# Remembering the Future

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**Abstract**

It is conjectured that our future experience could be 'remembered' at the present, in much the same way as our past experience is. No conflict with known physical laws is involved. An experimental protocol for testing future memory is proposed. All previous tests of so-called precognition, significantly deviate from the proposed protocol, possibly explaining their elusive and unstable results. Positive results of a modest field experiment are presented and analyzed .

## 1 Introduction

A thought process undoubtedly familiar to some readers of this paper, involves the birth of a complex idea—an idea conceived not in a single eureka but, rather, through a lengthy straggle, lasting months and even years. It usually begins with a very vague feeling, not even expressible in words, let alone in mathematical equations. Yet for some reason you believe that it is not a mirage; that there is something tangible out there, waiting to be unveiled. Ultimately, when the task is accomplished, the crystallization process of that initial vague idea appears remarkably similar to the evanescence of a memory over time, only in reverse! That is, a highly detailed and fully consistent account of something, gradually degrading into a low resolution, often inconsistent vague notion—only in reverse. Of course, the two processes are not at all time reversal of one another. Creative thinking involves also plenty of hard work (though mostly redundant from the author's personal experience; passage of time is the best predictor of progress). It is just the temporal change in one's mental representation of something, to which we refer.

There are countless other examples in which one's memory of his future experience—assuming it is possible—is a straightforward explanation of an otherwise mysterious phenomenon. Premonitions; prophetic dreams; love at first sight; thinking of someone and then he/she shows up/calls; chess grandmasters instantly knowing what their next move is in a novel position (and then spending fifteen minutes trying to justify it). In all such cases, however, there exist also semi plausible conventional explanations. What distinguishes our first example, of creative thinking, is the implausibility of the leading alternative: Creativity out of a machine. If recent progress in AI is telling us anything in this regard, it is that *some* primitive cognitive abilities of humans could be *emulated* by machines. The leap one has to further take in order to explain genuine creativity, of the type exhibited by Einstein for example, is so fantastically gigantic, so as to render that (impressive!) progress in AI moot. In fact, long before machines will produce the next breakthrough in physics, they are expected to be able to simulate a primitive organism, which they haven't yet—not even the simplest ones. We shall later conjecture that the two tasks will never be accomplished by machines; That living organisms are not machines in the usual sense of the word (no dualism implied...) and genuine creativity is a virtue of living organisms only.

The more outrageous aspect of our conjecture is probably that, it appears to conflict with a time asymmetry inherent in the definition of memory. Since our past is already determined, so is its memory (modulo obvious biases and errors). Our future, in contrast, is not yet fully determined and can still be influenced by our actions. However, this time asymmetry only means that we can remember only those aspects of the future which are consistent with our actions[1], and indeed, the 'memory' of our future is much more selective than that of our past. Had we 'remembered' also everything from our future, we would surely choose, whenever possible, to avoid its unpleasant aspects, thereby creating a paradox.

Closely related to the above time asymmetry is the direction in which memory is lost, which is co-oriented with the arrow-of-time. Conventional memory devices, such as films, magnetic tapes etc., constantly loose fidelity as a result of the second law of thermodynamics, hence a memory of a future event would seem to imply a reversal of the arrow-of-time. While this objection is certainly valid in the case of closed systems, living organisms are not closed systems, constantly dissipating free energy to counter the arrow-of-time's erosion. *The phenomenon of memory, in this case, is merely an affinity between the states of a system at two distinct times*, and to emphasize the conjectured common physical origin of all the previously mentioned psychological phenomena (ordinary memory, premonition, intuition etc.) a somewhat provocative title was chosen for this paper.

