Mind-Matter Mapping Project Round Table Series
Colloquium #2

The tip of the iceberg: placebo, experimenter expectation and interference phenomena in subconscious information flow

Appendix 3

Parapsychology needs paraphysics. Comment on question #13

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My personal perspective regarding the question addressed by Jean Burns is that there is a serious conceptual difficulty in the way most physicists and parapsychologists are approaching today both quantum entanglement and extrasensory perception (ESP). By this I don't mean to say that ESP and quantum entanglement would necessarily be related, in the sense that one could use the latter to explain the former, but that both phenomena can only be understood if one accepts to get rid of a radical preconception: that our physical reality is fully contained in our three-dimensional Euclidean space. From my viewpoint, this unjustified assumption is at the origin of most of the difficulties physicists and parapsychologists experience when trying to explain both quantum mechanics and Psi phenomena.

This difficulty is already manifest in the way Jean Burns formulates the premises of her questions when she states for instance that "ESP can travel without any physical signal to carry it," or that through quantum entanglement it would be possible "to make a connection with no physical signal." Indeed, if we consider that space, as we know it, is the only theatre of our physical reality, then we must admit that these statements remain totally unintelligible, and this is probably the reason why years ago Richard Feynman proclaimed that nobody understood quantum mechanics. I think however that in hindsight, Feynman would have stated today, more precisely, that nobody could understand quantum mechanics, if everybody would persist in enclosing reality in the limited three-dimensional theater of our ordinary space.

Without any doubts, if we analyze the *non-locality* effects exhibited by microscopic quantum entities in countless experimental situations, we can either resort to magic, and therefore renounce to explain their impossible behavior (e.g., being simultaneously present in different places, or remaining intimately interconnected without any detectable connection), or accept the fact that, quoting Diederik Aerts (1999): "[…] one cannot retain in quantum mechanics the hypothesis that at every moment every entity is effectively present in space," which means that: "[…] quantum entities are not permanently present in space, and that, when a quantum entity is detected in such a nonspatial state, it is 'dragged' or 'sucked up' into space by the detection system."

In other words, quoting again Aerts (1999): "Reality is not contained within space. Space is a momentaneous crystallization of a theatre for reality where the motions and interactions of the macroscopic material and energetic entities take place. But other entities – like quantum entities for example – ‘take place’ outside space, or – and this would be another way of saying the same thing – within a space that is not the three-dimensional Euclidean space.”

Burns’ question being specifically about entanglement, let me briefly present a simple but deep analogy, to explain what the important ingredients of quantum correlations are. Imagine a simple elastic band. As such, it is a whole (non-fragmented) entity, of which we can easily know some of its actual properties, like having a certain mass, a volume, and a specific length when in its unstreched condition. Let us assume that such length is precisely 10 cm. We also assume that the band is made of a very special, extremely elastic material, able to stretch on arbitrary distances, provided it is gently extended.

With the collaboration of a colleague, we perform the following experiment. We hold with our hand one side of the elastic band, and ask our colleague to hold the other side. After that, we gently walk away, putting a considerable spatial distance between us. When we are far enough, so that we can no longer see or communicate with our colleague, with a sudden jerk we break the elastic, so that one fragment will rapidly shrink in our hand, and the other fragment will shrink in the hand of our distant colleague (for simplicity we assume that the elastic can only break into two fragments).

The “magic” of this process is that, without any signal being sent between us and our distant colleague, we are able to predict with certainty the length of the unstreched fragment of elastic in his hands. Indeed, if we measure the length of our fragment, and discover that it is, say, 7 cm, we immediately also know that of our colleague’s fragment is 3 cm long. There is no “spooky action-at-distance” in this process, but only the *creation* of a specific correlation (that was not existing prior to the experiment) in the exact moment that we break the elastic band into two separate fragments. And since the experimenters cannot control, and therefore predict, the point at which the elastic breaks, there is no way to use such process to transmit information.

It is beyond the scope of this short comment to explore all the conceptual richness of the elastic band example. But for the purpose of my argument it will be sufficient to point out the following important facts.

Similarly to Aspect-like experiments with singlet (entangled) states, the elastic band experiment can be used to maximally violate Bell’s inequalities (Sassoli de Bianchi, 2013a), and such a violation, as is well known, is a signature of *non-locality*.

In Aspect-like experiments a rotationally invariant singlet state is “broken” into a separate (product) state, thus *creating* a pair of correlated polarizations (that were not existing prior to the experiment), in an unpredictable way. In the same way, during the elastic-experiment, a pair of correlated lengths are also *created*, in an unpredictable way, when the wholeness of the elastic is broken into two separated fragments.

This means that the simple elastic band entity can be used as a meaningful macroscopic analogy for the description of microscopic quantum entangled states. Of course, the analogy is not complete, as is clear from the fact that the elastic band is a macroscopic entity, whereas a pair of photons in a singlet state is a microscopic entity. However, it is exactly because of this diversity that the elastic band analogy is so instructive, as by observing what happens when elastic bands are used to create correlations (and therefore violate Bell’s inequalities) one can also understand what can possibly happen when correlations are created by using microscopic entities in entangled states.

