Homeopathy and the Action of Meaning: A Theoretical Approach

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Abstract—The purpose of this paper is a theoretical one. It does not enter the debate of evidence-based medicine (EBM) about the validity of meta-analyses including pooled data from placebo-controlled clinical trials of homeopathy and the result of epidemiological clinical studies about the success of homeopathic treatments. The paper tries to answer the question of why extremely highly diluted substances may be able to result in a medical reaction in a patient even if no single molecule of the used substance is present in the medicament. This paper describes the Model of Pragmatic Information (MPI) and the Generalized Quantum Theory (GQT) and how they can be applied to describe properties of homeopathic treatment. From the point of view of the MPI and the GQT, homeopathic treatment and medicaments are "pseudo-machines." The Model of Pseudo-Machines (MPM) includes sociological, psychological, physical, and causal—as well as non-causal (entanglement) processes that are relevant for the (homeopathic) treatment. This means that the properties of pseudo-machines can clearly be distinguished from placebos. In terms of MPM, placebos can be considered as a specific form of pseudo-machine. On the other hand, MPM is able to explain the limitation of double-blind, placebo-controlled studies in medicine, complementary medicine (CM), and elsewhere. Finally, the paper describes an experimental method (the Correlation Matrix Method, CMM), a way that the operation of pseudo-machines can be tested empirically. Furthermore, this method allows the distinguishing of causal and non-causal processes in medical treatments in general and is not limited to homeopathy but could serve as a new approach in EBM.

Keywords: Evidence-based medicine—complementary medicine—self-organization—NT axiom—Model of Pragmatic Information—macroscopic entanglement—Generalized Quantum Theory—pseudo-signals—pseudo-machines—homeopathy—Correlation Matrix Method —complementarity—organizational closure

Introduction

The controversy about homeopathy and other methods of complementary medicine (CM) is highly emotional and suffers from a strongly biased presentation in public mass media from both proponents and skeptics (Lucadou 1992a). It is obvious that this controversy goes far beyond the usual scientific debates about alleged anomalies and unconventional scientific claims because of ethical and commercial implications. Homeopathy is widely used not only by naturopaths but also by professional medical doctors and is accepted by many patients, as the Homeopathy Product Market report maintains (Transparency Market Research 2016). Usually it is argued that studies that fulfill the standards of Evidence Based Medicine (EBM) could not demonstrate a clinical effect of homeopathic treatment that goes beyond placebo effects. However, it is far beyond the scope of this paper to give an adequate overview about the state of the ongoing controversy. At least some authors (from mainstream science) argue that the presentation of homeopathy in mainstream medical journals suffers from data selection and is highly biased and unfair (e.g., see Hahn 2013). These authors concede that some clinical homeopathy studies show at least small but statistically significant specific treatment effects. (e.g., see Mathie et al. 2014, Milgrom & Chatfield 2012, Walach, Michael, & Schlett 2018).

In any case, these findings seem to be in contrast to individual reports of patients who present dramatic healing successes through homeopathic treatment after being given up on by conventional medicine. They usually deny possible suggestion effects or placebo effects. The following statement by a patient may serve as a typical example:

> More than 20 years ago, severe pain led me to visit a naturopathic cure. Beforehand I had a conventional medical treatment for several months, which had no effect. After taking a few granules, the pain was gone permanently. (Stieler 2018)

In this paper we do not enter the debate of EBM about the validity of meta-analyses including pooled data from placebo-controlled clinical trials of homeopathy and the result of epidemiological clinical studies about the success of homeopathic treatments. This paper tries to answer the question of why extremely highly diluted substances may be able to result in a medical reaction in a patient even if no single molecule of the used substance is present in the medicament. The crucial question is: Can the model explain why medical treatment "with nothing" in it produces such specific clinical effects and why the discrepancy between individual cases and placebo-controlled clinical studies is so large? Finally the model

should explain why replication studies often show a dramatic decline (or even a reverse) of the effect size.

