of the physically described universe.

By virtue of these laws, a classical Newtonian-type universe is "deterministic". This means that the entire history of the physical universe is fixed for all time, once the initial physical conditions and the mathematical laws of motion are specified. The free inputs into the physical universe are thereby limited to the choosing of the initial physical conditions, and the selection of the (assumed timeless) laws of motion. These two inputs then determine the evolution of the physical universe for all eternity: nothing is left to chance, or to the willful intent of either Man or Nature.

This way of understanding reality is called "materialism", and its expression in accordance with the ideas of Isaac Newton, is called "classical physics", or "classical mechanics".

Philosophers have been tormented for centuries by this apparent verdict of science, which reduces human beings to mechanical automata. Our rational thoughts and moral sentiments are rendered incapable of deflecting, in any way, our bodily actions from the path ordained at the beginning of time by the purely physical aspects of nature alone.

Then, during the first quarter of the twentieth century, a host of experiments were performed that were sensitive to properties of the atomic constituents of matter. The results turned out to be incompatible not merely with the details of the existing classical physics, but with the basic precepts of that theory as well.

Scientists, responding to this calamitous breakdown of classical physics, created a new theory called quantum mechanics. It is based on concepts radically different from those of classical physics, yet yields extremely accurate predictions of the outcomes of both the old and the new experiments.

Perhaps the most important of the rejected classical ideas is the notion that the basic scientific theory should be fundamentally about the properties of the physically described universe. The founders of quantum mechanics adopted the contrary view that science, properly conceived, is fundamentally about relationships between human experiences. The word "science" comes from the Latin word "scire", which means "to know". Hence science ought to be about "knowledge". But knowledge is a mental aspect of nature, and classical mechanics had reduced all mental things to causally inert bystanders to the deterministic flow of physical events. So what had formerly been regarded as impotent side effects, namely mental things, became the core realities of the new theory. This shift converted the mental aspects of human beings, as seats of expanding knowledge, into causally active agents.

The essential fact that drove the founders to this radical break with prior science was the totally bizarre way in which, according to the rules of the pragmatically successful new theory, an increase in a person's knowledge about the physical world is related to the behavior of that world. In the older classical theory our streams of conscious experiences were essentially a sequence of snap-shots of what was going on in the independently evolving physical world. But in the new theory each new experience has the effect of *resolving physical ambiguities created by quantum uncertainties*. This profound revision of the role of man in nature is succinctly captured by the oft-made remark of Niels Bohr, a principal founder of quantum mechanics: "In the great drama of life we are both actors and spectators."

According to the traditional classical precepts, the physical properties localized in a tiny region evolve over the course of time in a smooth and continuous way that is completely determined by local physical properties. But in quantum mechanics the evolution of such properties can be abrupt and jumpy, and can depend not only on local physical properties, but also on certain "free choices" made by observer/actors. These choices are not determined by the physical laws of quantum mechanics, and they are often described as arising from mental causes such as our moral sentiments, or our conscious reasons and intentions, or our aesthetic judgments. In fact, the fundamental difference between classical mechanics and quantum mechanics is precisely the nature of the connection between the aspects of our understanding of our experiences that we describe in physical terms and the aspects that we describe in mental terms. Quantum mechanics features a partial reversal of the causal flow between mind and brain: a person's brain is transformed from the master of that person's slavish mind to a dutiful responder to that person's mental intentions.

Belief in the power in the physical world of one's own mental intentions is the rational basis of one's active involvement in the world. If a rational science-minded person truly accepts, instead of fallible intuition, the classical-physics claim that his mental intentions are physically impotent side effects then he jeopardizes his effectiveness in the world: How can a rational human being summon the energy and effort to promote what he values while truly believing that everything that happens -- or will ever happen -- was determined at the birth of the universe by a mechanical process that totally ignores everything mental? How can a rational person act effectively while truly believing himself to be, as far as the physical world is concerned, a mindless mechanical robot?

I shall, in this book, explain the tremendous gulf between the earlier classical conception of reality and the revised conception of it offered by orthodox quantum mechanics. The former is inconsistent with huge amounts of unquestionably valid data, and claims that the incessantly reaffirmed capacity of your thoughts to influence your actions is an illusion. The latter agrees with all well-established empirical data, and explains in a rationally coherent and natural way how your mental intentions can cause your physical body to behave in the way that you mentally intend.

Yet today, more than a century after its falsification, that rationally untenable and morally corrosive classical mechanical conception of reality has been permitted by scientists to dominate the public perception of what science tells us about the nature of the physical world, and our place within it.

It is, of course, understandable that many scientists are primarily interested in making practical use of the marvelous tools that quantum mechanics provides, and hence eschew getting drawn into philosophical debates with people who do not comprehend the basic laws of nature. Moreover, the official doctrine of quantum mechanics, called the "Copenhagen Interpretation", urges quantum physicists, for reasons to be examined later, to refrain from worrying about, or thinking about, the reality that lies behind the successful quantum rules. Fledgling quantum physicists are strongly advised to focus, instead, on useful applications of the quantum rules; an advice intended to keep the trainee on a path to a successful professional career.

Nevertheless, the huge moral implications of the switch from an irrational classical conception of reality to a rational quantum conception demands, in today's troubled world, that thinking people be disabused of the fiction that or best contemporary science still claims us to be the biological automata that nineteenth century science proclaimed us to be. Within the rationally coherent orthodox (von Neumann-based) quantum mechanical understanding of reality, we human beings are recognized to be integral parts of a highly interconnected evolving psycho-physical reality. Our mental intentions are the causally effective initiators of corresponding physical actions. Our thoughts become, within that theory, causally effective components of the unfolding of experiential reality, rather than flotsam and jetsam tossed about by physical forces that remain forever untouched by our mental efforts.

The results of the new experiments that were mentioned in the opening paragraph play an important role in this discussion. Taken as valid, they suggest that even this contemporary orthodox quantum mechanical conception of reality cannot be exactly correct. The assumed exact correctness of the standard rules has, as just mentioned, deflected the interests of most physicists away from the problem of the nature of the reality that lies behind the pragmatically successful rules. But a putative failure of the standard quantum laws re-opens the question of the nature of a reality that could naturally accommodate the reported empirical phenomena.

It turns out that this new evidence, which seems at first to be completely at odds with the orthodox quantum mechanical conception of reality, suggests a modification of that conception which, from a certain perspective, appears to be more reasonable and natural than the orthodox one. This revised conception accentuates Bohr's dictum that in the drama of existence we are both actors and spectators.

Chapter 2: Miracles, Fraud, Gullibility, Psi, and Presentiment

Claims that miracles occur are common in religious traditions. They are used by religious leaders to demonstrate the power of the religion's gods and saints to override the normal laws of nature. The Catholic Church has instituted rigorous procedures designed to uncover fraud or gullibility on the part of the witnesses of such events, but skeptics remain unconvinced that any violation of the physical laws that they accept has ever occurred.

In 1882 the Society for Psychical Research (SPR) was formed in London, specifically to apply scientific methods to the study of reports of phenomena that appear to violate the laws of (classical) physics. Such phenomena now are called "psi" phenomena. The members of the SPR included many men of high scientific standing, including Sir William Crookes and William James. Voluminous proceedings, and other documents, attest to the diligence of the members. But ancient records of events that cannot be reproduced "here and now" tend, over the course of time, to lose their probative power.

During the last three and a half decades a reported phenomenon called "presentiment" has been studied within various experimental settings. Skin conductance, heart rate, pupil dilation, and brain activity are reported to "react" to a sudden stimulus shortly *before* the stimulus is applied to a human or animal subject. Such apparent reversals of the normal ordering of cause and effect are called "retrocausal". Dean Radin and Dick Bierman are two prominent investigators of presentiment effects.

A huge body of literature pertaining to psi phenomena now exists. It contains reports of widely differing qualities, together with challenges to their credibility. Dealing with all of that would demand a book that would exhaust the patience of most readers. To define a limited endeavor suitable for treatment in a short work aimed at readers unfamiliar with such phenomena, and who lack the time to examine and evaluate the voluminous and complex literature on the subject, I shall consider here the content of one single published article, which describes nine separate experiments that produced results similar in important respects to the recent presentiment experiments.

This single paper [1] has passed a particularly tough scrutiny by a major science journal. It reports experiments performed at a prestigious university, Cornell, by a professor of high repute, DaryI J. Bem. The paper describes nine different experiments that all point in the direction of an apparent biasing of nature's supposedly "random" quantum mechanical process in a way that favors the occurrence of certain positive human emotions, and disfavors the occurrence of certain negative human emotions.

The credentials of this paper seem to place it well within the range of mainstream science. It is also topical, having created a furor that reached the pages of the New York Times opinion page (Jan 7, 2011), where cognitive scientist and author Douglass Hofstadter claimed that "If any of Professor Bem's claim's were true, then we would have to rethink everything about the nature of the universe". Some outraged scientists called for Bem's paper to be banned from scientific journals, while others noted that major advances in science often contravene prevailing scientific opinion.

The main thrust of the present work is that although Bem's "retrocausal" results are incompatible with current basic physics, they can nevertheless be explained in a natural and rationally coherent way by modifying the standard rules of quantum mechanics in a way that leaves the prior successes of that theory essentially unaffected. This modification allows the "choices on the part of nature", which have been assumed to be completely "random", to depend upon features of reality upon which they had been assumed not to depend. These features are the emotional consequences of these choices in the minds of certain pertinent observers.. The revised assumption is that the "randomness" of these supposedly random quantum choices is not a basic feature of nature herself, but is, rather, a feature of a practically useful theory that arises by averaging, in a standard way, over the possible values of the unsuspected pertinent variable. This averaging procedure produces, in the present case, the pragmatically successful orthodox quantum mechanics.

Chapter 3: The Empirical Evidence and its Significance

Bem's paper [1] describes nine different experiments. Each of these experiments is performed on a group of experimental subjects, sometimes called the participants. Each of the nine experiments is a variation of a standard psychology experiment. In the standard experiment a random number generator (RNG) picks an action that is then performed upon the subject, who then performs an action. The RNG-chosen action that is performed **on** the subject is identified as the "cause"., and the action performed **by** the subject is identified as the "effect". But in Bem's variation, the RNG-chosen action is chosen and performed upon the subject, **after** the subject has already performed his or her action. Thus the order of what had been the "cause" and the "effect" is reversed.

In the Bem experiments the RNG is situated so that there can be no physical action upon it by the subject-system, and the RNG-chosen action upon the subject occurs only after the subject has already completed his or her action. Hence no correlation between the choice made by the RNG and the action performed by the subject is expected, either in standard classical mechanics or in orthodox quantum mechanics. A dependence of the later RNG choice upon the subject's earlier choice is blocked by the seeming absence of any possible physical carrier of such effect, and an effect of the later choice made by the RNG on the subject's earlier choice of action is blocked by the fact that causal effects act only forward in time, both in standard classical mechanics and in orthodox (or Copenhagen) quantum mechanics.

However, the subject will, by the end of the experiment, have both performed an action and been acted upon. The *combination* of these two events can be such as to produce a positive emotion or mood in the mind of the subject, a negative one, or a neutral one. A positive emotion might be produced by seeing an erotic picture, whereas a negative emotion might be produced by seeing a picture of a spider. A positive mood could be created by being exposed to a sequence of *harmonious* stimuli, whereas a negative mood could be created by being exposed to a sequence of *discordant* stimuli. Bem's results can be summarized by saying that, in all nine experiments, what actually occurs happens *more* often than, *less* often than, or *as* often as, what is entailed by the normal statistical properties of the RNG, according to whether the associated final emotion or mood is positive, negative, or neutral. What actually occurs under the conditions of these experiments is statistically biased -- relative to what the normal statistical properties of the RNG demand -- in favor of positive emotions and moods, or against negative emotions and moods. Such a biasing is, however, banned by both standard classical mechanics and orthodox quantum mechanics. Bem's experiments suggest, therefore, or indicate, that this ban is violated by nature's actual process.

Prior to the main part of most of the Bem experiments the participants were given a short questionnaire. They were then identified, on the basis of their answers, as either "stimulus seeking" (SS) or "not stimulus seeking". In four of the experiments the subjects in the SS group produced apparent "retro-causal" effects that had a probability of one in 500, or less, of occurring by chance; and in two of these four the probability of occurring by chance was less than one part in 5000. In all but one experiment the deviation from chance expectation, in the direction predicted on the basis of earlier experiments, was statistically significant.

All but two of the experiments involved the viewing of emotion-generating pictures. There were no significant deviations from normal expectations in the control experiments in which the emotion-generating pictures viewed by the subjects were replaced by emotionally neutral pictures.

In view of these multiple small probabilities, coupled with the null results for the control experiments, it seems prohibitively unlikely that the reported anomalies could occur by virtue of a statistical fluke. Nor does the possibility of experimenter errors sufficiently gross to account for the reported anomalies seem plausible. Thus I believe that these reports warrant being regarded, at least provisionally, as science-based empirical evidence about the nature of reality: I think there is enough evidence here to warrant a theoretical effort to understand what sort of modification of orthodox quantum mechanics would be able to account for the results reported by Bem, without upsetting the successes of the standard theory.

Also, in the study of phenomena that appear to violate the prevailing theory, it is helpful to have in hand an alternative theory that naturally accommodates, within a rationally coherent modification of the prevailing theory, both the newer and older data.

In the first Bem experiment the subject is seated before a screen with a pair of side-by-side neutral curtains, and is told that behind one curtain there is a picture, and behind the other curtain a blank wall. The subject is asked to choose the curtain behind which he or she feels the picture lies. Then either a picture or the image of a blank wall appears at the location, left or right, that the subject has chosen. This picture will turn out to be either erotic or nonerotic.

Actually, at the time of the subject's choice between left and right it has not yet been decided whether the picture that will appear will be erotic or nonerotic, or whether it will be assigned to the left or right position. After the subject makes his or her choice, two random number generators (RNGs) are consulted. The first (actually a pseudo random number generator--PRNG) chooses randomly between an erotic picture and a nonerotic picture. The second RNG (a true RNG) chooses randomly the left or right location for the placement of the picture. The PRNG choice is between instances that are part of experiment proper and those that are part of the control experiment. This procedure randomly intersperses control experiments into the sequence of actual experiments.

The play of pure chance would tend to make the subject's choice correct 50% of the time. That is essentially what happens for the nonerotic pictures. But for erotic pictures the subjects chose the correct location 53.1% of the time, with the probability that a result at least this deviant from expectations would occur by chance being 1%. But for the SS group of subjects, the correct choice of location was made 57.6% of the time, with probability one part in 50,000 that this would occur by chance.

How can such a departure from chance be explained in a way that leaves intact the monumental successes of orthodox quantum mechanics?

An obvious possible answer is this: switch from the strictly orthodox quantum theory, in which nature's choices are governed fundamentally by "pure chance", to a quasi-orthodox quantum mechanics in which nature's choices are determined by *sufficient reasons*, and in which these sufficient reasons cause nature, in her choice of what actually happens, to favor an outcome that produces a positive emotional experiences the mind of the probing agent, and to disfavor an outcome that lead to negative emotional experiences of the mind of the probing agent. Most experimental protocols are not able to reveal this scientifically unexpected biasing of nature's choices, and the outcomes are compatible with the standard predictions based on nature's choices being strictly random.