But perhaps the strongest case for keeping an open mind with regard to physical modelling of cognitive functions, comes not from the 'cognition side' but, rather, from physics. At the fundamental level, so the story goes, our physical world is governed by quantum mechanics (QM). Physical modelling of the brain must therefore be either quantum mechanical, or else explicitly contain a demonstration of why alternative, classical laws, are equally suited for the task. But since the conceptual difficulties with QM and its relation to the classical world, are as grave today as eighty years ago, neither approach can really lead anywhere. A fully quantum description of the brain would be some many-body wave-function. But how many body, given that all the atoms currently comprising my body, will be replaced within weeks? Where lies the boundary between me and the environment? Who is doing the measurement? Is it the 'owner' of of the brain? What about wave-function collapse? Or, perhaps, there is no collapse, and a solipsistic, many-worlds approach is mandated? But then go figure, who am 'I' in an infinite dimensional Hilbert space? To put it blatantly: A quantum mechanical description of the brain is utterly meaningless.

On the other hand, a fully classical description of the brain, based on the premiss (to which some researchers object) that the finest relevant biological features of the brain are sufficiently 'macroscopic', is equally problematic. Such a reduction is useful only when it leads to an 'integrable' classical dynamical system. This is achieved in the case of digital computers through careful design and manufacturing techniques, (avoidance of races, highly repeatable transistors, etc.) but the brain wasn't designed that way. The days when neurons

[1] In the case of the birth of an idea, it is the persistence of the thinker which brought to the successful discovery, hence its initial 'memory' is consistent with the thinker's future actions.

where believed to be simple switches are long gone, and insofar as they are such switches, the classical system they collectively make is approximated much better by a chaotic network than by a synchronous digital computer. There is currently not a shred of a clue as to how such a network could remember, let alone create original ideas.

# 2 The block-universe

The *block-universe* (BU) is the name colloquially given to the mathematical structure describing the universe which ultimately emerged from the general theory of relativity (GR). It is a four dimensional Riemannian manifold equipped with a covariantly conserved symmetric energy-momentum (e-m) tensor. Past present and future measurements are all 'etched' in the BU in the form of coordinate independent numbers, extracted from the e-m tensor.[2]

Prior to the advent of QM, that e-m tensor was believed to be the one derived from classical electrodynamics (CE) of point charges. However, as was known already to Lorentz, CE of point charge is ill defined due to the so-called classical self-force problem. Trying to retain both Maxwell's equations and local e-m conservation, collectively referred to here as the basic tenets of CE, can be achieved only with special extended 'non rigid' charges. Currently, the sole such (well defined) version of CE is dubbed extended charge dynamics (ECD) [4, 3] but its exact details will not concern us here, except for one: ECD does not admit a formulation in terms of an initial value problem (IVP). That is, no knowledge of data on any space-like surface, including 'hidden', unmeasurable data, is sufficient to uniquely determine the data on neighboring space-like surfaces. Nonetheless, in exceptional situations, the existence of *local* basic tenets, constraining the ECD block-universe, allows for an effective IVP description of the interesting attributes of a system, e.g., by means of local differential equations. For example, when shooting a hockey pack—what else can the pack do but keep moving straight, if it is to conserve momentum? *It is these local constraints, despite a global, non IVP construction, to which classical mechanics owes its phenomenal power*, but it must be remembered that classical mechanics is merely a seventeenth century mathematical model, aimed at calculating the motion of macroscopic matter, and its IVP aspect is much less sacred than its premiss of absolute time, which was refuted over a century ago.

We shall dub *machines* those exceptional systems which admit an effective IVP description, such as digital computers, and (in the absence of a better name) *non-machines* the generic group which doesn't. The term 'chaotic systems', used in [1] in this context, is deliberately refrained from, as its usual meaning is self contradictory from our perspective; Classically chaotic systems are also treated as IVP systems, viz., machines. In contrast, we view this mechanistic aspect of chaotic systems as a mere local approximation, imposed by the (local) basic tenets. Consequently, even if all external perturbations and the initial conditions where known with absolute precision, propagating a chaotic system is meaningless

[2] The mathematical machinery preforming this magic was developed mainly by Riemann and adopted by Einstein. In [2] we point to a crucial inconsistency in Einstein's adaptation which could be the root cause for all the major problems in astronomy, but it shall not concern us in this paper.

beyond a certain point.