As already pointed out by Schroedinger, a quantum entangled state is associated to a notion of *non-separability*, in which the properties associated to the entities forming the entangled pair remain totally undefined. Similarly, the pair of fragments forming a non-separated (unbroken) elastic band remain also totally undefined, as their respective lengths are not specified (and thus only correspond to a potential aspect of reality). This non-separability of entangled states is an expression of the wholeness of the entity in question, whether it is a pair of photons fused in a singlet state, or two elastic fragments fused in a single unbroken band.

In other words, the non-locality of the whole elastic band results from the fact that the two ends hang together *through space*, throughout the very body of the elastic band. This property has been called by Diederik Aerts *macroscopic wholeness* (Aerts, 1990), and it expresses the fact that if a macroscopic whole entity is localized in two different separated spatial regions, then it must also be localized somewhere in the region in between them. But this is precisely the property that a typical quantum singlet state doesn't possess. Indeed, the probability of detecting the two photons in an Aspect-like coincidence experiment at the two separated regions where the measuring apparatus are placed is very high, whereas the probability of detecting them in the region in between them becomes rapidly insignificant.

So, if we take seriously the structural analogy offered by the elastic band model, and consider that a pair of photons in a singlet state does not possess the property of macroscopic wholeness, i.e., that the photons do not hang together *through space*; and if we consider that in order to create correlations that can violate Bell's inequalities we need to break a whole entity into parts (as the very quantum mechanical formalism indicates), then we must accept the idea that the two entangled photons must hang together *outside of space*, i.e., in a space different from our ordinary three-dimensional Euclidean space.

What I am trying to emphasize is that, if we really want to understand quantum entanglement, we are forced to hypothesize the existence of an additional *extraordinary physical space* (Sassoli de Bianchi, 2013b), ampler than our ordinary one, through which quantum entities would entangle and form a whole non-separate entity. We are forced to do so if we want to save the intelligibility of our explanations, in the same way as Pauli was compelled in the past to hypothesize the existence of an elusive neutrinic field to explain beta decay, in obedience to Chatton's anti-razor principle (no less than is necessary).

In a nutshell, what I am here suggesting is that the only meaningful way to understand *non-locality*, is to consider it as an expression of *non-spatiality*, where the term "non-spatiality" is to be understood not in the sense of an "absence of spatiality," but in the sense of an "extended spatiality," i.e., of the existence of additional theatres for our vast multidimensional reality.

Having said that, let me now consider the issue of ESP. There are of course striking similarities between ESP, as revealed for instance by telepathy experiments, and quantum correlations, as revealed by Aspect-like experiments. Both phenomena show correlations between separated physical events that cannot be explained in terms of a "hanging through space" mechanism, or a "travelling through space signal" mechanism. Therefore, ESP, similarly to quantum correlations, points to the existence of an *extraphysical space*, beyond our ordinary one, which needs to be postulated in order to maintain the coherence of our explanations (I use here the term "extraphysical space" as an abbreviation for "extraordinary physical space").

Moreover, ESP, similarly to quantum correlations, reveal the existence of processes that can apparently unfold at speeds beyond the relativistic limit speed. This could be considered as a violation of relativity, but such violation is only apparent, as these processes would not happen in our ordinary three-dimensional space (or the four-dimensional spacetime), where relativity theory in principle applies, but in an extraordinary space, not a priori subjected to relativistic restrictions.

There is however an important difference between ESP and coincidence experiments on quantum entangled states: the former can be used to exchange information, i.e., to communicate (although for the time being not in a very efficient way), whereas the latter, as far as we know, cannot be used for that purpose. Indeed, as the elastic example clearly illustrates, when correlations are created by breaking a whole entity into parts, in a way which depends on environmental fluctuations, one cannot use such unpredictable creation processes to transfer information from one spatial location to another.

Of course, by this I do not mean to say that we will never succeed, in the future, to find a way to use quantum entanglement to transfer information. Consider again the elastic metaphor. One can imagine that the experimenters will learn over time to implement new experimental protocols. For instance, they could learn to impart to the elastic extremely soft jerks, so soft that its whole structure would not break, but at the same time sufficiently intense to be perceived by the distant colleague, so that they could be used to communicate.

Aspect-like experiments can only produce correlations by breaking a whole entangled entity into a pair of separated entities, described by a product state. However, we cannot exclude that in the future we will not find new experimental procedures allowing us to measure physical observable associated to entangled pairs in a way that would not cause the destruction of the entanglements, and at the same time would allow for the establishment of some kind of communication at a distance (if this became possible, then relativity would need to be revisited).

By this last remark, I do not want to suggest, as emphasized at the beginning of my comment, that quantum entanglement can provide an explanation for ESP, as many parapsychologists assume (as far as I can judge). Of course, I cannot exclude that in the future this will not be the case, but I think that the important lesson we can learn from quantum physics is another one. Quantum non-locality requires the existence of an extraphysical space, as the place of residence of microscopic entities (entangled or not). In the same way, to make ESP intelligible, we also need to hypothesize the existence of an extraphysical space, in which our mental processes would fully manifest their properties, which we perceive as non-local from the viewpoint of our ordinary spatiality.