I will explain in detail, in a later chapter, the logical structure of the orthodox quantum mechanical understanding of the mind-brain connection, and hence how the actions and experiences of the human actor/spectator/participant enter into the quantum dynamics, and how that actor comes to have experiences determined in part by the outcomes of nature's choices. But the key issue will be whether Nature's choices are really purely random, as contemporary quantum mechanics postulates, or are, instead, biased in the way that naturally accounts for the data reported by Bem.

Pending the later more detailed discussion of how quantum mechanics brings human consciousness into the psycho-physical dynamics, I will describe right away the essential point.

According to orthodox quantum mechanics, non-experienced quantum mechanical processes, such as the non-experienced activity of the RNG, merely generate "potentialities" or "possibilities" for future psycho-physical events. According to that idea, the effect of the choice made by the RNG is to separate the quantum state of the universe into two equally weighted branches within which *different* stimuli are applied to the subject. After the strong positive stimulus is applied to the subject in one branch, but is not applied in the other, the potential brain state of the subject will temporarily be split into two parts that will correspond to two different emotional states. Nature must then decide which of these two states will be actualized. When nature chooses between these two branches, it must, in order to fit the empirical data, choose more frequently than the orthodox quantum rules predict the branch in which the positive stimulus is applied. Thus, Bem's empirical findings can be explained by a quasi-orthodox quantum theory that allows nature's choice to deviate under certain conditions from the predictions of orthodox quantum mechanics. In this case of experiment 1, the deviation must tend to favor the actualization of the brain state in which the participant has been subjected to the strongly positive stimulus.

Essentially this same modification of the orthodox rules explains all of Bem's results.

In the second Bem experiment the subject chooses from a pair of neutral mirror images a "preferred" picture. After this choice of preference is made, a RNG chooses one of the two pictures as the "target". If the preferred picture is *not* the target then a highly arousing negative picture is *subliminally* flashed. Thus the preferred picture becomes associated, *after it is chosen as preferred*, with a strong negative subliminal stimulation provided this "preferred" picture is subsequently *not chosen* as the target. Since the RNG choice of target is made only after the subject's choice of preference, the target status should not, according to ordinary ideas about causation, influence the earlier choice of preference. But for subjects in the SS category the preferred picture turns out to be the target picture 53.5% of the time, with the probability of one part in 500 that this would occur by chance. Thus the empirical deviation from normal causal expectations is a decrease in the proportion of observed instances in which the participant is subjected to strong negative subliminal stimulation.

Bem's third experiment involves retrocausal priming. In a typical normal priming experiment, participants are asked to judge as quickly as they can whether a displayed picture is pleasant or unpleasant, and the time that it takes the subject to respond is then recorded. Normally, a positive or negative word (e.g., beautiful, ugly) is flashed briefly on the screen just *before* the picture appears. This word is called the "prime". Individuals typically respond more quickly when the valences of the prime and the picture are congruent (both are positive or both are negative) than when they are incongruent. In Bem's retroactive version of the procedure, the prime appeared 300ms *after* the participants reported their judgments of the pictures, hence *after* the reaction time is measured.

The effect of the later priming on the previously measured reaction time is statistically significant. The precise numbers depend weakly on details of how the data is treated, but the quoted probability is less than 1% that the empirically observed "retrocausal" effects are due to chance alone.

These results are explained if, in the instances in which the reaction time is shorter and the picture is positive, the output of the random number generator that chooses the 'word' were biased, so that it tended to favor choosing a positive word. But how can a mechanical device, the RNG, become sensitive to the faraway reaction time of the human subject, and to the *later* matching or non-matching *experiential qualities* of a picture and a word in the mind of the participant?

The quasi-orthodox explanation is that nature's later choice between the two alternative possible (still virtual or potential) brain states, favors slightly (relative to the orthodox quantum prediction) the state in which the tandem inputs of the picture and the word feel harmonious, rather than discordant. The order in which these two inputs enter into the determination of the subject's final mood should not be a critical factor. It is the final feeling of harmony or disharmony that presumably leads to the biasing of nature's choice in favor of the positive feeling of harmony. No mysterious backward-in-time action is involved. It is rather nature's sensitivity to the final feeling of harmony or discord in the mind of the participant that, according to the present proposal, changes the empirical probabilities associated with the two alternative branches of the quantum state generated by the two alternative possible outcomes of the RNG choice of the prime.

The point, again in this case, is that the action of the RNG splits the quantum world into two virtual or potential branches. A choice between these branches is made when nature chooses between the two differing final experienced moods of the participant. If this choice is biased, then it is "as if" the RNG choice is biased in the way that will lead to the positive experience of the participant. But the explanation involves no backward-in-time causation, or any mysterious capacity of the RNG to read and react to a future mood of the subject.

The fourth experiment was similar to the third, and gave similar results.

Bem's fifth retrocausal experiment is subliminal retrocausal *habituation*: the reduction, induced by repeated subliminal exposure to a negative emotional picture, of a person's emotional response to a conscious viewing of that negative picture. The subject is shown a pair of strongly arousing negative pictures (or, as a control, a pair of emotionally neutral pictures), and then chooses a preferred one. A computer then randomly chooses one of the two pictures to be the 'target', and subliminally flashes it several times. The empirical effect of this subliminal flashing is to make the *negative* target picture, which was randomly chosen by the computer *after the subject's choice of preference*, *and then subliminally shown to the subject,* more likely to be preferred by the subject at the earlier time. For negative pictures the preferred picture was the target picture 53.1% of the time, compared to the statistically expected 50%, with probability of occurrence by chance again 1.4%. For the neutral control pictures there was no significant deviation from normal expectations.

Again the quasi-orthodox explanation is that because there was no direct experience of which choice was made by the RNG, the quantum state after the action of the RNG will engender two (virtual or potential) branches of the quantum state of the universe. In one, the emotionally negative response to the negative picture is *diminished* by the repetitious flashes. Hence, if nature's later choices tend to avoid producing negative emotions, then the instances in which the flashing reduces the eventually experienced negativity will be more likely to occur.

The sixth experiment was similar to the fifth with, however, the addition of instances with positive (erotic) pictures to the negative ones. In the normal erotic case, in which the flashing occurs before the picture is evaluated, this repetitious exposure tends to diminish the erotic effect. The quasi-orthodox explanation is that the erotic picture will be less preferred also when the flashing is chosen and performed later. This is borne out: the target is preferred 48.2% of the time, with probability 3.9%. that this would occur by chance. For the subjects classified (on the basis of questionnaire responses) as "erotic stimulus seekers" the target was retroactively preferred 43.1% of the time compared to the expected 50%. The probability of this occurring by chance is one part in 500. For the subjects not pre-classified as "erotic stimulus seekers" the results did not deviate significantly from normal chance expectations.

Experiment seven tested the idea that the repetitious flashing of a picture produces boredom with respect to that picture, and hence that a flashing of that picture supraliminally 10 times should make it less preferred. In this experiment the pictures were also chosen to be less emotional, and they were a mixture of erotic and negative pictures.

For the full set of two hundred subjects the outcome did not deviate significantly from chance. But in the SS subset of subjects, the randomly chosen target, which was selected after the choice of the preferred picture, was the preferred picture 47.9% of the times, with probability 1.9% of occurrence by chance. The quasi-orthodox explanation is the same.

Experiment eight is "Retroactive Facilitation of Recall". Bem's description is this: "The current experiment tested the hypothesis that memory can 'work both ways' by testing whether rehearsing a set of words makes them easier to recall—even if the rehearsal takes place after the recall test has occurred. Participants were first shown a set of words and given a free recall test of those words. The participants were then given a set of practice exercises on a randomly selected subset of those words. The psi hypothesis was that the practice exercises would retroactively facilitate the recall of those words, and hence that participants would recall more of the to-be-practiced words than the never-to-be practiced words."

The empirical result was that the hypothesis was confirmed: a certain measure of success was achieved in 2.27% of the cases with probability 2.9% that this would occur by chance. For the pre-selected subset of the subjects in the high "stimulus seeking" category success was achieved 6.46% of the time, with probability 0.03%. that this would occur by chance.

Experiment nine was like experiment eight, but with an extra added practice. The results were stronger. Success was achieved by 4.21%, of the full set of subjects, with probability one part in 50 that this would occur by chance.

The quasi-orthodox explanation is the same. The participant takes the test and recalls a certain set of words. Nothing can change that! The subject passes or fails, and that's that! Considering each word separately, the participant either recalls it on the test or does not. Again, the RNG choice causes the state of "the RNG *and* the subject's brain" to evolve into a pair of alternative possible virtual branches in which different actions are performed upon the participant. But these two branches remain mere "potentialities" until an observer observes an outcome. That outcome is, according to orthodox quantum mechanics, selected by nature, as will be explained in detail in a later chapter. If nature's choice favors the branch in which the word is later practiced, then that branch is the one more likely to be "actualized". The RNG will thus, *in effect*, be more likely to have chosen the branch that leads to "practice" rather than the branch that leads to "no practice", because that branch is the one more likely – due to nature's bias -- to be eventually actualized !

It is, of course, highly anti-intuitive that the two macroscopically different brain states should co-exist, even briefly, after the computer has done its work. But if no experiential determination has yet been made of which branch will be actualized, then the strictly orthodox position is that no reduction to one branch or the other has yet occurred. This is the notorious "Schroedinger Cat" problem. Einstein used this anti-intuitive feature of quantum theory to ridicule it by noting that, according to that idea, the moon would be smeared out over the night sky until the first observer, say a mouse, observes it.

This issue has remained unresolved: it had seemed to be a purely metaphysical question. But now a simple empirical test is available: in these Bem experiments the apparent retrocausal effects should disappear if another (unbiased) observer witnesses the outcome of the RNG choice *before* the participant does! For then nature's choice of outcome should be associated with the experience of that other observer, thereby muting the dependence on the participant's emotional state.

This predicted dependence of outcomes upon the emotional state of observers may be relevant also to a certain problem with the scientific methodology, namely the "experimenter effect". During the 1960s over 30 experiments were performed in mainstream psychology documenting the empirical finding that experimental outcomes are often biased by experimenter expectations (See Appendix 3). Quasi-orthodox quantum mechanics might provide a theoretical framework for studying this phenomenon.

Bem has informed me of six "replications" of certain of his experiments (See Appendix 3 for details). But long-time skeptic Richard Wiseman and two colleagues have performed a three-part experiment that, taken as one, has the same number of participants as the corresponding Bem experiment. The experiment of Wiseman and his colleagues failed to reproduce Bem's results. Bem has informed me of two other apparent failures, one at Harvard, the other in Argentina. Failures of committed skeptics to get positive results could conceivably be examples of the experimenter effect, which might be explained by the very process being here examined.

Bem expects [See Appendix 3], on the basis of analogous situations in the past, that it will probably be several years before the experimental situation becomes clear.

The explanation given above rests on the core basic change in the scientific conception of reality entailed by the shift from the rules of classical mechanics to the rules of quantum mechanics. Insofar as one demands a rationally coherent realistic understanding, the universe must be fundamentally mental in character, not material. This is not a new conclusion. It was recognized in the early days of quantum mechanics when physicists and philosophers were still wrestling with the question of what kind of reality could underlie the strange new rules. But this question has been suppressed by the new generation of quantum physicists trained to focus on calculations, and to refrain from thinking about the nature of reality.

A few quotes from the founders will serve to emphasize this point.

"Reality is in the observations, not in the electrons" (Heisenberg, Physics and Philosophy)

"Modern physics has definitely decided in favor of Plato. In fact the smallest units of matter are not physical objects in the ordinary sense; they are forms, ideas […]." (Heisenberg. The New York Times Book Review, March 8th 1992.)

"I regard consciousness as fundamental. I regard matter as derivative from consciousness." (Planck quoted in the Observer, 25 January 1931.)

"The universe is of the nature of a thought or sensation in a universal Mind.
[…] To put the conclusion crudely – the stuff of the world is mind-stuff.
[…] It is difficult for the matter-of-fact physicist to accept the view that the
substratum of everything is of mental character. But no one can deny that
mind is the first and most direct thing in our experience, and all else is
remote inference – inference either intuitive or deliberate."
(Eddington, 1928, Chapter 13):

" it comes naturally to the simple man of today to think of a dualistic relationship between mind and matter as an extremely obvious idea. … But a more careful consideration should make us less ready to admit this interaction of events in two spheres----if they really are different spheres; for the … causal determination of matter by mind …would necessarily have to disrupt the autonomy of material events, while the …causal influence on mind of bodies or their equivalent, for example light…is absolutely unintelligible to us; in short, we simply cannot see how material events can be transformed into sensation or thought, however many text-books, in defiance of Du Bois Raymond, go on talking nonsense on the subject.
These shortcomings can hardly be avoided except by abandoning dualism. This has been proposed often enough, and it is odd that it has usually been done on a materialistic basis.

….But it strikes me that …surrender of the notion of the real external world, alien as it seems to everyday thinking, is absolutely essential.
….If we decide to have only one world, it has got to be the psychic one, since that exists anyway (cogitate----est). And to suppose that there is interaction between the two spheres involves something of a magical ghostly sort; or rather the supposition itself makes them into a single thing." (Schroedinger, My View of the World, pp. 61 -63)

The upshot of all this is that a deep familiarity with the failures of classical mechanics and the successes of quantum mechanics leads very well informed careful thinkers to the conclusion that the underlying reality must be mental not material: that the material aspects arise from a mental underpinning, rather than the mental from the physical. Von Neumann's orthodox quantum mechanics provides for a rationally coherent science-based formalization of that idea.

The main aim of this volume is to explain to lay readers, and in simple but accurate terms, the way that orthodox quantum mechanics describes the physical world and our place within it in mind-based rather than matter-based terms. Special attention is paid to well established phenomena that seem to imply effects upon past events of future freely (or randomly) chosen actions. A secondary aim is to explain a manageable and plausible way to modify the strictly orthodox theory in a way that will accommodate the Bem data while not upsetting the prior monumental successes of quantum mechanics.

Chapter 4: Waves, Particles, and Minds

Quantum mechanics emerged from a sequence of intellectual and scientific developments that led to severe difficulties that quantum mechanics was able to resolve by bringing our minds and our knowledge importantly into the dynamical workings of nature. To appreciate the reasons for abandoning the intuitive matter-based idea of nature that had worked so well for two centuries, one needs to have a general understanding of what led to the radical revision of our science-based conception not merely of the invisible atomic processes, but also of the "solid" objects of everyday life

Western civilization is based, intellectually, on two mutually contradictory foundations. On the one hand, there is an ancient religious tradition that claims the existence of an all-powerful deity that created us in His image, and granted us the free will to do what we want, but nevertheless wants us to follow His rules, and may punish us for transgressions.