The situation of homeopathy is in some respects comparable with the situation in parapsychology (Bauer & Lucadou 1988, Lucadou 1995b, 2000b, 2001a) where the claims of "mental action at a distance" such as "telepathy" and "psycho-kinesis" (PK) are investigated. The reports on individual spontaneous experiences show impressive effects (Lucadou 2003, 2010, Lucadou & Zahradnik 2004, Lucadou & Wald 2014), while the results of meta-analyses of experimental studies show often robust, but inconsistent and very small effect sizes (Radin & Nelson 1989, 2000, Bösch, Steinkamp, & Boller 2006, Beutler et al. 1987, Walach et al. 2000, 2004, Walach, Michael, & Schlett 2018, Witt et al. 2005).

In both homeopathy and parapsychology many theoretical approaches start from the assumption that a hitherto unknown process or signal causes the phenomena or effects. In parapsychology, researchers try to rule out any known and possible causal influence in order to find the alleged "psi signal" (May 1984, Lucadou 1986a,b). In homeopathy, however, only very high dilutions treat "with nothing," whereas low dilutions may have a real causal pharmaceutical effect (for instance on the immune system). This is an important difference (see below). Furthermore, homeopathic treatment—if applied "*lege artis*"—is a very individual treatment for each single patient, which cannot be blinded out as is required in EBM.

In contrast to these "signal" approaches, the present theoretical model which is used to describe the disturbing phenomenology of parapsychology and homeopathic treatment and its results (and possibly many other forms of CM) abandons the idea that special (but unknown) causal processes or signals may be responsible for the empirical results (Lucadou 1984, Walach 2002, 2003). It is based on ideas and concepts that have been developed in physics and biology from a system-theoretical perspective (Kornwachs & Lucadou 1975, 1977, 1979, 1982, 1984, 1985, Lucadou 1989a, Lucadou & Kornwachs 1975, 1977, 1980, 1983a,b). Insofar as it is not the aim of the model to deliver a "bottom-up" and reductionistic "explanation" of homeopathy, the model gives a theoretical and phenomenological description of the underlying processes using some concepts that are compatible with normal science and which already have been successfully applied in conventional issues. The model avoids specific ad hoc concepts and tries to find conclusions that can be tested experimentally.

The model we present here is called the Model of Pseudo-Machines (MPM) (Lucadou & Grösser 1998, Lucadou 2002a,b, 2009). It consists of two approaches, namely the Model of Pragmatic Information (MPI), which is an information-theoretical one, and the Generalized Quantum

Theory (GQT), which is a system-theoretical generalization of the structure of quantum theory in physics. The MPI (Lucadou 1974, 1987a, 1989b, 1995a,b) had been developed prior to the GQT and can be considered as a special case of GQT (Atmanspacher, Römer, & Walach 2002). The advantage of the MPM is that it can be applied both to artificial settings such as experimental and epidemiological studies as well as to spontaneous cases and individual medical histories.

Finally, the MPM can be examined by several experimental approaches. The Correlation Matrix Method (CMM) (Lucadou 2015a) which was developed on the basis of the MPI and the GQT has already been applied successfully in psychology and parapsychology. It seems that the CMM fits ideally in clinical tests in CM and EBM, because it allows the distinguishing of causal and non-causal processes in medical treatments.

The Model of Pragmatic Information (MPI) and the Generalized Quantum Theory (GQT)

Both models, MPI and GQT, are not completely independent and can be united to describe somewhat different aspects of the same situation. They both can be applied in normal psychology and in many other fields (Atmanspacher, Filk, & Römer 2004).

The basic assumption of both models stipulates that any description of nature must have a structure, which is isomorphic to the axiomatic structure of quantum theory.

There are several arguments for this basic assumption. The simplest would be that Quantum Theory (QT) is the most successful basic description language of natural systems and hitherto no indications were found that the axioms of QT have failed. Further, they hold from microscopic to macroscopic and even cosmological dimensions and also to any sort of physical observables regardless of which special field (electromagnetism, elementary particles, solid state physics, etc.) is considered. Furthermore, it can be shown that these axioms describe in a very general way how information (under the categories of space and time) can be obtained from any system if the interaction within the "measurement process" is not neglected. However, this does not necessarily imply that we can transpose without further assumptions the detailed structure of a special quantum physical system to another field as is done in some reductionistic models (e.g., Walker 1975, 1977, 1979, Mattuck & Walker 1979, Hameroff 1994).