Almost all man-made physical systems are machines (what use is a product whose future operation is unknown?). In contrast, most biological process, such as epigenesis and human creativity, are likely non-mechanistic. Looking at a single cell becoming a functioning organism under the microscope, it's hard to resist the feeling that what is being seen is one of those movies, formed from consecutive 2D slices of some 3D CT scan.[3] Only in our case, the slices are 3D each, of some 4D extended world line which is there all along—just as the BU instructs us to see things. Similarly, the final outcome of a long creative process was there from the outset, just waiting for the slice we conceive as the present to reach it. If this is the case, then describing the 'movie' formed from those consecutive slices by means of local rules, as many physicists nowadays attempt, is a pointless task.

It might seem that further developments in twentieth century physics, beyond GR, have somewhat shaken the conceptual foundations of the BU and of the CE based BU in particular, but on the contrary, they have even strengthened them. QM, for example, emerges naturally [1] as a statistical description of the ECD BU, elegantly solving all the conceptual problems of QM and quantum gravity. Moreover, there are good indications that nothing beyond ECD is needed in order to describe all known forms of matter, and that ordinary matter, thus represented, suffices in explaining the outstanding astronomical observations currently requiring to this end the contrived notions of dark-matter, dark-energy and inflation [2].

Admittedly, ECD is at present no more than a promising speculation. However, the possible reduction of all open problems in contemporary physics, to a single unsolved problem dating back to the nineteenth century—the classical self-force problem—is a sufficient reason, to the author's mind, to try and pursue ECD's radical implications to their fullest. And if this is not enough, and neither is the fact that an ECD BU is currently the only well defined BU respecting the basic tenets, then one should always remember that there isn't any concrete alternative.

# 3 Non-machines remembering the future

Machines can obviously remember their past. In particular, the nature of a randomly applied perturbation to a machine in its past, can be inferred from its present state. For simplicity, we shall deal with perturbations which can be of two types only, labelled 'L' ans 'R'.

In contrast, machines cannot 'remember' their future. Inferring a future random perturbation from a machine's present state is referred to as 'super determinism' in quantum foundations jargon; A machine is 'set on motion', propagating its initial state via its IVP mechanism, and some random bit generator, possibly not even existing at that initial time, later perturbs the machine in just the right way so as to agree with its initial state. If that were the case then the random bit generator would need to, literally, conspire with the machine.

This evident truth can be extended to non-deterministic machines in which the rest of the universe is (realistically) treated as the source of randomness and possibly dissipation. In

[3] For example: https://www.youtube.com/watch?v=uQMc2uYsNyY

this case, the machine's stochastic evolution leads to a certain probability distribution over its future states, parametrically depending on the nature of the initial perturbation (L or R in our case). If, on average, a randomly applied R/L can be deduced from that distribution with probability $p > 0.5$, then the machine is said to fuzzily remember a bit. As in the deterministic case, machines could fuzzily remember a past bit but not a future one.

Like machines, non-machines can remember their past. A sufficiently strong perturbation to a fully developed turbulence, for example, leaves a visible signature on the stream lines for a macroscopic time thereafter. But why shouldn't non-machines also remember their future, at least fuzzily?

### 3.1 Statistics in the BU

Our definition of fuzzy memory involves the repetition of an experiment. In the context of the BU this amounts to taking an ensemble of $4D$ structures, each corresponding to an instance of an experiment, and computing statistics thereof. A typical ensemble could consist of multiple 'time slices' from the (extended) world-line of a single non-machine, or single slices from multiple non-machines (see figure 1).

In the case of a binary type perturbation, there are four relevant sub ensembles of the full experiment ensemble, indexed by a pair $(m, p)$ with $p, m \in \{\mathrm{R}, \mathrm{L}\}$. The p(erturbation) index indicates which perturbation is finally applied to the non-machine, and the m(emory) is the result of some binary projection of an initial measurement, aimed at revealing the type of future perturbation. A fuzzy memory of a future random binary perturbation is demonstrated by a non-machine if

$$\| (R,R) \| + \| (L,L) \| > \| (L,R) \| + \| (R,L) \| \,, \tag{1}$$

with $\| \cdot \|$ being just the number of elements in the relevant sub-ensemble. Of course, the ensemble size should be large enough to exclude pure chance.