On the other hand, both the structure of our society, and the way we think about ourselves in relation to the universe around us, is deeply influenced by ideas stemming from the seventeenth century scientific works of Isaac Newton and Galileo Galilei. Those works culminated in what is now called classical mechanics, or classical physics. According to the classical precepts, the entire universe, including the human race, is basically a physical mechanism that churns out the course of physical events in accordance with microscopic mechanical laws that make no mention of our thoughts, ideas, and feelings. According to that science-based conception of nature, our conscious experiencing of the unfolding of physical reality is essentially like the viewing of a movie that we helplessly watch, unable to affect in any way what happens before our eyes.

Caught in the cross-fire of these conflicting world-views, no rational involvement with the world can be sustained. Classical mechanics undermines the claim of the authenticity and authority of the religious concepts, which appear, from this viewpoint, to be simply the product of human exploitation of human gullibility. Yet this classical conception of reality, if accepted, renders irrational any mental effort to create a better future for oneself or one's progeny, or to promote any other value. For the laws of classical physics mandate that mechanically described processes, acting alone, unaffected by any mental effort, completely determine every physical action: each of us is reduced to a mechanical automaton, mysteriously endowed with a stream of conscious thoughts that deludes us into believing that our conscious efforts can influence our physical actions.

This complete suppression by the laws of classical mechanics of the physical effectiveness of our mental efforts was revoked by twentieth century developments in science. An understanding of this fundamental change in science's conception of reality, and of our role in it, may constitute an offering of science as important to us in the end as its engineering achievements, for it is our idea of ourselves, as parts of an enveloping whole, that determines how we use our power.

Classical Mechanics

Classical mechanics developed during the nineteenth century -- due principally to the work of James Clerk Maxwell -- into a form that involved two different kinds of physical stuff: "particles" and "waves". Electrons are the prime example of particles, whereas "light", in the form of the electromagnetic field, is the prime example of a wave. Particles are tiny highly-localized structures, each with a center that, at each instant of time, is situated at one precise point in three-dimensional space, with the rest of the particle lying nearby. A wave, on the other hand, tends to spread out over a large region in space, and to exhibit interference patterns due to the cancellations or reinforcements of moving crests and troughs.

Particles and waves have, therefore, contradictory structures: particles always stay tiny, whereas waves tend to spread out. Thus Planck's discovery in 1900 that light , which had seemed to be a wave, had a corpuscular nature came as quite a shock. Light of a given frequency appeared to be emitted in chunks, each carrying a quantity of energy that is directly proportional to the frequency of the light wave, with a universal proportionality factor called Planck's constant. Five years later, Einstein won the Nobel Prize for his explanation of the photo-electric effect: Empirically, a metallic surface radiated by light of a definite frequency emits electrons with energies equal -- after a correction for the energy needed to get the electron out of the metal -- to the energy of the incoming quantum of light, now understood to be localized like a particle.

The concepts of classical physics were unable to cope adequately with either this wave-particle-duality problem, or a large number of other problems concerning the properties of atoms. A new understanding of nwas needed.

Quantum Mechanics

These problems of wave-particle duality and atomic structure seem to be completely physical in character. But the founders of quantum mechanics were men of profound philosophical bent. Niels Bohr's father was an eminent physiologist familiar with the writings of William James, and Wolfgang Pauli was the godson of the philosopher Ernst Mach. Werner Heisenberg, whose father was also a professor, was greatly influenced by the views of Bohr and Pauli, and all three were strongly influenced by the view of Albert Einstein that science rests in the end on empirical findings, and that our theories are human inventions that help us deal with the empirically experienced world. Bohr, concurring, announced at the start of his 1934 book, *Atomic Theory and the Description of Nature,* that "In physics...our problem consists in the coordination of our experiences of the external world..."

The founders of quantum theory offered their theory not as what would normally be called a description of the existing and evolving reality itself, but rather as merely a mathematical methodology for making testable predictions about future experiences on the basis of knowledge gleaned from prior experiences. This conceptual shift allowed the founders to cope with the issues of wave-particle duality and atomic structure in a pragmatically useful way that accounted beautifully for the existing empirical data, and moreover made many other testable predictions. However, considered as a description of reality, it was not logically coherent.

Difficulties with Quantum Mechanics

The logical difficulty was that the connection between the mathematical description of the physically described world and our mental experiences of that world was achieved by treating measuring devices, and other macroscopic objects, as if they were classical describable objects. But that approach endows these devices and objects with properties that contradict various properties that they acquire by virtue of being conglomerations of their atomic quantum constituents. Big objects are not *really* classical objects: they must be treated as conglomerations of quantum constituents in order to deduce their physical properties such as rigidity and electrical conductivity. So there is a first basic question of how to reconcile the quantum aspects of nature with classical appearances. There is also the closely related second question of how large does a system have to be in order to be "classical": where does nature draw the line?

A third problem is that the explicit quantum rules for computing predictions involve an instantaneous change in the quantum mechanical state in one experimental region due to effects associated with a simultaneous experiment being performed very far away.

The founders of quantum mechanics dodged these problems by proclaiming that their quantum replacement of classical mechanics was merely a procedure for making predictions about observable phenomena; by then arguing that no theory can be more complete *in this respect*; and, finally, by maintaining that theoretical efforts to do more than what this pragmatically successful set of rules can do take one outside the proper domain of science. Such endeavors were labelled "metaphysics", and were thereby officially transferred from physicists to philosophers..

Science and the Nature of Reality

A further problem with this pragmatic approach is that science is more than just an adjunct to engineering. The findings of science are important to us in many ways. The verdicts of science are accepted by the public, and by administrators, teachers, and officials, as truths about the nature of things, including ourselves and our relationships with the world about us. A science that consists merely of rules that mysteriously work, pragmatically, with no understanding of the underlying reality, is not a reliable source of information about, for example, the relationship of a person's mental self to the environment in which he is embedded. In the face of the silence of the quantum physicists about the nature of reality, the classical ideas, although known to be fundamentally incorrect, have nevertheless been generally accepted, even by neuroscientists, as the basic science-based conception of the mind-brain connection, in spite of the fact that quantum mechanics is a very different science-based theory of this connection..

In a broad context, a science that consists of merely a set of rules that mysteriously work, without any understanding of the reality behind those rules, is not good enough. Science is expected to be more than engineering, and it can be more. The immediate first task of bringing science to bear on the pressing empirical, philosophical, and moral issues of our times is to reconcile the science-based practical rules with a rationally coherent understanding of ourselves as parts of the basic psycho-physical reality.

Chapter 5: Orthodox Quantum Mechanics: The Observer's Free Choice and Nature's Random Choice

The Hungarian-American mathematician and logician John Von Neumann developed a formulation of quantum mechanics [2] that is called the "orthodox" interpretation. It is mathematically more rigorous and logically more cohesive than the original "Copenhagen" interpretation. It features a quantum state of the universe that represents all things composed of physically described quantum constituents, including, most importantly, our bodies and brains. The Copenhagen version had an imaginary boundary such that everything below the boundary was described in quantum mechanical terms, and everything above the boundary was described in classical physics terms. The orthodox version was constructed by pushing this Copenhagen boundary up until every physically described aspect of nature was shifted into the quantum mechanically described part. The remainder associated with any individual observer is called an "abstract ego", and is described in mental, or psychological, or experiential terms. This shift brings the formal structure into strict concordance with the successful rules of calculation that are the heart of quantum mechanics. These rules relate our empirical observations the physically described world.

This orthodox quantum mechanics has three important virtues, compared to the original Copenhagen quantum mechanics. First, it gives a rationally coherent objective description of the physical aspects of nature herself, rather than a mere set of computational rules that mysteriously allow us compute correlation between aspects of "our knowledge". In the orthodox theory the computational rules work because of the way that our subjective minds are connected to the objective physically described world. Second, the physically described aspect of the theory is consistently quantum mechanical in character, instead of being a hybrid quasi-classical description in which the visible aspects of sufficiently large objects miraculously acquire classical properties that contradict properties entailed by the quantum laws that govern their atomic constituents. Third, the theory automatically entails that the very same laws of mind-matter interaction that account for the success of the quantum mechanically computations pertaining to "our knowledge" explain also the causal influences of our mental intentions upon our physical actions, thereby nullifying the debilitating claim of classical mechanics that, in open defiance of the countless experiences of everyday life that provide the very foundation of our active lives, our minds can have no effects upon our bodily actions. Philosophers have spent three centuries desperately trying to reconcile that now-understood-to-be-false claim of classical mechanics with a rational approach to a productive life.

The Observer's Free Choice

According to orthodox quantum mechanics, every conscious observer experience is related to a physically described *probing action*. This physical action is *initiated by a mental intention of an agent*. In concordance with the ideas of Descartes, this physical action begins in the brain of the initiating agent, and extends to the rest of the body of this agent via the quantum mechanical physical laws. The mental intentions of agents are thereby enabled to influence the course of physical events in a way specified by the laws of quantum mechanics.

In quantum mechanics, in either its Copenhagen or Orthodox form -- but in contrast to the claims of classical mechanics -- the physical world does *not* determine what the impending mental choice will be. These initiating mental choices are called "free choices" to emphasize the important fact that they are not determined by any law or rule of the presently existing theory. Nor are they constrained by any known statistical rule.

The existence of these elements of freedom constitutes a 'causal gap' in the theory. It is this causal gap that allows our minds to influence the physical world in ways not predetermined by the prior physical world. Consequently, according to orthodox quantum mechanics, but in sharp contrast to the claim of classical mechanics, the mind-matter connection is not an action of the physical world upon passive minds. The causal flow is partially from mental to physical.

These probing actions, which play this essential dynamical role in the determination of our experiences, are generalizations of elements in Copenhagen quantum mechanics that were called "free choices" on the part of the experimenters. Von Neumann's analysis of the problem of measurement in quantum mechanics pushed these choices out of the physical world and into what he called an "abstract ego". The choices made by a human experimenter are, in the Copenhagen view, influenced by his scientific motives and intentions. In the orthodox view these free choices are, similarly, influenced by motives and intentions residing in an "abstract ego", here called the mind of the observing agent.

Quantum Mechanics and Mind-Brain Problem

This revised understanding of the mind-brain connection, though absolutely antithetical to the classical-physics understanding, is in very close accord with our common-sense understanding of ourselves, a circumstance that greatly facilitates applications of the theory.

"The overwhelming question in neurobiology today is the relationship between the mind and the brain." These are the words of Francis Crick [3], written about ten years ago. In the same venue, Antonio Damasio [4] writes that the mind-brain question "towers above all others in the life sciences".

Given this recognized major importance of the mind-brain problem, you might think that the most up-to-date, powerful, and appropriate tools would be brought to bear upon it. But the opposite is true. Most of the neuro-scientific studies of this problem are based on the precepts of nineteenth century classical physics, which are known to be fundamentally false. They have been replaced by a theory that pays detailed attention to the connection between the mind and the brain, and that basically reverses the direction of the causal flow. Yet this presumably highly pertinent replacement of the patently false and inadequate classical concepts is largely ignored by most neuroscientists and philosophers engaged with this problem. Their occasional references to quantum mechanics are concerned mainly with small-scale behavior at the molecular level, rather than with the main issue of the dynamical connection of the large-scale wavelike activities in a person's brain to that person's conscious thoughts.

The core problem is that most scientists and philosophers interested in the mind-brain problem tend to assume that the big "observable" aspects of nature can be described in terms of the concepts of classical physics, and that only tiny atomic-sized things need be described in terms of the concepts and laws of quantum physics. But, as emphasized by Einstein [5], big observable things are built, in a very important sense, out of small atomic-sized things. That idea is needed to explain various physical properties of big observable things, such as their rigidity and electrical conductance.

The Schroedinger Equation and the "Smearing" of Reality

Atomic-sized things normally evolve in accordance with a quantum generalization of the classical laws of motion called the *Schroedinger equation*. Using this equation, and treating big things as conglomerations of atomic-sized things, leads to one of the two core problems that need to be faced: big things generally evolve via the Schroedinger equation into "smears" of structures of the kind that we actually observe. The second core problem, non-locality, will be considered later.

A simple example of this smearing effect was described by Einstein [6]. Suppose a radio-active nucleus is surrounded by a detection device. Suppose that when the device detects the decay of the nucleus it causes a movable pen to make a blip on a moving scroll. The location of the blip on the scroll will then be a record of the time of the detection of the decay. Suppose, now, that the entire physical system evolves in accordance with the Schroedinger equation. Then the blip on the scroll will not be confined to a single location corresponding to some single definite time of the decay. The blip will, instead, be smeared out over a continuum of locations, with each such location corresponding to a different *possible* time of the decay.

Moreover, the brain of an observer who is looking at the scroll, in order to find out the time of the decay of the nucleus, will, according to a universally applied Schroedinger equation, evolve into a smeared out continuum of classically describable brain states, with each component of this smear corresponding to a different time of the decay. If mental experiences were to simply bubble up from corresponding activities of the brain, as they are imagined to do in classical mechanics, then the experience of the observer would be a continuous blur of the possible times of the decay, rather than the essentially one single time that would actually be experienced by a human observer in such a situation. Thus the unrestricted validity of the Schroedinger equation would lead to brain states that fail to correspond even roughly to the form of a human experience, where each visible object has a fairly well defined experienced location, rather than being smeared out over a large collection of distinguishable locations.

A second example mentioned by Einstein concerns a mouse and the moon. Suppose there had been, since the birth of the universe, nothing that interrupted its evolution in accordance with the Schroedinger equation. Then the quantum state of the moon would be smeared out over the entire night sky, until the first observer, say a mouse, looked. Indeed, the mouse itself would be a smear of possible mouse-copies, and the city it inhabits would be a smear of all possible cities, and similarly for the earth, for the solar system, for the galaxies, etc. etc..

Acts of Observation

To cope with the gross mismatch between actual human experience and the wave-like properties of the quantum world, the founders of quantum theory broke away from the basic precepts of classical physics. They introduced into the quantum dynamics "acts of observation", each associated with a psycho-physical part of nature identified as an observing agent.

Each such act is the initiation by the agent of a particular probing action. This probing action "puts to nature" a particular question. As in the game of twenty questions, each question is of the kind that is answered by either a "Yes", or a "No". (Multiple choice questions can be accommodated by successively decomposing answers "No" into a "Sub-Yes" and a "Sub-No" etc.).

Thus we have a question-and-answer scenario, where the questions are freely chosen. But what is the character of the process that delivers the *answers*?

Nature's Random Choices

According to quantum mechanics, the answer to the question is determined by "a choice on the part of nature". The answer "Yes" is revealed to the probing agent by the pertinent experience. For example, if the question is "Is that fire engine 'red'?" then nature's positive answer will be revealed to the agent by an experience of redness added onto the previously existing form of the fire engine. [In the version considered here, negative answers are not experienced. This allows many negative responses to occur between each positive response.} In any case, experienced reality is created by dialogs between localized probing agents and a global aspect of reality called "nature". The probing and answering processes have certain characteristic properties that will be discussed presently.

The agent's choice of question is, as mentioned, determined by no known rule, and is thus "free". But nature's choice of response is subject to certain definite conditions. According to the orthodox theory, Nature's choice is "random". This means that in each individual instance the answer is indeterminate, but that there are statistical conditions on long strings of instances. For example, the predicted ratio of answers "Yes" to answers "No" in a long string of effectively equivalent instances is, according to the theory, determined by mathematical properties of the physical state of the system being probed.