The initial idea of GQT was described by the author in 1972 (Lucadou 1974, 1991a, 1998). A mathematical formulation of GQT was given by Hartmann Römer, Harald Atmanspacher, and Harald Walach in 2002

(Walach & Römer 2000, Atmanspacher, Römer, & Walach 2002, Filk & Römer 2010, Walach, Lucadou, & Römer 2014).

In GQT, the fundamental notions of *system*, *state*, and *observable* are taken over from ordinary quantum theory:

A *system* Σ is any part of reality in the most general sense, which can, at least in principle, be isolated from the rest of the world and be the object of an investigation.

A system is assumed to have the capacity to reside in different *states*. The notion of state also has an epistemic side, reflecting the degree of knowledge an observer has about the system. Unlike in ordinary quantum mechanics, the set **Z** of states is not assumed necessarily to have an underlying linear Hilbert space structure.

An *observable A* of a system Σ is any feature of Σ that can be investigated in a (more or less) meaningful way. Let *A* denote the set of observables. Just as in ordinary quantum mechanics, observables $A \in A$ can be identified with functions on the set of states: Any observable *A* associates to every state $z \in$ **Z** another state $A(z) \in$ **Z**. As functions on the set of states, observables *A* and *B* can be composed by applying *A* after *B*. The composed map *AB* defined as $AB(z) = A(B(z))$ is also assumed to be an observable. Observables *A* and *B* are called *compatible* or *commensurable* if they commute, i.e. if $AB = BA$. Non-commuting observables with $AB \neq BA$ are called *complementary* or *incompatible*. In ordinary quantum theory, observables can also be added, multiplied by complex numbers, and conjugated, and the set of observables is endowed with a rich structure called *C**-algebra structure. In GQT, observables can be multiplied only by the above composition. In Atmanspacher, Römer, and Walach (2002), GQT is characterized by a list of axioms.[1]

The most important aspect of the MPI (Lucadou 1984, 1987a,b,c, 1998, 1995, 2001b, 2002b, Kornwachs & Lucadou 1985) is the so-called "NT axiom" (Lucadou, Römer, & Walach 2007). It assumes that the origin of paranormal phenomena are not signals, but macroscopic entanglement (ME) correlations, which are created by the "meaning" (pragmatic information) of the situation. Further, the MPI and the GQT assume that these entanglement correlations cannot be used as signal transfers or causal influences. This axiom leads to a naturalistic explanation of decline effects and the displacement effects in parapsychology, psychology, and therapy research (Lucadou 1983, 1989b, 1990, 1991b, 2000b, 2001a). Lucadou, Römer, and Walach (2007) argue that the MPI is a subclass of the GQT.[2] In agreement with GQT, the MPI assumes that structure S and function F of a system are complementary observables. Formally, we can write the commutator:

$$[S*F - F*S] \neq 0 \text{ or } S*F \neq F*S \qquad (1)$$

Which means that we will get different results in a measurement if we first measure the structure and then the function or vice verse (the character * means product). To any biologist who wants to investigate the behavior (function) or the anatomy (structure) of an animal, this statement sounds trivial.

The key concepts in the MPI are: pragmatic information, novelty, confirmation, autonomy, reliability, temporal dimensionality, and minimum action.

- Pragmatic information (I): The meaning of given information. It describes its potential action on a system and is measured by the reaction of the system.
- Novelty (E): Aspect of pragmatic information that is completely new for the receiving system.
- Confirmation (B): Aspect of pragmatic information that is already known by the receiving system.
- Autonomy (A): Behavior of a system that cannot be predicted.
- Reliability (R): Behavior of a system that is expected.
- Temporal dimensionality (D): Measure for the interrelationship of temporal events that belong to a history.
- Minimum action (i): Smallest amount of action on a system that cannot be avoided during a measurement or observation.[3]

The concept of pragmatic information has been developed to quantify the meaning of given information. It is assumed that the (potential) action that meaningful information exerts on a system can be used for such quantification. E. von Weizsäcker (1974)[4] proposed that pragmatic information could be written as a product of two observables that he called "Erstmaligkeit" E (novelty) and "Bestätigung" B (confirmation).[5]