As non-machines are not governed by an IVP mechanism, our argument against future memory of machines does not apply to them. A future perturbation determines the evolution of a non-machine, no less than a past one. However, there appears to be a related implausibility argument, involving two inevitable noise sources, one coming from the rest of the universe, and one from the act of measurement. Non-machines, a category allegedly including classically chaotic systems, appear prone to such uncontrollable perturbations. For non-machines to remember their future, then, they must conspire with their noise sources in a way which is even less conceivable than the sort of conspiracy mentioned in the machine case.

Nonetheless, living organisms are fairly robust to noise. Given that so many 'copies' of a given organism, in different environments, evolve in a very similar manner and over very long periods of time, robustness is clearly a defining characteristic of biological non-machines, distinguishing them from non-biological ones.

Machines typically obtain their robustness to noise through well-thought-out design, involving redundancy, rounding (the digital age), high power (increasing s/n ratio) etc. Such

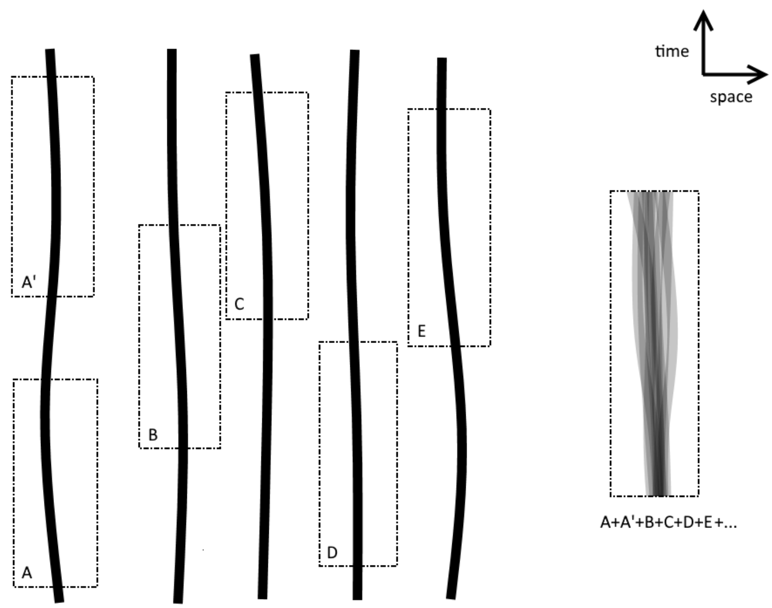


Figure 1: Typical time slices (A,A',B,C,D,E) taken from the e-m/charge distribution associated with individual non-machines. In the simple case of single-particle such non-machines, it can be shown [1] that, by 'superimposing' all members of the ensemble (right), one gets various ensemble densities, e.g. charge density $\rho_{\rm ens}$, from which the (statistical) results of any QM experiment can be deduced. From the basic tenets constraining individual members in the ensemble, equations for the ensemble densities can be derived and, upon writing $\rho_{\rm ens} \equiv \phi^\dagger \phi$, QM wave equations for $\phi$ follow. The different ways of superimposing the different members, correspond to different solutions of the same equation. A straightforward generalization to non relativistic many-body non-machines also exists [1].

design 'tricks' don't readily generalize to non-machines and, in fact, the very definition of a robust machine involves its IVP nature, viz., the way it propagates a perturbation. However, to conclude from this that, robust systems must all be machines, is groundless.

With the sensitivity-to-noise objection removed, the author can think of no reason why inequality (1) must not be satisfied by robust non-machines.

# 4 Discussion

From a physicist's perspective, living organisms are truly nature's most amazing systems. Trying to reduce them to machines, not only does it play into the hands of creationists (legitimately seeking their creator, given that all systems around, certified as machines, are man-made) but it further ignores the radical developments in physics which took place since the days of Darwin.