The infamous quantum element of "randomness" enters quantum mechanics precisely in this way -- and only in this way -- through statistical conditions on Nature's choices. Although the mathematically determined evolution of the physical state via the Schroedinger equation plays a very important role in quantum theory, the empirical content of the theory depends heavily on these two choices, the first of which is "free", and the second of which is "random".

The Role and Importance of Free Will

The linkage between the *free question* and the *random answer*, if straightforwardly interpreted in the orthodox way described by John von Neumann, ties the mental and physical aspects of nature into a single cohesive dynamically evolving reality, in which the mental actions of observers play a dynamically important initiating role.

But why should you care about such a recondite matter? Why does it matter whether you believe your mind to be a causally inert helpless spectator of a universe that evolves in a completely mechanical way, with no input from your conscious feelings and efforts -- as classical physics claims -- or whether your mind is, instead, an active participant in the psycho-physical process that creates your future?

The answer is that your belief about this matter can make a big difference in your life. As just mentioned, your conscious choices are "free". But that does not mean that they arise from nothing at all. It means, rather, that, since the physical laws are not coercive, there is room for mental causation. Rational arguments along the lines pursued by Schroedinger, outlined above, lead naturally, within a world governed by the quantum rules, to the conclusion that all of Nature, including our own mental aspects, must be part of one all encompassing mental whole, a conclusion that opposes, therapeutically, the materialist message that each of us is a separate and isolated hunk of mud; a pure accident of nature that, in some incomprehensible way, can think and feel. Perceiving oneself to be an integral part of the mental whole tends to elicit a feeling of connectivity, community, and compassion, with fellow sentient beings, whereas the materialist message of survival of the fittest tends to lead to selfish, and even hateful, actions. One's entire approach to life rests heavily on whether one views oneself, rationally, and in accord with all the empirical findings of science, as a fundamentally mental component of a mental whole, or an isolated piece of essentially mindless machinery, with an attached powerless mind that spins pure delusions.

The classical mechanistic self-image has a tendency to produce attitudes of resignation, depression, hopelessness, pointlessness, and amorality; whereas the quantum self-image, which makes your conscious efforts causally effective, tends to create a dynamic, elevated, hopeful, forward-directed, moral attitude. Recent experiments [Jonathan W. Schooler] reveal a positive empirical correlation between people's belief in free will and the morality of their actions. Quite generally your choices of your actions, and your outlook on life, depend strongly on your idea of yourself in relation to the reality that surrounds you.

Chapter 6: The Physical Effectiveness of Conscious Intent

Classical mechanics says your thoughts cannot affect the physical world: quantum mechanics shows how they can. It explains how something as unsubstantial as a mental intent can cause your arm or leg to move.

Your choices of which probing actions you perform, and when you perform them, are not determined by any quantum mechanical law: these choices enter the theory as *free choices*. Yet those free choices can profoundly affect your future experiences, and the experiences of those around you.

How can this come about? How can something as intangible as a thought, or a mental intention, move tangible objects such as your arms and legs. By what process can the motions of your fingers come to express the complex thoughts that you intend to express in written words?

The Quantum Zeno Effect

Within the orthodox quantum mechanical understanding of nature this physical power of your conscious thoughts can naturally arise from a well-known property of quantum mechanics known as the quantum Zeno effect. This effect is sometimes called the "Watched-Pot-Never-Boils Effect" and sometimes the "Watch-Dog Effect". The latter is more accurate. The basic idea is that a rapid probing of whether a system has a certain property that it originally had will tend to keep that property in place, even though it would rapidly change if it were observed only occasionally.

As an illustration of the watch-dog effect, consider a burglar standing at a gate, a house that he intends to burgle, and a watch dog, Fido, who is watching for the burglar. Fido first sees the burglar at the gate. This happens at time t=0. Then at time t=1 Fido poses the probing question: "Do I, Fido, see the burglar standing at the gate." If the answer is "Yes", which is possible, then Fido will perceive the burglar standing at the gate, and so will all passers-by. Fido can then at time t=2 again pose the same question, and may again receive the same response "Yes". This can be repeated at times t=3, at t=4, at t=5, and so on.

Quantum mechanics gives, under suitable conditions, the probability that, at time T, all of the answers are "Yes" for all times t less than or equal to T, but then a No at the first observation after T. This probability is 100% at T=0, and decreases as T increases, if the burglar, unobserved, would move. One can then ask: "What is the time T.99, such that this probability first falls to less than 99% ?"

The answer depends upon the details of the situation. But quantum mechanics makes a prediction that (under idealized perfect conditions) is independent of the fine details. If the times t at which Fido poses his questions are not {1, 2, 3, …} but rather {1/n, 2/n, 3/n, …} then as n gets bigger and bigger without limit, T.99 also gets bigger and bigger without limit. And this holds also in the case in which .99 is replace by .99999, or any other number less than 1.00.

This result means, roughly speaking, that increasing the repetition rate of the probing action, tends to keep exactly in place a particular physical that is being probed that is being repetitiously probed.

Templates for Action

A person's stream of conscious experiences might, in some circumstance, be focused on an intended bodily action. Suppose, for example, you are walking alone at night along a dark path, and a shadowy figure suddenly jumps out of the darkness. Will your bodily response be fight or flight? What goes on in your brain, and what role does your mind play?

It is reasonable to suppose that, in this situation, your quantum mechanically described brain will construct, via bio-physical processes, a quantum mixture of several patterns of neurological activity corresponding to alternative possible bodily responses to the situation. These patterns are called *templates for action*. If such a brain pattern is actualized and held stably in place for a sufficient period of time then it will send out a sequence of timed neural signals that will tend to produce both the chosen physically described action, and, later, an experiential confirmation that the chosen action has actually occurred, if it has indeed actually occurred.

But which of the two templates for action, fight or flight, will be actualized, and how is that pattern held stably in place, in case you really commit yourself to performing this action?

The Mind-Brain Connection

According to orthodox quantum mechanics these questions pertaining to the mind-brain connection must be answered by a combination of your free choices of probing actions and nature's (immediate) choice of response to each of your chosen questions.

The basic philosophical and scientific question is this: How is the connection established between a mental intention to do some envisioned physical action and the template for action that, if actualized and stabilized, can cause that action to occur.

The mental image of the intended action and its neurologically described counterpart are described in very different terms, and there is no intrinsic connection between the conceptual realms in which these two descriptions lie. So how does the mental image of the intended bodily action get hooked up to the pattern of neurological activity that will cause that intended bodily action to occur?

The lack of a *logical* linkage between the differently described mental and physical aspects of our understanding of nature has long been a core problem in philosophy. Classical mechanics renders a science-based non-mystical understanding of this question beyond reach, because it forbids what we think to affect what we do.

But given the quantum mechanical framework there is a natural way to establish the needed linkage: the mind-body entity that constitutes the person can learn, by trial-and-error, what the experiential responses to its various possible freely chosen probing actions are likely to be.

Beginning in the womb, the agent's mental aspect can begin to map out the experiential feel of the "Yes" responses to its various possible choices of probing actions.

On the basis of this "empirical" examination, the experiential responses to various consciously felt, freely chosen, probing actions, the agent can gradually acquire the knowledge it needs in order to select a template for action that is likely to achieve a mental intent. Then a commitment to actualizing this mental intent can activate a rapid sequence of probing actions that will hold the selected template for action in place by means of the quantum Zeno effect.

This scenario identifies a person's "abstract ego" with his mental self.

In a classical model, in which the brain simply creates a mental image, there is no comparable feedback loop. The brain could be creating a sequence of mental images that are completely off track – are completely unrelated to what is going on physically – and it would not affect the physical one iota: the brain would just do whatever the physical laws require it to do regardless of how off track the mental image or mental intent becomes. Because there is no natural correction mechanism, the classical materialist scientist/philosopher must just assume that God has arranged for this completely useless mental side-effect to occur, and stay in step with the physical, by supernatural fiat.

Orthodox quantum mechanics provides an escape from that classical absurdity. It provides a conception of reality that accommodates, in one rationally coherent package, not only the findings of atomic physics, in the mathematically rigorous formulation of von Neumann, but also a reasonable general account of how our minds are linked to our brains in a way that allows our conscious intentions to influence our bodily actions in the way that we mentally intend.

Chapter 7: Reality and Faster-Than-Light Transfer of Information

Spooky action at a distance

The non-material character of the universe is entailed by a bizzare property of nature called by Einstein "Spooky action at a distance". The empirical evidence for the actual existence of this property rests on experiments of a kind first performed in the early 1980s by Alain Aspect and his colleagues, and which are by now quite commonplace..

These experiments involve two measurements, one performed in each of two far-apart experimental regions during the same short interval of time. Under certain conditions the information about which experiment is freely chosen and performed in one region must become immediately present in the faraway region for the determination of the outcome of a companion measurement performed there. The existence of this "spooky action-at-a-distance" property is logically entailed by the validity of four elementary predictions of quantum mechanics. These predictions pertain exclusively to visible large-scale behavior of the measuring devices. These predictions have been empirically verified repeatedly in numerous experiments of this kind.

The key phrase "freely chosen" means that the choice of which large-scale measurement action is performed in the region can be selected whimsically by the experimenter, or by a quantum random number generator, or by any other process that, barring deep conspiracy, is effectively uncorrelated to the system being measured.

This near-instantaneous transfer of information about which large-scale physical action is chosen and performed in one region to a very faraway region rules out the possibility that the process by which nature selects outcomes is "purely physical" -- in any sense of the term "purely physical" that means understandable in terms the idea of a material universe in which any transfer of information must be transmitted by matter, or some other physical conveyance, that can move no faster than light.

A simple proof of this fundamental non-locality property of nature is given in Appendix 1. The logical need for this instantaneous transfer of information follows merely from the validity of the four empirically validated predictions of quantum theory, coupled with the idea that the "free choices" made by experimenters, about how to orient their measuring devices, can be treated as free variables. Although the predictions were derived from microscopic consideration, there is absolutely no reference in the proof to any invisible substructure. The conclusions are derived from, and pertain to, large-scale visible, actions of devices, or, more precisely, to our observations of what appear to us to be activities of measuring devices.

Quantum dynamical origin

The dynamical origin of the non-locality property, within the quantum mechanical formalism, is the fact that quantum state of the universe is defined essentially at each instant of time (or a simple relativistic generalization) and it represents the physical state of affairs over all of space at that instant of time. If, at some moment, nature makes a choice of response to a probing action localized in some confined spatial region then, according the basic rules of quantum mechanics, the quantum state changes not just in that local region, but over all of space at that instant of time. This abrupt change is called a "collapse" of the wave function, or a "reduction" of the quantum state.

Under appropriate experimental conditions, this collapse abruptly changes aspects of the quantum state that are located in a very faraway spatial region, where another experiment is just about to be performed. Thus nature's choice of which outcome appears in one region can, *according to the standard quantum rules*, instantly change the physical state of affairs in that faraway experimental region. Here "the physical state of affairs" is whatever it is that the quantum state represents.

Evasion via pragmatism

This theoretically explicit, and essentially instantaneous, transfer of information between two far-apart experimental regions poses an immediate seeming conflict with Einstein's two theories of relativity, which limit the motion of physical matter, and hence also the physical transfer of information, to the speed of light. The founders of quantum mechanics did not want to admit or suggest that, in defiance of the theory of relativity, information could *really* be transmitted faster-than-light. Hence they evaded the issue by adopting the pragmatic position that the "physical state of affairs" represented by the quantum state was not a representation of physical reality itself, but was something more akin to knowledge than to classically conceived matter. Being also unwilling to defend the idea that the physical state represents some absolute, objective kind of knowledge, which would mean a retreat to an "idealism" deemed antithetical to science, the founders adopted the position that the quantum mechanical state was merely part of a practical procedure for making predictions about upcoming empirical findings. Thus no claim was made that the quantum mechanical state represented "reality": any such claim would generate an immediate conflict with Einstein's claim that no "real" faster-than-light transfer of information is possible.

That official position is a half-way house to idealism. Yet in spite of such metaphysical posturings and cloakings, pertaining to the reality-status of the invisible quantum mechanical state, there are the predictions about the visible macroscopic actions of the experimenters and their experienced observations. Hence the question becomes: what can be proved from these predictions themselves, without reference to any invisible theoretical substructure. That is the context of the proof mentioned above of the existence in the quantum world of essentially instantaneous transfers of information, and consequently the failure of the materialist conception of nature.

EPR

The presumed failure of this spooky property was the basis of an effort by Einstein to prove that quantum mechanical description could not provide a complete description of physical realty. In 1935 he wrote, in collaboration with two young colleagues, Boris Podolsky, and Nathan Rosen, one of the most renowned scientific papers of all time [7]. Entitled "Can Quantum Mechanical Description of Physical Reality Be Considered Complete?", it is usually identified by the initials EPR of its three authors. It *assumes,* in concordance with the theory of relativity, that information cannot be transferred faster than light, and then argues that quantum mechanical description cannot be a complete description of physical reality itself.

Bohr's response to EPR

A possible easy response to EPR by the founders would be simply to admit that quantum mechanical description does not describe physical reality itself. However, a simple response of that kind would have sparked, among scientists that aspire to be more than high-level engineers, efforts to find a more complete theory. That is exactly what Einstein believed scientists interested in basic questions ought to be doing, but what the founders of quantum mechanics believed productive scientists ought not to be doing. Thus Niels Bohr, the senior founder of quantum mechanics, chose to answer EPR by focusing on the slippery question of what constitutes physical reality.

What, exactly, is "physical reality"? A logically sound argument pertaining to "physical reality" requires giving some definite meaning to that phrase. But our ideas about physical reality are deeply influenced by our experiences of the world around us, which *seem* to conform to the principles of classical physics. Thus any proposed characterization of physical reality is in jeopardy of being challenged as resting on intuitive classical ideas alien to the quantum precepts, and hence as being prejudicial: as begging the question.

The EPR paper was erected, therefore, *not* upon some notion of "physical reality" that could be attacked as obscure, unscientific, or question-begging. It rested on the demand -- enshrined in Einstein's theory of relativity -- that information cannot be transmitted faster than light. The opening for using this demand was slipped by EPR into their famous "criterion of physical reality", which asserts that "If, without in any way disturbing a system, we can predict with certainty (i.e., with probability unity) the value of a physical quantity, then there exists an element of physical reality corresponding to that quantity." The requirement "without in any way disturbing" was met by considering situations in which the possible disturbance would require faster-than-light action. EPR were then apparently able to conclude that a certain two properties were both physically real, a possibility that the principles quantum mechanics forbad.

Of course, an alternative conclusion would be that faster-than-light actions can occur!