This approach takes into account that each piece of meaningful information must contain a certain pre-structure (confirmation)—for instance, one's native language—in order to be understood by the (receiving) system but also something new in order to produce a change ΔC in the receiving system. For instance, a joke in a foreign language that cannot be understood would not cause anybody to laugh (no confirmation), and a joke of yesterday would not do so either (no novelty). This includes the idea that pragmatic information is not a static, but a highly dynamic, process. The changes in the system are measured in terms of changes of complexity $\Delta C/\Delta t$ of the system (Kornwachs & Lucadou 1975, 1977, 1979):

$$I = R * A = E * B; I = f(C; \Delta C/\Delta t) \qquad (2)$$

The model further assumes that there exists a minimum amount of pragmatic information (or action) i which has to be exchanged if an informational exchange (measurement) with another system or between two systems takes place. This is simply another formulation of the inevitable interaction in a measurement. The value of i depends on the system and does not need to be a universal constant (like ℏ in QT). This presupposes that systems have boundaries that define the "inside" and the "outside" of a system, the "endo-system" and the "exo-system." The exo–endo distinction was introduced by Hans Primas (1990, 1992) with respect to physical systems. The exo-perspective is the perspective of the experimenter or the critical observer in relation to the "object" that has to be observed or measured. The endo-system is, in contrast, the "real nature" in its ontic existence. He states: "Experimentally inaccessible ontic states are not meaningless . . . "

A concept to describe the boundaries of natural systems was introduced by Maturana and Varela (1981) and is called "organizational closure" (OC). Varela (1981) states:

> An organizationally closed unity is defined as a composite unity by a net-work of interactions of components that (i) through their interactions recursively generate the network of interactions that produce them, and (ii) realize the network as a unity in the space in which the components exist by constituting and specifying the unity's boundaries as a cleavage from the background.

It is interesting to remark that the concept of OC makes no sense from inside the (endo-) system. A necessary condition of OC is the self-organization of the system and a consequence is that OC is a self-stabilizing property (conservation of entanglement, see third law of MPI).

The most important difference between parapsychological experiments (such as "psycho-kinesis" PK-experiments) and experiments in other fields of science is that, due to the definition of parapsychological effects, any "normal causal" links between subject and target have to be ruled out, whereas in "normal" science the structure of such "normal causal" links is investigated. This is also the case in homeopathy if high dilutions are applied, since no causal effects of the applied substance can be expected. Of course, this definition is highly problematic, and it seems that most researchers in the field are beginning to share a common minimum consensus that paranormal effects (psi) could positively be defined as "meaningful non-local and non-causal ME correlations" between a living system and other (causally) separated systems (Lucadou 1984, 1991b).

Entanglement correlations are pattern matches within organizationally closed systems, measured from outside the system, and which are created by the relevant pragmatic information. The term non-locality / non-local means that an observable does not explicitly depend on time and distance (e.g., the importance of a personal relationship). Thus, one could redefine parapsychology—and to some extent homeopathy—as the investigation of "non-local effects in entangled living systems." The term "non-local" or "entanglement," however, is not just a new word for "something unknown" but has a quite definite meaning in the context of the axiomatic structure of GQT. It is important to notice that "non-locality" is nothing principally different from all the other physical interactions. But to isolate it for investigations, causal interactions have to be ruled out. In physics, entanglement can be considered as a more or less well-established fact. However, most researchers doubt that it plays a role in living systems.

Since such non-local effects of a system (with a certain reliability R and certain autonomy A) can be regarded as something "exceptional," within MPI this means novelty E. This is especially the case in spontaneous cases where paranormal events or healing normally occur unexpectedly. We can also say that the pragmatic information that describes the entanglement correlation is mainly represented by novelty E. Implicitly this means that there is not much confirmation B present (due to the NT axiom, see below). Since, according to Equation (2) pragmatic information is the product of novelty E and confirmation B, the same amount of pragmatic information can be expressed either as much novelty and little confirmation or vice versa. However, if the total amount of pragmatic information is limited, it follows immediately that events containing much novelty E (unexpected events) cannot occur very often (much confirmation B).