That said, factoring in those developments in physics is easier said than than done. Twentieth century physics is currently no more than a set of equations, applicable in concrete situations, and not remotely as coherent and consistent as (classical) physics serving Darwin's argument. Before the mechanistic model of living organisms can be put in doubt, modern physics must be put on firm conceptual foundations, on par with those of Newtonian physics. ECD is a concrete proposal for doing exactly that.

In the current letter we proposed to view living organisms as robust non-machines. How such non-machines, as oppose to, e.g., turbulent flow, obtain their robustness to noise, is currently unclear to the author.[4] Nonetheless, one thing is clear in this regard: Evolution is not the explanation. Evolution, as well as more specific biological processes, do not constitute the *mechanism* responsible for the creation of man out of dirt, but merely a *constraint*, like the basic tenets; An organism must fit its environment, no less than it must conserve e-m. And as with our earlier example of classical chaotic systems, misusing these constraints for the long time propagation of a biological system, is utterly meaningless.

Although not interpreted as such, future memories have been reported by individuals throughout the ages and are part of almost any person's experience at some point in his/her life. Parapsychology, or Psi research, attempts to replicate those, and related, seemingly paranormal phenomena, under controlled laboratory conditions, and is met with considerable scepticism and suspicion by most of the scientific establishment for two main reasons: First, with the exception of the so-called autoganzfeld experiment to which we return below, the (alleged Psi) effect size, whenever found, is always meagre, requiring meta analysis over many, usually distinct experiments in order to achieve statistical significance. Almost a century of parapsychology research has not managed to substantially increase the effect size to the point that a *single* experimental protocol could be repeatedly reproduced with statistically significant results, as is required in most other scientific disciplines [5]. A second,

[4]One appealing speculation in this regard, pertaining to the robustness of the brain, is that, sleep plays an essential role, or else, from a purely engineering perspective, sleep is an unforgivable flaw in the design of brains—all brains! This flaw should have been, at least partially, corrected by the enormous evolutionary pressure associated with the vulnerability of sleeping creatures.

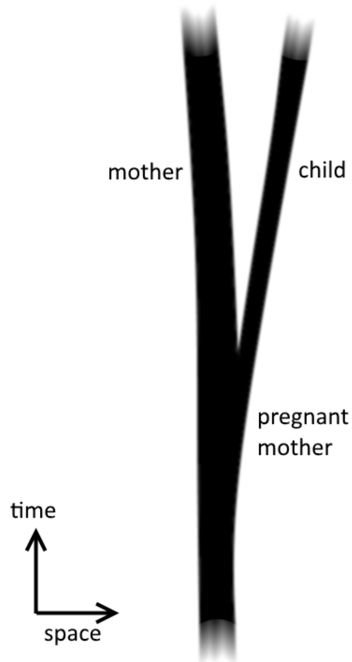


Figure 2: Energy density associated with a pregnant mother.

perhaps stronger reason for that scepticism, is the lack of any concrete model explaining the findings, which does not conflict with well tested physical laws. The sentiment is that, if parapsychology claims were true, then everything else we believe in is not.

The above two reasons are, in fact, overlapping. A concrete model is what enabled, e.g., the amplification of electro/magneto-statics from the curiosity it was in ancient times, to a practical tool in Farraday's lab. Further refinement of the model by Maxwell, tied electromagnetism to the seemingly unrelated phenomenon of light. Similarly, our proposed model for 'precognition'—as it is called in parapsychology—points to new directions that could amplify the current meagre effect size (see appendix). It further invalidates the second objection; ECD, on which our model of precognition rests, is not only consistent with known physics but, in fact, known physics is currently ill defined without ECD.

The ECD block universe may further render normal other paranormal phenomena, beyond precognition. Consider, for example, the alleged 'telepathic bond' between a mother and her child. Figure 2 schematically depicts the relevant spacetime structure, having a tree like shape. That the two branches occasionally show some affinity across a space-like section of the tree, needs not be attributed to any spooky, superluminal mode of communication. Instead, it may be just an inherent property of such spacetime trees, just like the occasional synchronous motion of two branches of a pine tree is.