Most of the EPR argument was straightforward physics and not open to challenge. But it depended upon one metaphysical element, the EPR Criterion of Physical Reality, which begins with the words, "If without in any way disturbing a system …"

Bohr [8] attacked this metaphysical element of the EPR argument. He says

"Of course there is in a case like that just considered no question of a mechanical disturbance of the system under investigation during the final last critical stage of the measuring procedure. But even at this stage there is essentially a question of *an influence the very conditions which define the possible types of measurements regarding the future behavior of the system.* Since these conditions constitute an inherent element of the description of any phenomena to which the term 'physical reality' can be properly attached, we see that the argumentation of the mentioned authors does not justify their conclusion that quantum mechanical description is essentially incomplete."

Bohr went on to argue that quantum mechanics was *pragmatically* complete, which, in the end, is what matters most to most physicists, who could now, if challenged about the failure of science to talk about physical reality, refer to Bohr's reply to the EPR argument pertaining to that issue.

Notice that the EPR argument is based on the matter-related assumption that, in reality, information, cannot be transferred faster than light; whereas Bohr's argument is based on the *pragmatic* idea that our understanding of nature be based, not on matter, but on knowledge, and to the possibilities of future knowledge. So the conflict came again down to the question of the proper foundation of science: the materialistic concepts of the classical physics stemming from the work of Isaac Newton; or on our observation-based knowledge, as proposed by David Hume, along with many others. Yet in spite of this fundamental disagreement, the two protagonists appeared to agree on one key point: there could be no *real* transfer of information faster than light. The now-known failure of that notion rules out the materialist possibility, and allows Bohr's reply to be upgraded from an evasive pragmatic position to a straightforward ontological knowledge-based position spelled out by von Neumann.

Bell's Theorem and the Non-Material Nature of Reality

Historically, the controversy lay semi-dormant -- with practicing physicists generally siding with the pragmatic position of Bohr -- until John Bell wrote a paper [9] based on the notion of "hidden-variables". Bell's hidden-variable approach added to the assumptions of the predictions of quantum mechanics, and the notion of free choices, the assumption that, in general concordance with Einstein's essentially materialist position, there was an underlying invisible substructure that accounted for our observations, but permitted no transfer of information faster than light. These assumptions led to a logical contradiction!

That conclusion delivers a knock-out blow to Einstein's essentially materialist world view, insofar as one allow the applicability of the requirement free choice, which all parties had agreed should be applicable to the experiments in question..

On the other hand, that hidden-variable approach completely begs questions about the locality properties *of quantum mechanics itself*, by demanding consistency with an essentially classical idea that is completely alien to the basic precepts of quantum mechanics. Thus Bell's hidden-variable-based theorems do not prove, or aspire to prove, that faster-than-light influences are required merely by the validity of the macroscopic predictions of quantum mechanics, together with the notion of free choices that Bohr, Bell, and EPR all embraced.

In contemplating these matters it is important to recognize that the mere existence of correlations between outcomes in two far-apart regions does not entail faster-than-light transfer of information. Such correlations might be created simply by transfers of correlated information from a common origin in the past. For example, sending correlated pairs of billiard balls, one black and one white, to the two regions allows an observer who sees the ball in his region to "predict with certainty" the color of the paired ball in the other region. This capacity of an observer in one region to instantly know the color of the faraway ball is not a "spooky action at a distance" of the kind that Einstein objected to, and that the EPR argument assumed did not exist. But the mere existence of this seemingly analogous case tends to becloud the essential point, which is that rational coherence can achieved by replacing the essentially classical Einsteinian materialist conception of reality by a knowledge-based conception. The materialist approach leads to logical inconsistencies, whereas the knowledge-based approach leads to a rationally consistent idea of reality that is, moreover, in line with our intuitive and important belief that one's mental intentions can influence one's experienced future..

Neuroscientists and philosophers who base their attempts to understand the connection between mind and brain on the precepts of materialistic nineteenth century classical physics might consider taking account of the tremendous transformations in basic science that occurred during the twentieth century, which is basically a radically revised conception of the relationship between mind and brain.

Chapter 8: Backward-In-Time Causation?

The recent experiments mentioned at the outset appear to involve backward-in-time causation: the effects of events occurring at one time on what already happened earlier. But asserting that what happened in the past did not happen in the past violates laws of logic. Such a blatant irrationality has no place in science.

Experiments that seem to involve backward-in-time causation have already been encountered in quantum physics, and they have been resolved without introducing any real backward-in-time action. It is instructive to see how this was achieved in the earlier cases.

Delayed Choice Experiments

John Archibald Wheeler [10] described an experiment that seemed to show that an experimenter's free choice about which experiment he or she performs at one time can affect what happened at an earlier time. The essential point can be illustrated by the following idealized version.

Suppose you have acute vision and can detect individual photons falling upon your retina. Imagine that you are looking through one eye at a screen with two small holes through which light of a visible frequency is passing. Quantum mechanics says that if you focus your vision on the screen, and the light is sufficiently weak, and your vision is sufficiently acute, you will see the individual photons passing essentially one at a time through either one hole or the other. But if you focus, instead, on a location far behind the screen then the photons will still come one at a time, but will build up an interference pattern that depends on the distance between the two holes, showing that the light associated with each individual photon has, in some sense, passed through both holes: what happens earlier at the screen seems to depend on what you choose to do later.

Essentially the same experiment can be performed with devices that act so fast that the choice between the two alternative possible observations can be made after the photon has passed through the screen. Thus it would appear that, in some sense, the photon either passes exclusively through one slit or the other, but not both; or, alternatively, through both together, depending on which kind of observation was chosen *after the photon has already passed through the screen.*

This kind of experiment is called a "Delayed Choice" experiment, and various refinements of it have been designed and successfully carried out by Scully and colleagues [11]. The observed phenomena certainly conform to the just-described predictions of quantum theory, but the causal implications need further discussion.

The “Bohmian” Approach

For example, one way to understand quantum mechanics, favored by some physicists, was proposed in the early days of quantum mechanics by Louis de Broglie, then pretty much abandoned due to criticisms by Pauli, but resurrected and developed by David Bohm [12] in the 1950s. This way of understanding the success of quantum mechanics asserts that there really is a classical-type world of tiny particles, but *also* a wavelike quantum state of the universe that evolves *always* in accordance with the Schroedinger equation, and hence never “collapses” in association with an increase in “our knowledge”, as specified by both the Copenhagen and Orthodox versions of quantum mechanics. In Bohm’s no-collapse quantum mechanics the function of the wave is to “guide” the particles, which are assumed to be the aspects of nature that control our conscious experiences.

In this “Bohmian” model of reality the changes made in the focusing of your eyes influences the evolution of the quantum wave within your eyeballs, and this influences the trajectory of the photon (particle of light) *when it reaches your eye*. This theory correctly accounts for the phenomena without invoking any notion of backward-in-time action or causation.

This Bohmian approach fails, however, to adequately resolve the measurement problem. It fails to bring in the crucial elements of discreteness and definiteness that the Copenhagen and orthodox interpretations bring in via the experimenters’ free choices. These choices pick out discrete aspects of nature that will be either actualized or rejected by nature’s choice. The Bohmian treatment of the measurement process assumes that some particular measurement setup is in place, whereas in a world described by a quantum state that never collapses, no such discrete setup exists: the conditions for the applicability of the quantum rules for making predictions about observations are never satisfied. It is the essential definite choice of a specific probing action that, in orthodox quantum mechanics, sets the stage, mathematically, for the logically subsequent statistically conditioned choice on the part of nature. Without the prior choice of probing action the quantum mathematics cannot be applied.

On the other hand, the results of delayed-choice experiments are neatly explained within forward-in-time orthodox quantum mechanics. But this orthodox explanation involves two different conceptions of the past.

Chapter 9: Actual Past And Effective Past

Orthodox quantum mechanics is based on a forward-in-time process that creates an *actual past* that continually grows, and is never revised. But it creates also, at each collapse, a new *effective past*.

The point is that, insofar as expectations about future events are concerned, one must take into account what has just happened. But what has just happened has, according to the orthodox *collapse* interpretation, created a new state. This new physically described state is the state that controls the potentialities for the upcoming observational events. This pertinent-to-the-future state is, due to the collapse that has just occurred, not the smooth continuation of the prior state. Consequently, as regards future expectations, the actual past, though it did indeed exist, and was never revised, does not give the pertinent conception of the past that is relevant to the future. The pertinent conception of the past, namely the one that gives valid predictions about the future, is the "past" that smoothly evolves, according to the continuous laws of motion, into the quantum state that has just been created. This *causally pertinent state of the past* is called the *effective past*.

This important aspect of quantum mechanics is succinctly captured by an assertion made in the recent book "The Grand Design" by Stephen Hawking and Leonard Mlodinow: "We create history by our observations, history does not create us" [13].

According to orthodox quantum mechanics, we do indeed create, by our observations, the history that is relevant to our future. Moreover, the effect upon the effective past of the current observation is global. The "choice on the part of nature" that fixes what has just happen here can instantly change the predicted probability for an impending faraway event.

The rules of (relativistic) quantum (field) theory do ensure, however, that this instantaneous effect can never be used to send a *sender-controlled message* faster than the speed of light. Hence Einstein's claim of no-faster-than-light transfer is in fact satisfied, insofar as what is transferred is "sender-controlled information", not information pertaining to nature's choice, which the sender does not control. Care must therefore be taken to make distinctions that have no counterpart in the simpler classical mechanics.

Consider now the delayed choice experiment. At the moment that the pulse of light is passing through the holes, the quantum wave that represents the light is divided between the two holes. If, at a later time, the observer sees the photon coming through the left-hand hole then, according to the rules of orthodox quantum mechanics, a global collapse will occur: the parts of the quantum state incompatible with that observation will be obliterated. The new state, representing the potentialities for the future experiences of all observers, will be the continuation into the future of the surviving part of the prior state. *The continuation of the new state backward in time, using the Schroedinger equation in reverse, is the effective past.* It is, as Hawking and Mlodinow state, created by our observations. All future experiences of all observers will be concordant with the new "empirical fact" that the photon was seen by some observer to pass through the left-hand hole.

The evolving situation during the time that the pulse of light was passing through the screen was that the wave was passing through both holes. That fact is fixed and settled: it is never revoked. But if the observer poses the question do I see the light coming through the left-hand hole, and nature's response is "Yes", then the quantum state collapses to the part compatible with the observer's experience. This state, extended backward in time via the Schroedinger equation acting in reverse will have the light wave passing through the left-hand hole, and the effect of this observation and reduction will be incorporated into all future experiences of all observers. This is all neatly captured and represented in von Neumann's mathematical rules.

This orthodox way of understanding the apparent backward-in-time effects uses only strictly forward-in-time evolution of the quantum state. It achieves an explanation of apparent retrocausation by using the orthodox rules. Some of these rules lead to the continual generation of smears of alternative classically conceivable, but mutually incompatible, possible worlds. Other orthodox rules govern the collapses of this evolving quantum state. These collapses systematically trim away the branches of this growing quantum state that become irrelevant to the future. These branches have become irrelevant to the future because they led to possibilities that were probed by observing actor/agents, and were caused not to occur by the associated choice on the part of nature.

Each such collapse, although precipitated by the probing action of some localized observer, is a global event. It instantly alters the aspects of the quantum state that pertain to observations just about to occur in faraway regions. This instantaneous effect was called a "spooky action at a distance:" by Einstein because it is incompatible with the notion that causal connections are carried by material conveyances.

Chapter 10: The Principle of Sufficient Reason

There is one aspect of contemporary quantum theory that I have long regarded as unnatural and unreasonable: its violation of the Principle of Sufficient Reason. This principle asserts that nothing happens without a sufficient reason: no definite fact can just pop out of the blue, with no reason at all to be what it turns out to be. This principle is often ascribed to Gottfried Leibniz, who Bertrand Russell called "one of the supreme intellects of all time". But the first recorded statement of this principle in Western Philosophy was by the Ionian philosopher Anaximander of Miletus. Thus this principle has a long and distinguished philosophical lineage. Demanding that quantum mechanics should honor this principle is neither unnatural nor unreasonable.

The feature of quantum mechanics that violates this principle is the notion that nature's choices of what actually happens are purely random. This is the idea that the rules of quantum theory specify the "probability" that a particular event will occur under specified conditions, but what actually happens in any individual case is determined by absolutely nothing at all!

It is, of course, completely reasonable that a *pragmatic* theory should be basically statistical. Such a theory is designed to make practical predictions about what will happen in a real situation, where many pertinent facts may be unknown to the user of the theory. But a theory that aspires to be a rationally coherent description of reality itself should, in my opinion, not have things suddenly become definite with no reason at all to be what they turn out to be.

Orthodox quantum mechanics, as I construe it, aspires to provide a rationally coherent description of reality. Thus, on the basis of the Principle of Sufficient Reason, it is completely natural and reasonable to suggest that, contrary to the usual precepts of strictly orthodox quantum mechanics, nature's choices are not fundamentally random, but have sufficient reasons to be what they turn out to be. Bem's empirical findings provide statistically significant scientific support for this possibility.

Chapter 11: Questions And Answers About Minds

The first question is: Why bring mind into the dynamics as an independent variable instead of allowing all mental properties to be determined by physical properties as in classical physics?

The ultimate reason is that we need, for the rational conduct of our lives, a rationally coherent conception of ourselves that is compatible with validated scientific findings. Within the context of classical mechanics there is the "two hats" problem. The classical-minded scientist in the laboratory, with his scientist hat on, believes that he is a mechanical automaton deluded by the illusion that his mental intentions can influence his physical actions. But when he steps outside the lab, he puts on another hat: he must now act on the belief that his mental efforts can make a difference in what happens. Thus the classical-minded scientist lacks a single rationally coherent world view that he can live by. Moreover, his science-based conception of himself is based on a classical-physics foundation that is now known to be false.

The basic rational reason for bringing mind into our scientific account of nature is that science is a road to understanding that is based on empirical knowledge, not mere philosophical speculation. Thus an adequate scientific account of reality needs to include an account of our growing body of knowledge. We do not know, a priori, how our knowledge fits into the total picture, but quantum theory starts with the premise that the theory must contain an account of our acquisition of knowledge about the parts of nature that the theory describes in physical terms, rather than in mental terms. How is "our knowledge" connected to the physically described aspects of nature? That is a core question addressed by quantum mechanics, but given no satisfactory answer by classical mechanics.

The short answer is that we bring in mind because what we know is lodged in our minds.

The alternative approach is to accept as an unresolved mystery the fact that our mental experiences are connected to the physically described aspects of nature, but to claim that large objects somehow *physically* acquire certain definite classical-type properties, and that our minds then merely grasp these already determined classical properties, rather than entering into the determination of these properties, as they do in von Neumann's formulation of quantum mechanics, in close concordance with Heisenberg's assertion that "Reality is in the observations, not in the electrons."

The wide-spread belief that quantum mechanics allows, in a rationally coherent way, the concepts of classical mechanics to hold at the level of visible physical properties conflicts with basic precepts of quantum mechanics! As shown in Appendix 1, certain quantum precepts entail, *strictly within the realm of pertinent visible properties*, the existence of "spooky action at a distance": instantaneous transfers of information that cannot be conveyed by classically conceived matter.

The second question is: How do you account for data that seem to show that an associated brain action precedes the mental act of consciously willing one's finger to move?