Of course, there are no reasons to believe that the extraphysical space associated to microscopic entities would be the same as the extraphysical space of our extended mind-processes. The only thing we know for sure is what these extraphysical theatres do have in common: they both interface with our ordinary three-dimensional space, which is the place of residence not only of our measuring apparatus, but also of our soma, and more particularly of our brain, which probably acts as a measuring apparatus for our mind.

If the above is not totally incorrect, then the problem of understanding the functioning of our mind (and more generally of our consciousness) when it produces Psi phenomena, risks to be much harder than the (already difficult) problem of understanding quantum physics, as it would require the development of a completely new kind of physics, which sometimes I like to call *paraphysics*.

The point is that, as I wrote some time ago: “[…] paraphysics has not yet reached the level of development of a quantitative, fully mathematized, hard science. […] paraphysicists are in the same situation today as were Greek philosophers like Democritus (about 460-370 b.c.) when speculating about the atomic or non atomic nature of physical matter” (Sassoli de Bianchi, 2009).

A last remark is in order. My comment to Jean Burns’ question was mostly devoted to the parallel between ESP and quantum entanglement. There is however another important Psi occurrence, the so-called *PK-effect*, which appears to be also associable to an aspect of quantum physics, the so-called *observer effect* (also denoted *measurement problem*). Here again the temptation is to use the quantum measurement process to try to explain the PK-process. But once more we must take care not to improperly reify what most probably is just an analogy.

If I can affirm this without much hesitation, is for a very simple reason: quantum physics, as far as I can judge, does not need to invoke a mind-matter interaction mechanisms to solve the measurement problem, i.e., the problem of understanding the processes of *actualization of potential properties*, when specific measurement contexts are imposed to microscopic entities; see for instance (Sassoli de Bianchi, 2013c, 2013d, 2013e) and the references cited therein.

Indeed, the presence of fluctuations in a measurement context is more than sufficient to explain the emergence of quantum probabilities, through a simple and natural mechanism which was clearly identified by Diederik Aerts, in his *hidden-measurement approach*; see for instance (Aerts, 1986, 1990, 1995, 1999), (Coecke, 1995). Therefore, this time it is Occam’s razor that we need to apply (no more than is necessary), being careful not to let the mind (or consciousness) play a role that it has not, in the explanation of the quantum mechanical observer effect, which until proven to the contrary is just an *instrument effect.*

Generally speaking, an instrument effect can be understood as the result of an observation that includes, in its operational definition, an irreducible invasive interaction between the observed entity and the observation system. The instrument effect associated with a quantum observation (measurement) corresponds, more particularly, to the situation where there is a mechanism of *random selection* of a specific (possibly deterministic) interaction, among a number of possible ones, involving a pure act of *creation*, which means that the observed property, whenever actualized, is literally created by the interaction itself (Sassoli de Bianchi, 2013e).

As an example, consider once more the elastic band experiment. Clearly, to each possible breaking point of the elastic band corresponds a specific *deterministic interaction* between the measuring apparatus (constituted by the hands of the two experimenters) and the system (constituted by the elastic band entity). Because of the many subtle oscillations of the experimenters’ hands, the changing pressure exerted by their fingers, the effective speed with which the elastic is suddenly stretched, and many other fluctuating factors, it is impossible for the experimenters to know in advance which specific interaction, among the countless a priori possible, will be selected, and consequently the exact point at which the elastic will finally break, so *creating* the two fragments’ lengths (which are the outcome of the experiment).

The above situation is characteristic also of the quantum measurement on microscopic entities, as shown by Diederik Aerts in his hidden-measurement approach, which, technically speaking, is a *hidden variable* approach. However, since the hidden variables are not referring to the state of the system (which is assumed to be fully known), but to the interaction between the system and the measuring apparatus, the usual restrictions imposed by the celebrated *No-Go theorems* do not apply in this case.

Much more should be said, of course, to fully clarify the present discussion, but I believe this is already a rather long comment to Jean Burns' question. A deepening of some of the concepts presented in this note can be found in the references given below. My recent book on the specific theme of the *observer effect* (Sassoli de Bianchi, 2013e) is also a good starting point to approach these ideas in a lay, non-technical manner.

In conclusion, quantum measurements, until proven to the contrary, should be considered purely physical processes (Sassoli de Bianchi, 2013c). A human mind can certainly also work as a measurement context (although of a much subtler kind), and therefore be at the origin of *quantum-like* processes of *actualization of potential properties*, as evidenced in many experiments of psychokinesis, like those recently conducted by Dean Radin *et al.* (2012). But these processes have *a priori* nothing in common (apart possible structural analogies) with those observed in conventional physics' laboratories, as they would be the result of the action of non-ordinary substances, belonging to non-ordinary spaces different from our ordinary three-dimensional one, and probably also different from the extraphysical space (or spaces) associated to microscopic entities.

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