Biological family ties, direct or indirect, are only one example of connected (extended) world-lines, each belonging to a different individual. Any ordinary interaction between two people, is represented in the BU by some sort of an e-m bridge, making their combined structure a (weak) version of the mother-child tree. This may, in part, explain the enhanced role of the experimenter in Psi research, dubbed henceforth the *weak experimenter effect*, which is now a part of the experiment. The great virtue of QM in this regard is that it manages to incorporate the experimenter into the formalism. The price paid for this universality, however, is that QM can be practically applied only to extremely simple systems compared with biological ones. For the derivation of QM from ECD, appearing in [1], to work, the systems making the experimental ensemble must initially comprise *exactly* the same number and type of particles, and this is merely one necessary condition. Waving with QM as an explanation of telepathy is therefore pointless from our perspective, notwithstanding the fact that the spacetime structure depicted in figure 2, could also be viewed as the "tree" representing a decaying atom, referred to in [1] in explaining Bell's inequality violation.

## 4.1 The ganzfeld experiment

Attempts to demonstrate telepathy under controlled conditions, consisted in recent years primarily of so-called ganzfeld experiments. In a typical such experiment, one subject, referred to as the *receiver*, tries to envision what a second, remote subject—the *sender*—is simultaneously seeing (typically a short video clip). To decide whether the sender succeeded in communicating the clip, at the end of the 'transmission session', the receiver is shown four clips—three selected at random from a large pool plus the transmitted clip—and then asked to single out the one closest matching his vision during the transmission session.

There is still an ongoing debate as to the interpretation of the results of many such experiment. However, a summery of the situation to which most Psi researchers and skeptics alike would subscribe to, is the following.

**1)** The relatively recent 'autoganzfeld' protocols adhere to reasonably high experimental standards.

**2)** Meta-analysis gives a considerable effect size (32% success instead of the 25% expected by chance) with a high statistical significance.

**3)** The effect size of individual experiments are extremely unstable and their distribution is strongly skewed (as high as 75% success, as oppose to just below chance).

While skiptics are right in that, autoganzfeld experiments alone prove nothing, the statistical peculiarities implicit in points 2 and 3 above, beg for an explanation, and our proposed model of precognition can offer one: Ganzfeld is a poorly conducted precognition experiment, rather than a properly conducted telepathy experiment! For, suppose that the sender and the receiver meet after the session and exchange their experiences. Surely, the sender would then supply the receiver with some information regarding the content of the 'transmitted' clip. Now, the receiver has also seen that clip as part of the experiment's protocol, so whatever little information is supplied by the sender, could give in the identity of the transmitted clip by singling it out from the rest of the three. Not mutually exclusive is a possible direct feedback to the receiver, by the experimenter (following the receiver's guess) as to the identity of the transmitted clip. Consequently, the transmitted clip would most likely be (past) remembered with relatively greater details and for a longer time, *following* the experiment. Our conjectured model of memory implies that this should be so also for the future memory of the transmitted clip, manifested in the imagery perceived by the sender while in the ganzfeld state. No spooky sender–transmitter communication is involved in our explanation.

As argued in the appendix, a properly conducted future memory experiment must be carried out only once on a given subject (point 2 there). The autoganzfeld protocol, being relatively time consuming, is unique in this regard. Assuming that future memory is the dominant effect behind *all* Psi experiments, the relatively much larger effect size in autoganzfeld is readily explained.

Our model could further explain the highly unstable results of autoganzfeld experiments (point 3 above). Since the above post-guessing factors, viz., feedback/sender-receiver interaction, were not monitored, a key ingredient in a future memory test, viz., a perturbation (singling out one clip), could have been absent from some experiments.

# 5 Conclusion

Physical modelling of cognitive functions requires, first, that physics be put on firm conceptual ground, which is not its current status. The ECD block-universe is a concrete proposal for doing exactly that. In an ECD universe, there is no apparent obstacle for certain systems, dubbed robust non-machines, to remember their future state, insofar as they can remember their past state, and in the same sense. Once such a possibility is acknowledged, many normal phenomena could be explained differently, and various, otherwise paranormal ones, become normal. Modulo the weak experimental effect, our conjecture can be put to test, utilizing known effects associated with the psychological phenomenon of (ordinary) memory (see appendix).