Before a person can initiate a contemplated action there must be a brain representation of the contemplated action. This is the readiness potential, which exists before the decision to act is made. It was emphasized by William James that the actual action does not occur until a "consent" is given. Benjamin Libet says that this permission takes the form of a withholding of a "free won't": there is a short window of time between the appearance of the readiness potential, but before the bodily action occurs, during which consent must be given or withheld.

There is also in orthodox quantum mechanics a seeming action backward in time, associated with the distinction between actual past and effective past discussed above. In the lead-up to the raising of the finger, the actual past can be filled with a whole series of possible "readiness potentials", most of which will never be actualized. When the final choice is made to move, there will be a collapse of the effective past that will actualize, for future experience, the particular readiness potential that leads to the movement that actually occurs.

The third question is this: Mind is elevated to a basic role in your quantum view of reality. How do you distinguish those views from: Western idealists such as Berkeley; and from Eastern philosophies, based on Buddhist & Hindu teachings?

Quantum mechanics grew out of the work of Isaac Newton, who focused on the physical side of Descartes' dualism. Thus it rests upon, and gives a highly accurate account of, a vast store of accumulated empirical data about the physically described aspects of reality. Berkeley's idealism focused on the mental side of Descartes' dualism, and thus lacks the capacity to reply adequately to Samuel Johnson's famous refutation: Kicking a rock he proclaimed, "I refute it thus!" Although both of the two approaches end up in a similar idealistic stance, quantum mechanics is able to explain in terms of detailed physical laws why Johnson's boot did not penetrate the rock; while a Berkeley-type reply, probably about the will of God, is relatively lame.

A reply based on Buddhist or Hindu teachings is, similarly, far less potent than a reply based on experimentally tested and validated science-based laws of physics.

The fourth question is: If mind is an important aspect of reality, then what do you say about the world before the emergence of life?

This question moves us outside the realm of what we know about reality -- by virtue of experimental examinations of many specimens -- into the domain of cosmology. An important issue in cosmology is the "anthropic principle", which pertains to the fact that a number of seemingly arbitrary physical parameters, such as the charges and masses of physical particles, and the strength of gravity, must be very close to their observed values in order for life to be possible.

The standard scientific explanation, today, is that huge numbers of universes are created, with varying values of these parameters, and, by chance, there are ones with just the right values to support life, and that we must, of course, be in one of those. Before the first abstract ego appears, the universe of orthodox quantum mechanics simply grinds out potentialities.

Orthodox quantum mechanics is, however, essentially a minimalist account: it makes the minimal assumptions needed to give an adequate rationally coherent realistic account of the empirical phenomena. It brings in a process or agency called "nature" that has global access to information, and the power to convert potentialities to actualities, but limits her activities to responses to questions posed by "abstract egos". If, as the Bem experiments suggest, nature has preferences pertaining to human experiences, then it would not be out of character if nature did not restrict her actions to this minimal involvement. A search for evidence that might support this possibility would be the scientifically proper way to examine this issue.

Chapter 12: Conclusions

The overall effect of intense twentieth century efforts to bring physical theory into concordance with empirical findings was to reverse the previously believed causal primacy of the physical over the mental. Our mental aspects were elevated, within the standard formulation of quantum mechanics, from causally inert by-products of physical brain activities to active participants in the unfolding of a psycho-physical reality.

The big problems of the connection between mind and brain, of free will, of the capacity of mental intention to influence bodily action, of ghostly action at a distance, and of the rational foundations of morality and compassion, have been addressed within the orthodox quantum mechanical conception of reality, which is built directly upon the empirically validated computational rules of quantum mechanics. These quantum rules account accurately for the great successes of the prior physical theory, classical mechanics, while eliminating its major liability, namely its claim that your mental efforts cannot affect your physical actions

As regards the connection between mind and brain, the classical dogma that our classically conceived brains can -- in some incomprehensible way -- produce something of a logically different nature, thoughts, that can neither aid our survival, nor allow us to improve the world for others, is revoked. It is replaced by an understanding of how a person's mental aspect engages nature by initiating probing actions, to which nature responds with a psycho-physical action that produces related consequences in the mind and the brain of the inquiring person. As emphasized by Niels Bohr, this change converts man's science-based self-image from that of a passive spectator of an independently evolving physical world to that of an actor and spectator in the drama of existence. Orthodox quantum mechanics thus endows us with powers and emotions that make life sensible and worth living.

This science-based conception of the nature of the human person is concordant with our deep-seated intuition about our own personal nature. But the quantum conception of nature entails relinquishing the notion that concepts of classical mechanics hold at the macroscopic level of visible actions and appearances: the existence of "spooky actions-at-a-distance" rules out the relativistic conception of a material universe, and the evidence for these spooky actions resides in the realm of macroscopic phenomena.

Bem's empirical findings suggest that nature may be more responsive to our mental aspects than has been assumed, a possibility that needs to be further examined.

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Appendix 1: Proof That Information Must Be Transferred Faster Than Light

David Bohm described in his 1951 book, *Quantum Theory*, an experiment much more practical than the one considered by Einstein, Podolsky, and Rosen. This Bohm experiment, together with a similar one involving photons (light quanta) instead of spin-1/2 particles, has been the basis of most of the subsequent experimental and theoretical work pertaining to the faster-than-light question.

The physicist is thinking, in the design of the experiment, that the initial preparation procedure will produce a pair of tiny invisible particles. These two particles will be sent in opposite directions to two faraway experimental regions. Each of these experimental regions contains two detection devices. Each device will produce a visible signal if the invisible particle reaches it.

Each region has a preferred axis that is perpendicular to the common initial line of flight of the two particles. The two detectors in each region are displaced from the line of flight in opposite directions along the preferred axis for this region. Thus the location of each detector can be specified by an angle Φ that specifies the *direction* of its displacement away from the common initial line of flight of the two particles. Clearly, the two angles Φ that specify the locations of the two detectors in a region differ by 180 degrees.

Under these conditions, quantum theory predicts that, if the detectors are 100% efficient, and if, moreover, the geometry is perfectly arranged, then for each created pair of particles, exactly one of the two detectors in each region will produce a signal (fire). The key prediction is that the fraction F of the pairs for which the detectors that fire in the first and second regions are located at angles Φ1 and Φ2, respectively, is given by the formula $F = (1\text{-}Cosine(\Phi1\text{-}\Phi2))/4$.

For example, if the locations of the two detectors that fire are both specified by the same angle, Φ1 = Φ2, then, because *Cosine 0 =1*, for each created pair these two specified detectors will *never* both fire: if one of these two specified detectors fires, then the other will not fire. If Φ1 is some fixed angle and Φ2 differs from it by 180 degrees then, because *Cosine 180 degrees* = *--1*, these two specified detectors will, under the ideal measurement conditions, fire together for *half* of the created pairs. If Φ1 is some fixed angle and Φ2 differs from it by 90 degrees then these two specified detectors will fire together for ¼ of the pairs. If Φ1 is some fixed angle and Φ2 differs from it by 45 degrees then these two specified detectors will fire together, in a long run, for *close to 7.3%* of the pairs. If Φ1 is some fixed angle and Φ2 differs from it by 135 degrees then these two specified detectors will fire together, in a long run, for *close to 42.7%* of the created pairs.

I have listed these particular examples because they enter into the following proof, which shows that the *locality hypothesis* -- that information cannot be transferred faster than light -- is logically incompatible with the validity of these four empirically validated predictions of quantum mechanics, in a conceptual framework that includes the quantum mechanical precept of "free choices".

This idea of "free choices" is that the choice made by the experimenter about which probing action (which measurement) will be performed can be regarded as a free variable whose input into the dynamics is localized in the space-time region where the experimenter's action occurs. My claim is that, in a quantum framework that allows (in the analysis of these experiments) the choices made by experimenters in the two space-time regions to be regarded as free variables, the validity of the (empirically validated) predictions displayed in Diagram 1 is logically incompatible with the Locality Hypothesis, LH, that, for each of the two space-time regions, the information about which experiment is chosen in that region cannot get to (be available in) the other region.

The two regions can be *very* far apart, and the two experimental region relatively tiny, and essentially simultaneous. So what the Locality Hypothesis LH forbids is an essentially instantaneous availability in one experimental space-time region of the outcome of the free choice made in the other space-time region. The laws of physics forbid any material conveyance of this information. Thus we are confronted by the logical need for "spooky action at a distance".

The experimenter in the first region chooses between two experimental setups. In the first setup the two displacements are "up" ($\Phi 1=90$ degrees) and "down" ($\Phi 1=-90$ degrees). In the second possible setup in the first region the displacements of the two detectors are "right" ($\Phi 1=0$ degrees) and "left" ($\Phi 1 = 180$ degrees). In the first possible experimental setup in the second region the displacements of the two detectors are "up" ($\Phi 2= 90$ degrees) and "down" ($\Phi 2= -90$ degrees), respectively. In the second possible setup in the second region the displacements of the two detectors are specified by $\Phi 2= 45$ degrees and $\Phi 2=-135$ degrees. These angles deterrmine the 16 numbers appearing in the sixteen little boxes in diagram 1. The number in a box is the predicted most-likely number of pairs that will satisfy the condition specified by its row and column for an experiment in which the total number of pairs is 1000. For each of the four alternative possible experiments the 1000 pairs will be distributed among the four alternative possible outcomes of that experiment.

Diagram 1

	↑	↓	↗	↙
↑	0	500 A	73	427 B
↓	500	0	427	73
→	250	250 D	73	427 C
←	250	250	427	73

In Diagram 1, the first and second *rows* correspond to the two detectors in the first setup in the first region. The third and fourth rows correspond to the two detectors in the second setup in the first region. The four *columns* correspond in the analogous way to the detectors in the second region. The arrows on the periphery show the directions of the displacements of the detectors associated with the corresponding row or column. [The number, 1000, of created pairs can be increased to, say, a billion, with the number in the box the number of millions, in order to decrease the expected statistical error. So we can assume that the numbers in the boxes are essentially accurate. These predicted fractions have been empirically validated to high accuracy in scores of very high quality experiments.]

The argument then goes as follows. Let the pairs in the ordered sequence of the 1000 created pairs be numbered from 1 to 1000. Suppose the actually chosen pair of measurements corresponds to the first two rows and the first two columns in the diagram. This is the experiment in which, in each device, the displacements of the two detectors are "up" and "down". Under this condition, quantum theory predicts, and experiments can confirm, that some particular 500-member subset of the full set of 1000 created-and-sent pairs are such that the outcomes conform to the condition associated with the little box labeled A. The corresponding 500 member subset of the full set of 1000 integers is called Set A. This Set A is specified by a string of 500 integers, all less than 1001. The first 4 elements in this Set A might be, for example, {1, 3, 4, 7}.

If, at the last minute, the free choice in the second region had gone the other way, then the prediction of quantum mechanics is that the thousand integers would be distributed among the four little boxes that lie in one of the first two rows and also in one of the last two columns, with the number of integers lying in each of these four boxes (or, equivalently, the number of pairs assigned to this box) being the number written in the box in the diagram.

But if we now add the locality condition, then the demand that the macroscopic situation in the first region be left undisturbed by the reversal of the free choice made by the experimenter in the second (faraway) region means that set of integers in Set A must be distributed between the two little boxes standing to the right of the little box A. Thus the Set B, consisting of the integers in box B, would contain 427 of the 500 integers in Set A. This assertion is analogous to the EPR assertion that changing the experimenter's choice in one region leaves the situation in the other region undisturbed.

Given this condition on what would have happened if the choice in the second region had gone the other way we can inquire next about what would have happened if the choice in the first region had gone the other way, and can conclude, by virtue of the locality hypothesis, that the integers in box C, must include at least 427-73=354 of the integers in the set A, which are specified by what actually happened.

If we repeat the argument, but reverse the order in which the two reversals are made, then we can conclude, from the same line of reasoning, that the number of elements in Set C that belong to Set A can be no greater than 250. Thus the conditions on Set C that arise from different orderings of the two reversals are contradictory!

The key assumption is again the locality hypothesis that the outcome that appears in a region (in this case the first region) cannot depend upon which experiment the experimenter in the faraway region chooses to perform. For this requirement means that the 250 elements of set D must be distributed among the two boxes standing to its right, one of which is box C.

In the argument given above there is a reversal, in each of the two far-apart regions, of the original choice of which of two alternative possible experiments is performed in that region. A contradiction is established between the consequences of the two alternative ways of ordering these two reversals. Because, according to the locality hypothesis being examined, no information about the choice made in either region is present in the other region, no information pertaining to the order in which the two experiments are performed is available in either region. Hence nothing pertaining to outcomes can depend upon the orderings of these two reversals.

This argument refers only to empirically validated macroscopic predictions of quantum mechanics -- without any reference to any micro-structure from whence they came, *or to any other assumption about micro-structure* -- to demonstrate the failure of the hypothesis of no faster-than-light transfer to an experimental region of the information about which of the two alternative possible measurements is freely chosen and performed in a faraway experimental region.

This argument does not go through if one considers the four experiments considered by EPR, whose argument depends both on some characterization of "physical reality", and also on some conflict with ideas about the details of the quantum formalism. It also does not depend upon extra "reality" conditions imposed by demanding that the predictions be compatible with a "hidden-variable" condition. The locality hypothesis is stated directly in terms of the condition that information about a free choice made in one region cannot be instantly present in a faraway region.

The situation can be described in more picturesque language. Suppose a preparation is carried out in a central region, and measurements are then carried out in two far-apart regions L and R. Suppose the preparation consists of 1000 instances (pairs) numbered from 1 to 1000. Suppose, for each instance, the observer in each region can choose to measure either "color" or "shape", but not both. Suppose that if he measures color then he finds, in each instance, either "yellow" or "blue", and if he measures shape he finds, in each instance, either a "sphere" or a "cube". Thus in Diagram 1 we now have along the top not arrows, but, reading from left to right, Y, B, S, C; and along the left side, reading from top to bottom, the same sequence.

To make the situation even more clean, without changing the principles, let the two numbers 427 be changed to 500, and the two numbers 73 be changed to zero. Then, for each individual pair, if color is measured in both L and R, then Yellow in one region entails Blue in the other region and Blue in one region entail Yellow in the other: the two colors are exactly anti-correlated in each individual instance. Similarly, if shape is measured in both L and R, then the two shapes, Spherical and Cubic, are exactly anti-correlated for each individual pair.

If one now adds the condition that the change in what is measured in one region leaves undisturbed the outcome observed in the other region, then one can conclude that, in each individual pair, finding the color Blue in a region if color is measured logically entails finding a Cube if shape instead of color were to be measured in that region; and finding Yellow if color is measured in a region logically entails finding a Sphere if shape instead of color were to be measured in that region.

This result is exemplified by the fact that if in a particular instance, the outcome of a color-color measurements is specified by little box A, then if, instead, a shape-shape measurement were to be performed the outcome would be specified by little box C. The argument goes, as explained above, via little box B.