The Three Laws of the MPI

In general, the model can be formulated in three main "laws":

First law of the MPI:

"Paranormal" phenomena (psi) are non-local macroscopic entanglement (ME)-correlations in socio–psycho–physical, self-organizing, organizationally closed systems, which are induced by the pragmatic information, which creates the system.

Assuming psi would be a time-independent effect (as in precognition or backward causation) and it would lead to a real physical effect, this would enable us to build an "oracle" which could be used to create an intervention paradox (Lucadou 1988, 1992b):

The "oracle" (E) would produce a significant deviation of a random sequence (effect) from the null-hypothesis (H0) in a psi experiment (S) which operationalizes "backward causation." If the criterion C (C: $Z > Z_{crit}$, Z is the number of standard deviations of the effect in relation to H0) is fulfilled, it is decided by a "preinspector" (for instance by a computer) that the random sequence (S) will not be used for the future subject. This is of course paradoxical because, in this case, the future subject will not be able to exert an influence on the sequence, which however was the reason for the selection.

The MPI makes the assumption that nature does not allow (intervention) paradoxes. This holds even for classical systems, where a "time traveler" is not allowed to kill his grandfather.[6] However, in GQT this statement is much more strict and powerful: Situations in which the "time traveler" could potentially kill his grandfather do not occur!

This is the "Second law of the MPI":

Any attempt to use a non-local correlation as a signal transfer makes the non-local ME correlation vanish or change the effect in an unpredictable way (e.g., the effect may show up in a different variable, which was not considered beforehand, known as "displacement effect").

Above we said that the partitioning of pragmatic information into novelty and confirmation depends on the measurement we apply to get the information I from the system. Thus, the experimental conditions mainly determine whether we get mainly novelty or confirmation or both from an organizationally closed system. Assuming we could perform two ME experiments where all conditions except the number of trials could be kept equal (practically this would of course be very difficult), and assuming further that the Z-score of our ME experiment is a good measure for the entanglement correlation, we could then conclude that the effect size ES depends on the run length (n) in the following way:

$$ES(n) = c / \sqrt{(n)} \qquad (3)$$

The value of c is a constant that depends on the design and setting of the experiment. It is a limit for the maximum of ES for a single trial (or a single experiment in a meta-analysis). This limiting principle is a result of the NT axiom (NT = Non Transmission) (Lucadou, Römer, & Walach 2007): In QT it can be proven that entanglement correlations cannot be used for any signal transfer or causal link. In general systems, this has to be accepted as an axiom.

It can be concluded that natural systems themselves may produce larger

fluctuations if they are not observed (in quantum physics this is known as the "Quantum Zeno effect" (Atmanspacher, Filk, & Römer 2004). It is a fundamental assumption of the MPI that observation and also negative-result observation (Renninger 1960) are different preparations of the system. This idea can also be found in folkloristic reports that spooky events seem to happen at unobserved places, for instance abandoned houses crumble more rapidly than inhabited ones even when natural explanations like lack of ventilation and heating, lack of care, etc., are taken into account.

The second law does not maintain that ME correlations need to be weak or unstable. In general (e.g., in physics), it is difficult to isolate them experimentally but they are "powerful" components of nature. In physics they are necessary to stabilize matter (exchange forces, Chaudhury et. al. 2009) and in spontaneous cases in parapsychology and healing it seems that their effect can be huge. As a metaphor one can compare the causal processes in nature with a dry sponge and the entanglement correlations with liquid water. The dry sponge alone is not very helpful for cleaning, and liquid water neither, but together they serve well!

This feature is expressed in the "third law of the MPI" (Lucadou 2017); it a result of both theoretical considerations and empirical findings:

Macroscopic entanglement (ME) correlations are ecologically stable and are limited only by the NT axiom. They are formed by causal processes, which in turn stabilize them. Potential causal links amplify entanglement.

"Ecologically stable" means that the self-organizing, organizationally closed system is in a steady state with its environment. Potential causal links are causal processes that are not actualized, but which could potentially play a role in the organizationally closed system (see example below, or for example in physics entanglement leads to so-called "exchange forces" which are necessary for instance to stabilize molecules).

How Large Can Macroscopic Entanglement Effects Become According to the MPI?