# A An experiment for testing future memory in humans

Any experiment aimed at testing the conjecture that, precognition is nothing but ordinary memory—only of future events—should follow these guide lines:

1. Subjects must eventually be exposed to the event whose future memory they had reported. This might appear part of the definition of any memory test, past or future, but in an individual run of a future memory test, the reported memory will remain the same with or without feedback to the subject. However, inequality (1) involves an entire experiment, not a single run. Protocols with and without feedback, describe distinct experiments.

2. Subjects must be tested only once for future memory. Otherwise, their response in the first test could be the future memory of the event in the second test, and the response in the second test could be the past memory of the the first test. To the author's best knowledge, this critical point, has never been adhered to in past precognition experiments, possibly explaining (at least part of) the reported decline effect (The initial guesses are only affected by multiple future memories; the latter—by both future and past). This could further explain 'beginner's luck' in gambling. Note that, the subject must also not be exposed to other's

tests, whether before or after his.
3. Subject's degree of certainty in their memory should be factored into the results. The reason is that, confidence and fidelity of past memories are strongly correlated. Selecting only memories with a relatively higher degree of confidence should amplify the effect size also in future memory.
4. Subjects with a relatively good past memory should be selected for an experiment, as our conjecture is that past and future memories are essentially the same phenomena—affinity between the states of one's brain at different times.

A modest field experiment, implementing the above points, was done by the author. Point 2 makes is difficult to obtain a large sample, so only 46 trials[5] were done, involving 18 subjects, none of which was tested more than once a day (typically one a week). Since, naturally, short range future memory was tested, point 4 suggested testing kids (yet another reason for that is the 'strong experimenter effect', discussed next). To implement point 3, with a two-level confidence scale (unsure/somewhat sure), the following protocol was used. I would stand in front of the subject with my arms reaching forward, wide spread, palms up, and then instruct him/her to close his/her eyes. The subject would then hear me saying: "When told, you will open your eyes, and in one of my palms there will lie a coin. Now, without opening your eyes, point in the direction ($R$(ight) or $L$(eft)) of section 3) of the hand where you see, or feel the coin is in. Do not guess. If unsure, just say so" (It is crucial that the instructions be given verbally, without ever exposing the coin; see next). The subject would then point in either directions (revealing his future memory $m \in \{R, L\}$ from section 3), I would toss the coin to decide upon the hand,[6] closing my eyes just before catching the coin to avoid possible unconscious selection of desired outcome, and the subject finally instructed to open his eyes, seeing the coin in one of my hands (suffering a perturbation $p \in \{R, L\}$).

Why should the image, invoked in the subject's mind by my request to imagine where the coin is, correspond to future memory? Well, isn't this exactly what one does when asked where the coin *was*, in a past memory test, viz., invoke an image? In this case, the R/L symmetry breaking in the imagined image is caused by a similar symmetry breaking in a past image, projected on the the subject's retina, whereas in a future memory test, it is a future image breaking the symmetry.

The right vs. left protocol was preferred over more conventional tests, such as head-or-tail, or Zener cards, for two main reasons. First, there is no need to expose the subjects to the images they are about to guess, which might get 'imprinted' as past visual memory; The instructions can be entirely verbal. Second, a privileged direction can be remembered in more than one ways. The reports of the kids as to what it was which compelled them to

[5]This arbitrary number simply reflects my limited resources. The low-passed progression of the hit rate remained approximately linear throughout the entire period of the experiment.

[6]In fact, to minimize the feedback time, in about half of the runs, the coin was tossed *before* or simultaneously with the subject's pointing, but always after the subjects would close their eyes, and with my back turned to them, blocking their view to the coin. In strict parapsychology terms, this would be a clairvoyance rather than precognition experiment but, if the proposed model is valid, it should not matter and, indeed, the results where basically independent of the tossing method.

choose a preferred direction, ranged from images of "a circle in one of your hands" to physical sensation. Moreover, typical of vague memories is their low resolution; Discriminating between, e.g. 'head' and 'tail' requires far greater resolution than between left and right.