But now applying the no-instantaneous-action-at-a-distance condition to the first two columns one concludes that if the shape-color measurement were to be performed in this instance the outcome must lie in the column containing little box A. It must, likewise, lie in the row containing little box D. Thus the outcome must lie in little box C. But that contradicts the predictions represents by the four numbers 250. Indeed, the only consistent solution for the lower-left quadrant is to make it just like the other three quadrants, with zeros on the diagonal and 500s in the two off-diagonal slots.

The point is that the no-instantaneous-action-at-a distance condition A coupled with the condition B that the choices of the two experimenters can be treated as independent free variables places conditions C on the predictions in the four alternative possible cases, and confirmed predictions of quantum mechanics violate these conditions C.

The upshot is that classical concepts fail even at the level of large-scale visible events: locality and freedom cannot co-exist even at the level of large measuring devices. On the other hand, von Neumann's orthodox quantum mechanics gives a rationally and mathematically coherent theory of a reality that is compatible with all established data. It evades the inconsistency encountered here by accepting that nature's choices of macroscopic outcomes have the nonlocal feature that is explicitly exhibited in actual quantum calculations by the global collapse of the quantum state.

The fact that Einstein regarded this foundational feature of quantum mechanics to be "Spooky" highlights the fact that reconciling the predictions of quantum mechanics with a rationally coherent understanding of something that can be construed as "reality" demands, even at the level of macroscopic visible phenomena, transfers of information that cannot be understood in terms of the concepts of relativistic classical mechanics that Einstein embraced.

One final technical remark: At one time I proposed improving the proof of non-locality, relative to the hidden-variable proofs of Bell and others, by replacing the hidden-variable substructure by the macroscopic condition that the macroscopic results of all four alterative possible experiments be assumed to be well defined, even though the results of only one could actually be observed. I called that assumption "contrafactual definiteness" (CFD). That shift emphasized that the microscopic (hidden-variable) machinery was not important: it was the definiteness of the macroscopic results that was important. (I used the equivalence, proved by Arthur Fine, and earlier by myself, of the stochastic and deterministic hidden-variable theories.) The present proof is better, because it needs, beyond the four confirmed predictions, only the idea that the experimenters' choices can be treated as independent free variables. Then assuming no instantaneous transfer of information leads to a logical contradiction.

Appendix 2: Counterfactual Reasoning

This appendix can be safely ignored by readers not concerned with technical issues that arise in connection with counterfactual reasoning.

The argument in Appendix 1 is based on statements of the form:

"If Experiment E is performed and the outcome is O, then
if, instead of E, the experiment E' were to be performed, then the outcome would be O'. "

Statements of this kind can be definitely true or definitely false in the context of a physical theory that has logically consistent laws that allow the "free choices" between which of several experiments is performed to be treated as a free variable. Orthodox quantum mechanics is such a theory.

Logical reasoning is aided by having a "mechanical" way of checking the truth or falsity of statements. Then all competent users of the logic can agree on the truth or falsity of the propositions.

Robert Griffiths [15] has invented such a "mechanical" procedure for counterfactual reasoning. It is a graphical procedure. It involves a tree graph that, reading from left to right, has branches that branch at branch points into more branches. Some branch points represent the occurrence of events where a choice must be made between two (or more) alternative possible experiments. Other branch points represent events where some particular outcome of some particular experiment must be chosen (by nature). If, as in our case, there are two far apart experimental regions, then the full graphical part that represents the possible events in the later region must be hooked onto each of the branches representing an outcome in the first region, in order for the graph, reading from left to right, to represent all possible sequences of the macroscopic events.

Griffiths allows graphs that include branch points corresponding microscopic (invisible) events, but I exclude all such branch points and consider only visible events.

Diagrams 2 and 3 give the graphical representations of the two parts of the argument in Appendix 1. The part of the graph that corresponds to the part of the process labeled L (for left-hand region) stands to the left of the parts labeled R (for right-hand region). The left-to-right ordering in the graph corresponds to increasing time. Thus the L part of the physical process is earlier than the R part.

The argument in Appendix 1 involves two different orderings of the reversals. So one might consider a second graph with the L-R ordering reversed. But a key requirement of Griffiths' formalism is that a valid argument must be expressed by using only one single graph. So, within Griffiths' theory, the counter-factual reasoning in Appendix 1 must be justified by using only one the single graph. Consequently, the two parts of the argument must use the same graph. The superposed lines in the two diagrams represent the propositions in the two parts of the argument.

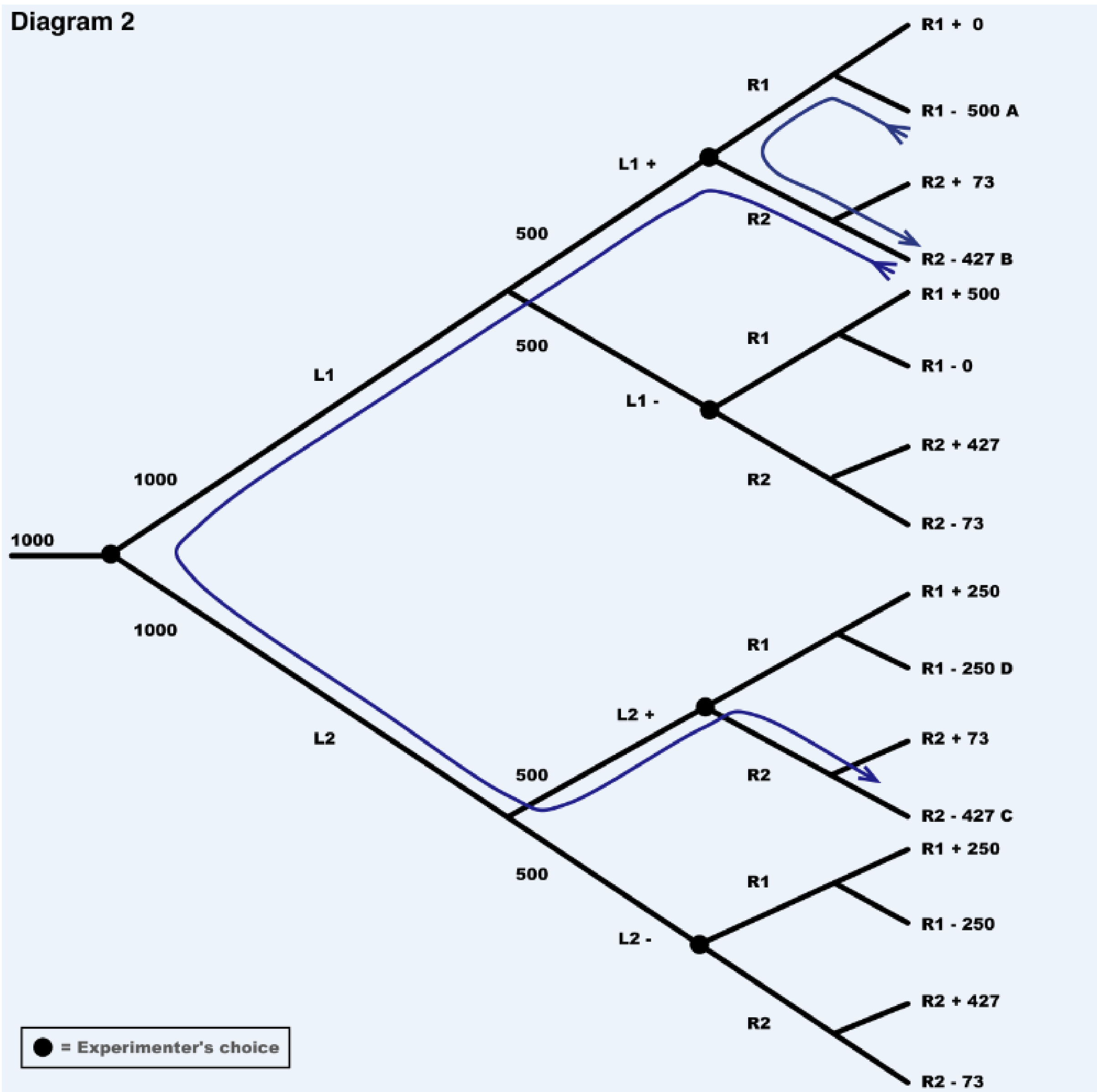

Diagram 2. The Griffiths Diagram Corresponding to the part of the argument given in Appendix 1 in which the reversal R1 to R2 in region R precedes the reversal L1 to L2 in region L .

Diagram 2 represents the case in which the reversal from experiment R1 to experiment R2 comes first. Keeping track of the 500 elements of Set A under this reversal, which leaves everything in region L unchanged, we see that 427 of the 500 elements a Set A go to Set B. Next comes the reversal L1 to L2 in region L, with the experimenter's choice of R2 in region R left unchanged. We are interested in how many of the 500 elements in set A end up in set C, which corresponds to L2+. These must come from the 427 elements in set B. Because at most 73 of these 427 elements can go to R2+, at least 427-73= 354 must end up in set C. This is just a diagrammatic representation in the pertinent Griffiths graph of the first half of the argument given in Appendix 1.

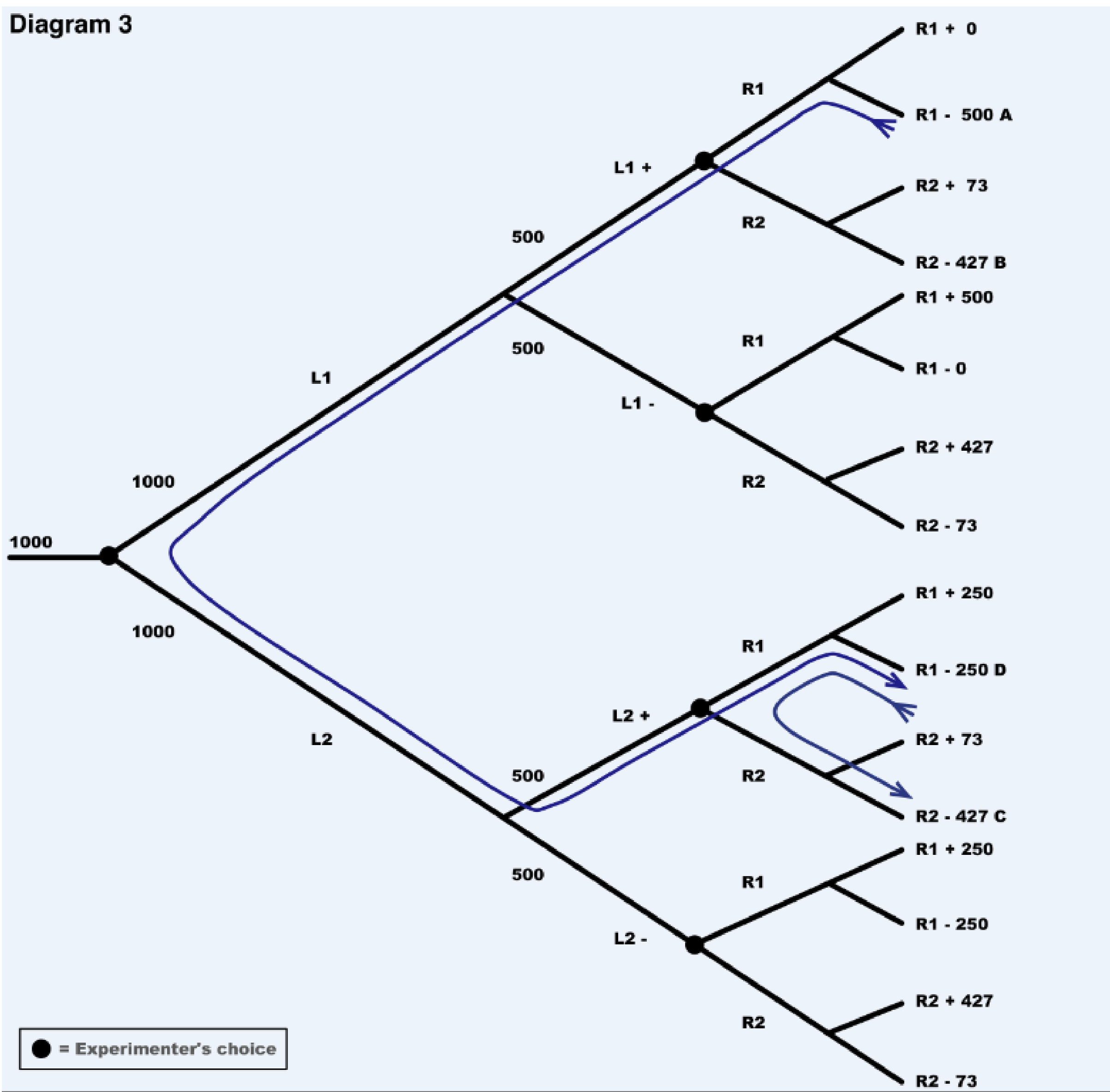

Diagram 3. The Griffiths Diagram Corresponding to the part of the argument given in Appendix

1 in which the reversal L1 to L2 in region L precedes the reversal R1 to R2 in region R.

.

Diagram 3 represents the second half of the argument given in Appendix 1, the part in which the first reversal is the reversal of L1 to L2 with the choice in region R of R1 held fixed. Starting again with the 500 elements in set A, but now tracing first back to the experimenter's choice between L1 and L2, and then forward along the other branch, L2, and following the L2+ branch that leads to branch D. Only 250 0f the original 500 instances in Set A end up in D. This takes at Then the reversal of R1 to R2 keeping the choice in region L of L2 unchanged allows at most 250 of the elements in Set A to be in Set C. This conflicts with the conclusion associated with Diagram 2, which was that at least 354 elements of set A are contained in set C. Thus the conclusion deduced in Appendix 1 by using the common-sense understandings of the meanings of the words is confirmed within Griffiths' graphical representation of the structure of counterfactual reasoning, restricted now to visible macroscopic events.

A variation of this argument based on experiments of the kind proposed by Julian Hardy has been described in [16, 17, 18, 19]. The argument given above is essentially the one given in [20].

Appendix 3: Communications

From d.bem@cornell.edu Thu Mar 1 14:31:45 2012
Date: Thu, 1 Mar 2012 17:30:17 -0500
From: Daryl J. Bem <d.bem@cornell.edu>
To: Henry P. Stapp <hpstapp@lbl.gov>
Subject: Re: Replications

Dear Professor Stapp:

Here is a rundown of replication attempts I know about. Just in case you don't have a copy of my published article, I attach a copy here:

[Part 2.2, Application/PDF (Name: "Feeling Future scanned.pdf") 9.1]
[MB.]
[Unable to print this part.]
[Part 2.3: "Attached Text"]

The first experiments I conducted (Experiments 5 & 6 in my article) were on Retroactive Habituation. In these subjects first select which of two pictures they prefer on each trial. Some trials use pairs of negatively-toned pictures; other trials use pairs of erotic pictures. The computer then randomly selects one of the pictures as a "habituation" target and subliminally displays it subliminally several times. The predictions are that subjects will have preferred the habituation target-to-be when the pictures are negative but the non-habituation target when the pictures are erotic. Control pairs of neutral pictures are also used on some trials. There have been several replication attempts of the experiment, many of them using only the negative pictures.

I know of 4 successful replications of this protocol in addition to my own replication (Experiment 6 was a replication of Experiment 5).