Why are spontaneous paranormal and healing experiences much more impressive and larger than the very small (yet highly significant) deviations that can be obtained in experiments (Lucadou 2000a, 2001a)?

The concept of the Hausdorff dimension of paranormal events and developments (Lucadou 2000b) may give us an answer. It takes into account that paranormal and healing experiences are embedded in "life events," which have their "history," whereas experimental trials do not show temporal correlations to previous and later events—simply due to the

fact that pure random events are used as targets. In homeopathy the first step of treatment after the diagnosis is to find out which substances (nosodes) create certain symptoms within the patient. This includes "life events."

Normally, natural time-ordered events (for instance a random sequence) cannot be "enlarged" like a film in slow motion. However, this becomes possible to some extent if one does not consider singular events themselves, but their transition matrices.

Random events are single events that are isolated in space–time, they have no history. This is not the case with a biological system. Their main property is development and they create histories. History instead means— statistically speaking—that events are correlated sequentially with each other. At least one PK experiment (Lucadou 1986a) has clearly demonstrated that correlated random events (Markov chains) as PK targets yield stronger psycho–physical effects. In some PK experiments, a Brownian random walk was used with great success (Peoc'h 1995).

Brownian motion can also be considered as an observable "with history." Starting from this idea, a measure for the "historical meaning" of events was developed. It is called the "dimensionality of temporal events" or "temporal dimensionality" (D). Mathematically, it is defined as a "Hausdorff dimension" of a fractal structure in time.

Similar to the geometrical case, the Hausdorff dimension for temporal events tells us how many temporal sub-elements are needed to create a new "enlarged" unity, which creates a history. This means that the transition matrix $\mathbf{M}_{i,j}$ for example of a Markov sequence is "compared" with the transition matrix $\mathbf{M}_0$ of a random sequence (for details see Lucadou 2000b).

A possible interpretation of the definition of D is that every singular event is not an independent event that counts for its own value, but is only a "partial" event. For a normal binary random sequence, each "singular event" is independent: D = 1. Thus one could also say that a singular event in a sequence with D > 1 is only "a fractal part (namely 1/D) of an event." If such a sequence is the target of a psi effect, obviously such "partial events" do not fully contribute to the limitations that are induced by the second law. Therefore, we can reformulate the limiting formula Equation (3) in the simplest case by the following expression:

$$ES = c/\sqrt{(n/D)}; \ D = D(n) \tag{4}$$

If D is large enough, quite large effect sizes ES may occur.

In principle this can be applied for experiments. First of all, it seems not useful to work with "ideal" REGs (random event generators) anymore. One could speculate whether the decline effect observed in meta-analyses

may partly be a result of using increasingly "better" REGs. Of course one has to avoid statistical artefacts. A possible solution to this problem could be the use of Markov REGs. A further experimental requirement from our consideration is that very long runs are not really helpful, because due to the limiting relations, the psi effect would be blurred out. This could also be part of the observed decline, especially in PK research, where the run length has become abundantly large during the last decade (see Lucadou 2001a).

If we have a normal binary random sequence, the ME effect has—so to speak—no "working surface" or in computer terms no "user surface." In contrast to ME experiments, homeopathic treatments, for instance, have a large working surface or an effective user surface. The "therapeutic ritual" has a high dimensionality D, at least as far as it is not "blinded out" by double-blind conditions (Römer 2014, Walach & Römer 2016).

One could also say that dependent singular events are better targets for non-local effects. Further it is to be expected that the first singular events show the highest effect size. This could give a natural explanation for the fact that spontaneous events seem to have a much higher effect size than experimental events. Everyday life events are normally dependent events, which are part of long, complicated, and interwoven (personal) histories such that ME effects have "enough possibilities to link with."

Further, the limiting laws do not apply because the events are spontaneous, or of short duration, or of poor documentation quality, and mainly elusive (see Lucadou 1983, 1989b, 2000b).

The assumptions and predictions of the MPI are summarized (for details see Lucadou 1984, 2015b) in Table 1.