The results were as follows. Twenty five 'remembered' correctly, thirteen were unsure, and only eight remembered incorrectly. The benefit of using a (binary) confidence scale is evident from the results. Assuming that the 'unsure' group, if forced to choose, would have contributed equally to both positive and negative guesses, the corresponding hit rate would have dropped from 0.76 to 0.68 and the statistical significance decreased from $p = 0.0045$ to $p \simeq 0.01$ (two sided).

There was a striking difference in the performance of kids with no prior acquaintance with me: They were responsible for all false memories and, in that case, admitted to have simply guessed, or even 'calculated' where the coin should be, based on various far-fetched assumptions. This could be attributed, at least in part, to the weak experimenter effect, as defined in section 4, but our model suggests more direct causes. The first is that, future memory is a subtle sensation, requiring full concentration and cooperation on the part of a subject. A kid in the park, approached by a complete stranger, is initially suspicions and not fully immersed in the experiment, unlike my 'little friends' who seemed eager to succeed and, indeed, *never* guessed wrong. The second, perhaps more dominant cause for the strong acquaintance–success positive correlation—the *strong experimenter effect*—is that my little friends, in one way or another, looked up to me. If I asked them to see the future, so I believe, they must have considered it possible.

The reason one's belief in the possibility of future memory should be relevant is the following. Consider our original experiment, only ran backwards, viz., a subject sees me with a coin in one of my hands, told to close his eyes, and *only then* revealed the goal of the experiment—to try remembering in which hand the coin was[7]. The actual sensations, eventually leading to a guess, could be extremely vague. Without one's confidence that those are his (ordinary) memory, of something which really happened, they might be interpreted as noise instead. This positive correlation between attitude towards Psi and performance in Psi tests, is a common theme in Psi experiments but, to the best of my knowledge, is never given such a prosaic explanation.

There is an important lesson here for future experiments. Subjects should first take the 'backwards ran test', in order to get acquainted with the (surprisingly small) magnitude of memory sensations. This would allow them to calibrate their confidence scale in the subsequent (say, a day later) future memory test. From personal experience, as well as other's, once this is done, a 5+ confidence grade on a 0 to 10 scale, is often given to future memory sensations preceding a positive guess, but no more than 2 or 3 for a negative one. A properly calibrated, higher resolution confidence scale is therefore expected to dramatically increase the effect size and statistical significance. Alternatively, one could use the response time as a measure of confidence (in qualitative agreement with the results of the experiment).

[7]Exposing in advance the purpose of the experiment would allow a subject to remember which hand via (concious or otherwise) association techniques.

## A.1 A second experiment

Further analysis of the previous experiment revealed that, when the coin was in my right hand, the percentage of kids guessing correctly was significantly higher than in the left hand case. The most straightforward explanation for this finding is a past memory bias; objects are usually seen in one's right hand.

To overcome this bias, a similar double-blind experiment was conducted, in which the subject was asked to imagine a soft-drink cap in each of my hands, one red and one blue (but otherwise identical) and determine the color of each.

In addition to the modified task, this second experiment differed from the first in a number of other ways. The first is a longer 'priming session'; the subject was asked to stare at my open palms for approximately twenty seconds before closing his eyes. By doing so, the subject's imagination is more confined to the task at hand, suppressing thereby relict past memory biases (such as the red-blue bias introduced by domestic water mixers). The second difference was in forcing a definite answer, even when the subject is clueless. To replicate the number of definite answers from the first experiment, 33 subjects were tested. As expected, the positive hit rate among the clueless subjects was just above chance. The third difference was that no subject was tested more than once. Consequently, I had to lift the age restriction.

Despite the fact that clueless subjects were not discarded, the hit rate rather *increased* to 0.82 (27/33); $p = .0003$ double sided. Apart from that, all the qualitative findings of the first experiment were replicated.

# References


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