1. A straightforward exact replication of the retroactive habituation experiment was conducted by the late Robert Morris at the University of Edinburgh. The hit rate on negative trials was significant and the hit rate on erotic trials was in the predicted negative direction but not significant. The predicted difference between the two conditions is significant.

2. Professor Kenneth Savitsky, a skeptical colleague at Williams College, and his students in a social psychology seminar (ironically, “The Psychology of Superstition and Belief in the Paranormal”) served as both experimenters and participants in a modified replication of the experiment

that used supraliminal rather than subliminal exposures. Only negative picture pairs were used. There were 84 participants and there was a significant hit rate on the negative trials, but not on control trials.

3. Savva, Child, & Smith (Savva, Child, & Smith, 2004) conducted a conceptual replication of the retroactive habituation experiment at the Liverpool Hope University College in the United Kingdom in which 25 spider-phobic and 25 non-spider phobic individuals participated in an experiment that used 12 spider picture pairs and 36 neutral picture pairs. The spider-phobic participants had a significant hit rate on the spider trials and a chance hit rate on the control pairs. The hit rates for non-spider-phobic participants was at chance on both spider and control trials.

4. Parker and Sjödén (2010) also conducted a replication using only negative and neutral pictures, but their participants went through both the retroactive habituation procedure and an adaptation of Dijksterhuis and Smith’s (2002) original (non=psi) habituation procedure. The same stimulus pictures were used in both.

Overall, there was not a significant retroactive habituation effect on the negative pictures, but there was a highly significant correlation between habituation and retroactive habituation to the negative pictures ($r = .34$, $p =.008$). The participants who showed (non-psi) habituation also showed significant retroactive habituation; the participants who failed to show (non-psi) habituation also failed to show retroactive habituation.

I have been informed of 2 failed replication attempts, one at Harvard and one in Argentina.

The experimental protocol that has been the subject of more recent replication attempts is the Retroactive Facilitation of Recall (Experiment 8 in my article and its successful replication, Experiment 9). In these subjects are shown 48 words, then given a surprise recall test on those words. The computer then randomly selects 24 of those words and gives the subject practice drills on them. The prediction is that on the earlier recall test, subjects will have recalled more of to-be-practiced words than the non-practiced control words.

I know of two successful replications of this protocol in addition to my own replication that I reported in the article.

One was carried out in the UK by Eugene Subbotsky, a developmental psychologist who is not identified as a psi researcher. His associate Adrian Ryan assisted him. Ryan, an experienced programmer, asked me to supply the source code for the experiment, which I did. He went over line by line to make sure the program didn't "cheat" and then recompiled the code and ran the experiment with it.

There were several interesting subsidiary findings in this study regarding experimenter blinding and non-blinding, strongly suggesting experimenter expectation effects are operative (see below for more on this).

A second successful replication was conducted by Patrizio Tressoldi at the University of Padova in Italy. He is known as a psi researcher and is a frequent contributor to the psi literature. This was a particularly interesting replication because he used Italian words (using the same selection criteria I used to select the words in own experiments) and ran Italian participants who were not fluent in English. Except for that, he used my materials for the replication.

There are also some failures to replicate:

Well-known skeptic Richard Wiseman and two skeptical colleagues reported an attempted replication at the meeting of the Society of Psychical Research (SPR) in Edinburgh last summer, and they have tried unsuccessfully to get the study published at several journals. Although they presented these as 3 separate experiments because each of them ran 50 subjects in their own labs. But the total number of subjects run (150) is exactly the number I ran in my own experiment (Experiment 8 and its replication, Experiment 9). So, their replication is essentially one experiment with 3 experimenters. They found no psi effect. As you my know, psi-skeptic Wiseman had previously teamed up with psi-advocate Marilyn Schlitz in 3 attempts to replicate a psi effect (distant influence over a subject's response), using the same subject pool and randomly assigning subjects to either Richard or Marilyn. Marilyn got a significant psi effect in 2 of the 3 experiments, but Wiseman got null results every time. I believe this points to an experimenter effect in which an experimenter's attitudes toward psi and/or expectations about the outcomes affects those outcomes. In mainstream psychology, experimenter expectations has been well established (back in the 1960's) in over 30 experiments, in which subjects do better when either the principal investigator or research assistants under his or her direction expect positive or negative outcomes—whether the subjects are undergraduates making interpersonal judgments or are rats running mazes.

Another replication failure has been reported by Galak at Carnegie-Mellon University. This was not an exact replication because he did not use my computer program to run it.

I doubt that this covers all the attempted replications, just the ones I know of. Wiseman set up a registry so that those planning to replicate my studies could pre-register their studies. His website stated that they would do a meta-analysis of the studies after the deadline of December 1, 2011 has passed.

From what I understand, 6 studies were completed at the time of the deadline, including the "3" that he had reported earlier and the successful replications by Subbotsky and Tressoldi. (This leaves one registered study that I don't know about.) Across all six experiments, the combined z was 1.20, p = .12, which is not significant. (This leaves one registered study that I don't know about.)

Across all six experiments, the combined z was 1.20, p = .12, which is not significant. I don't know if this is too much or too little detail for you. My own view is that it is much too early to conclude anything, especially since I believe experimenter effects are strong in these experiments. (I plan to investigate this more systematically in the coming months.) When one examines the mainstream psychology literature (or the medical literature for that matter), even robust effects that everyone believes to be true and that reveal a reliable overall effect in a meta-analyses show many failed replications. It typically takes several years to sort out the variables that mediate successful vs unsuccessful replications.
Have a good conference.

Daryl J. Bem
Professor Emeritus of Psychology

Department of Psychology - Uris Hall
Cornell University
Ithaca, NY 14853-7601

Website: http://dbem.ws (ws stands for website)
E-mail: d.bem@cornell.edu

From: Rupert Sheldrake
Sent: Thursday, March 15, 2012 8:40 PM
To: pdl
Subject: Re: Ritchie, Wiseman, and French's "Failing the Future" published online

This evening I received a request for a comment from a journalist at The Daily Star. He was responding to the following Press Release which is obviously designed to ensure that the skeptical claims are blazoned across the media tomorrow. The Specialist News Service is a PR agency, presumably hired by Wiseman et al.

The following is the copy from the Specialist News Service.

Bet the fortune tellers didn't see this coming.

For a major new scientific study claims there is NO evidence to suggest humans can predict the future through psychic ability.

Researchers from three British universities spent a year carrying out various experiments on over 1,000 volunteers to see if they had any secret powers at all. Nine tests included asking them to memorise words on cards and then predict which ones would be turned over or knowing which of two curtains hid an image. But, importantly, the tests were identical to those carried out by a controversial US professor claiming the results DID prove the existence of psychicability.

But now those findings have been debunked, although the debate over whether or not anyone can really see into the future will no doubt continue for years.

The UK team was Chris French of Goldsmiths, London, Stuart Ritchie of the University of Edinburgh and Richard Wiseman of the University of Hertfordshire.

They set out to replicate to the tiniest detail a series of tests carried out by psychologist, and former magician, Dayrl Bem at Cornell University in New York. His results suggested that all but one of his tests offered proof of some kind of psychic ability in the average adult.

He claimed it proved the existence of precognition - an ability to 'perceive' future events.

The UK study, conducted under exactly the same conditions, came up with totally negative results, according to the journal PLoS One who published it.

And the professors carried out the replication THREE times at three different campuses just to make sure there was no doubt.

The full report is called 'Failing the Future' to show exactly what the respected researchers found in their study.

In one of Bem's tests, volunteers were better at memorising words from a list which matched the ones randomly chosen by a computer later on.

This, he claimed, suggested the human brain could 'reach forward in time' to practice something they would need to know later, even if no one had told them.

But there was no evidence of this in the British study, said Professor Ritchie. He said: "We went to great pains to ensure we followed the same procedures as Bem.

"Using Bem's own computer programme and stats methods, we replicated his experiment three times, at each of our respective campuses, with the same number of participants as the original study." Bem's original study was seized upon by many psychics, astrologers and others as proof of their 'abilities.' Professor Wiseman added: "By having our paper published, we hope academic journals and popular media alike will offer the same weight to negative results as given to eye-catching positive results."

-------Original Message-------

On Wed, Mar 14, 2012 at 7:56 PM, Daryl J. Bem <d.bem@cornell.edu> wrote:
After unsuccessfully trying to get their report on 3 failed replications of my Retroactive Recall study published in a journal, Ritchie, Wiseman, and French have now published it online at PloS One (which costs an author about $1,300). It is titled "Failing the Future: Three Unsuccessful Attempts to Replicate Bem's 'Retroactive Facilitation of Recall' Effect." You can find it and my reply at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0033423.
My response, invited by the editor, is the first comment following the article. Feel free to chime in by setting up a free account.

You can also download my reply directly from my DropBox:

http://dl.dropbox.com/u/8290411/Comment%20on%20Failing%20the%20Future.pdf

Best,
Daryl

From dradin@noetic.org Sat Apr 28 21:57:15 2012
Date: Sat, 28 Apr 2012 21:56:56 -0700
From: Dean Radin <dradin@noetic.org>

It may be worth noting that while Daryl's study has justifiably sparked interest in conducting replications, to date there have already been about 40 replications of the physiological-based presentiment experiment, and an meta-analysis provides strong evidence that the effect is independently repeatable. An article describing the meta-analysis is, I think, in press in the International Journal of Psychophysiology.*

Other studies to add to the mix are our experiments investigating whether observation affects the interference pattern of a double-slit optical system.
The first six studies will be published in Physics Essays in a few months, and
we've just completed two replication attempts, both of which were successful.
One of those tests was conducted over the Internet with a few hundred unselected
volunteers from around the world. This approach may provide a way for large-scale replications of these consciousness-related phenomena to be conducted quickly. I'm now in the process of writing up these two studies.

best wishes,
Dean

*Title: Predictive Physiological Anticipation Preceding Seemingly
Unpredictable
Stimuli: A Meta-Analysis

Authors: Julia Mossbridge, Patrizio Tressoldi, Jessica Utts.
Julia is at Northwestern University, Patrizio at Università di Padova, and
Jessica at UC Irvine

Appendix 4: Reply to Sam Harris on Free Will

Sam Harris's book "Free Will' is an instructive example of how a spokesman dedicated to being reasonable and rational can have his arguments derailed by a reliance on prejudices and false presuppositions so deep-seated that they block seeing science-based possibilities that lie outside the confines of an outmoded world view that is now known to be incompatible with the empirical facts.

A particular logical error appears repeatedly throughout Harris's book. Early on, he describes the deeds of two psychopaths who have committed some horrible acts. He asserts: "I have to admit that if I were to trade places with one of these men, atom for atom, I would be him: There is no extra part of me that could decide to see the world differently or to resist the impulse to victimize other people."

Harris asserts, here, that there is "no extra part of me" that could decide differently. But that assertion, which he calls an admission, begs the question. What evidence rationally justifies that claim? Clearly it is not empirical evidence. It is, rather, a prejudicial and anti-scientific commitment to the precepts of a known-to-be-false conception of the world called classical mechanics. That older scientific understanding of reality was found during the first decades of the twentieth century to be incompatible with empirical findings, and was replaced during the 1920s, and early 1930s, by an adequate and successful revised understanding called quantum mechanics. This newer theory demands, in order to resolve certain quantum mechanical uncertainties, the occurrence of actions that are not determined by the known laws of physics, and that, moreover, are not fixed by the quantum elements of random chance. These actions are, in both Copenhagen and orthodox quantum mechanics, influenced by "free choices" on the part of the spectator/actors. These "free choices" are not determined from the prior physical world via the known laws of physics. The origin of these choices, which can profoundly influence human behavior, is currently unknown. Yet Harris confidently asserts that "Even if you believe that every human being harbors an immortal soul, the problem of responsibility remains." But given this science-based indeterminism of the logically needed "free choices", how can Harris rationally exclude the possibility that the immortal soul of which he speaks bears some responsibility for not over-riding the physically described mechanical tendencies. According to standard quantum mechanics, the physically described world represents mere tendencies, which are converted into actualities only via a process involving these "free choices", which are able to influence bodily behavior.

This science-based understanding of the physical power of our free choices undermines Harris's claim that "there is no extra part of me that could decide to…resist". It casts doubt on his claim that "if I had his genes and like experience and an identical brain (or soul) in an identical state---I would have acted exactly as he did. There is simply no intellectually respectable position from which to deny this."

He said, parenthetically, "or soul", not "and soul". Therefore that parenthetical clause can be omitted. But then there certainly is an intellectually respectable position from which to deny his claim, namely the one based on replacing empirically invalidated classical mechanics by empirically validated quantum mechanics. Quantum physics *allows* the responsibility to be placed upon the person's immortal soul of which Harris speaks, even though that theory does not *demand* the existence of such a thing. For that "immortal soul" *could be* a contributor to the currently unknown process that determines the causally effective "free choices" on the part of human actor/spectators.

Later on, Harris looks for origins of "will". Referring to his choice to drink coffee rather than tea at breakfast, he asks "Did I consciously choose coffee over tea? No. The choice was made for me by events in my brain that I, as the conscious witness of my thoughts and actions could not inspect or influence."

That explanation is based on the precepts of classical-physics. But according to the laws of quantum mechanics the physical state, evolving in accordance with the quantum analog of the classical equations of motion *does not determine a person's conscious thoughts:* some extra input is needed. That extra input *could* come from a mental realm. So Harris's assertion that the choice was made by events in his brain is not scientifically justifiable: the choice is not determined by physical properties via known physical laws; an extra human choice is needed. Thus certain rational science-based possibilities opened up by the failure of the precepts of classical mechanics simply do not enter into the realm of possibilities encompassed by Harris's arguments.

Harris gives a classical understanding of the experiments of Benjamin Libet. I have given a quantum mechanical understanding of Libet's experiments in the above chapters on backward-in-time causation and the effective past.

Harris goes on to defend compatibilism", the view that claims both that every physical event is determined by what came before in the physical word, and also that we possess "free will". Harris says that "Today the only philosophically respectable way to endorse free will is to be a compatibilist----because we know that determinism, in every sense relevant to human behavior, is true.

The final clause is presumably meant to discount the relevance of quantum mechanical indeterminism. The quantum element of pure chance (in nature's choice of outcome) is indeed beside the point: "free will" is not pure chance. But dismissing the possible relevance of the spectator/actors's "free choice" is again a serious begging of the question at issue. Quantum mechanics demands, in order to resolve quantum uncertainties, the entry into the unfolding of reality of choices that are not determined, via any known law, by the prior history of physical world. Both Copenhagen and orthodox quantum mechanics tie the entry of this needed choice to these "free choices" on the part of the spectator/actors. Harris's approach excludes this science-based possibility that the determination of the unfolding of reality depends on these "free choices" (on the part of spectator/observers) that are not determined by the prior physical aspects of mature. So the flaw in Harris's arguments is always the same: Harris effectively accepts the ideas of classical mechanics, and ignores the scientific opening up of relevant possibilities by the replacement of the invalidated precepts classical mechanics by the validated precepts of quantum mechanics.