Pseudosignals

The "impression" of many observers and operators of ME effects that there is a "real force" working should not be laid aside as a mere illusion. From the point of view of the observer in an ME experiment (i.e. from her or his endo-perspective, see below), she or he is "influencing" the observed random sequence according to the instruction. Since this leads to many typical misunderstandings, with respect to a proper distinction of endo- and exo-descriptions of a system, it is useful to introduce the specific notion of a pseudo-signal in order to characterize non-local correlations as they arise within an endo-description of the system. Internally, pseudo-signals appear to be deterministic "signals." However, from the point of view of the exo-description of the system they are nothing but non-local correlations. Pseudo-signals are experimentally inaccessible.

Concerning the psychology of the observer, it becomes obvious that the description of such inaccessible ontic states is not meaningless since the

TABLE 1
Assumptions and Predictions of the MPI

Potentiality	No subjectivism, even potential actions induce system changes
Entanglement, no Signal	Psycho–physical correlation (1st Law of MPI)
Complementarity	$[F,S] \neq 0$; F = Function, S = Structure
Dimension of Action	Dim (I) = MLL/T; M = Mass (Meaning), I = Pragmatic information L = Length (Distance), T = Time (Rate)
Dimensionality	D = f(F, S, t, n); (complexity), f = function of, t = time
Least Action	$I = n \cdot i$, i = f(D); f = function of, I = least action, n ∈ IN (natural number, repetitions), I = Pragmatic Information
Novelty, Confirmation	$E \cdot B = I$
Autonomy, Reliability	$A \cdot R = E \cdot B$
Uncertainty	$E \cdot G \leq$ Entanglement; G = Goodness of Documentation (2nd Law of MPI)
Conservation of	Entanglement during changes within the system (3rd Law of MPI)
Minimal Divergence	Iext / (Iint + Iext) << 1 Iint, Iext = internal, external
Displacement	$Es_i(t) = Es_j(t + \Delta t)$, $\Sigma Es_i = f(D)$, ES = Effect size (2nd Law of MPI)
Decline: Effect size	$ES \leq (E \cdot D) / G \cdot \sqrt{(n/D)}$

"impression" (of signals) of the observer is necessary to create (in the endo-system) the pragmatic information, which produces the OC of the psycho–physical system as a whole and thus the ME correlations and psi effects. Without these "illusionary impressions," psycho–physical entanglement correlations could not emerge. Or to put it in metaphorical language: As long as the subject is able to stay in the "heaven of the endo-system," she or he is "part" of universal laws of nature and thus interconnected with everybody and everything that has "meaning" for her or him.

On the other hand, it is an illusion to believe that pseudo-signals can be used to transfer information. Information transfer requires a real measurement which is not possible inside the endo-system—an "impression" is not operationalization. But it is also impossible to transfer information by pseudo-signals in the exo-system, where "impressions" might be operationalized (e.g., by measuring actions). In the exo-system, a pseudo-signal is not a signal but just a non-local correlation (see also Primas 1996).

Again, in metaphorical language: If the subject leaves the "paradise of unintentional, holistic interconnectivity" and enters the "hell of observer experiments," she or he is no more able to use the non-local correlations in

a definite way because they are cut off by the separation of the observer and the observed in the exo-system. There may remain "patterns" as a vague "memory of the paradise," but in most cases these patterns have lost their meaning. If we detect by normal signal transfer that such a pattern fits with a pattern in the exo-world, we call this a "hit" or "clairvoyance."

In psychological systems, however, one might think of a conversion from a given exo-system into an endo-system, for instance by introducing a meta-description in such a way that the meta-level becomes a new exo-system and hence the original level can be regarded as a corresponding endo-system. In experiments this can be done, for instance, by measuring the "motivation," "absorption," or "creativity," the "awareness of impressions" or "awareness of emotions" of the subjects (see Lucadou 2006). In this case, the "awareness of impressions," etc., can be regarded as an exo-system and the system of "impressions" as an endo-system. It is important to realize that the concept of "awareness of impressions" cannot be applied to the level of "impressions" themselves, but often such different levels of description are not clearly distinguished.

In general it is not always easy to avoid the illusion that psi is a kind of influence of the "mind over matter." It seems plausible that this misunderstanding is one of the reasons (in terms of sociology of science) why observer effects have been overlooked for such a long time in both physics and psychology.

From this point of view there seems to be no hope that a post-Cartesian science (Primas 1990) could ever enable us to heal the Cartesian cut by consciously sending real signals from "mind to matter." The "reunification of the world" or a "reentry into paradise" can only occur on a subconscious (dream-like) level. For this kind of "perception" the term "entanglement perception" (Lucadou 2014) seems to be appropriate. It can be considered as the "forgotten" category in the sense of the German philosopher Imanuel Kant, who described the perception of space and time and causality as fundamental categories of human perception. But in spite of the impossibility of conscious operationalization, psi effects demonstrate that the Cartesian separation between mind (*res cogitans*) and matter (*res extensa*) is less fundamental than we have been taught to believe.

The Model of Pseudo-Machines (MPM)

Another important application of the MPI is the description of the so-called man–machine interface. The issue is how psychological variables can be taken into account when a human user works with technical devices. The problem of the adequate "user surface" has a growing practical relevance. As an example, "homeopathic treatment" in medicine can be considered

as a technical process or as a kind of "machine"—in a very general sense, which we will call a "pseudo-machine." In this case the user surface is the homeopathic treatment or ritual (Lucadou 2002a,b, Lucadou & Grösser 1998). The MPM includes sociological, psychological, physical, and causal—as well as non-causal (ME)—processes that are relevant for the (homeopathic) treatment.

Definition: *"Real machines" are technical gadgets or devices and/or related technical manuals that have a clearly defined aim. They can be regarded as "amplifiers" or at least as "converters."*

Thus a block and tackle serves as amplifier and transformer of a force. A microscope is an optical amplifier. A hairdryer amplifies the property of air to dry the hair. A medicament is a machine to amplify the healing capacity of organisms. Only a few machines such as a computer are "universal." One could call it an amplifier for the velocity and rate of formal operations.

The aim of a machine needs not necessarily be of a technical nature. It can also be used for entertainment, healthcare, or education. An effective drug is in this sense a real machine, as is a musical instrument.

Definition: *"Pseudo-machines" are defined as technical gadgets and/or related technical manuals or rituals that are assumed to operate in an objective, purely physical way. Closer consideration, however, reveals that pseudo-machines refer to psycho–physical systems and contain hidden subjective, psychological components.*

Definition: *"Classical pseudo-machines" allow a clear-cut distinction between physical and psychological effects and are separable in this respect. "Non classical pseudo-machines" do not allow a separation between physical and psychological effects; both are entangled.*

As examples of classical pseudo-machines, most superstition instructions may serve: They only work psychologically, they include charms, astrology, precious stone therapy, consecrated, magnetized, or levitated water, the pyramid force, or tachyonic therapy. With aura photography, Kirlian diagnosis, magnetic and copper bracelets, there may be an underlying real physiological part. In general, however, such procedures are not sufficiently investigated or are too complex, so that a careful investigation seems hopeless (Federspiel & Herbst 1994). The underlying psychological mechanism of attribution cannot be recognized by the persons concerned and thus plays an important role with many classical pseudo-machines.

Examples of non-classical pseudo-machines can be found in the area of medicine and in border areas, so-called alternative medicine or complementary medicine. These include acupuncture, homeopathy, bio-resonance, and last but not least so-called spiritual healing. It is astonishing

that these methods, in spite of being discussed extremely controversially in conventional medicine due to their insufficient scientific foundation, are widely used by an increasing number of practicing physicians.

Within conventional medicine, several clinical studies have been started to investigate the action of these methods. The main issue is whether the method under study produces an "objective effect" that cannot be explained on the basis of suggestion, which is how placebos are explained. These studies are double-blind studies as well as epidemiological studies and also meta-analyses that allow comparison and summaries of different studies. The results are astonishing: Generally speaking, the studies show that the methods really work and that significant differences exist between the experimental and the control groups. They show that the results cannot be explained as a placebo effect, but are robust effects with a high statistical significance[7] (e.g., the study about paranormal healing by Beutler et al. 1987, the homeopathy study of Taylor et al. 2000, and the meta-analyses of "spiritual healing" by Roe, Sonnex, & Roxburgh 2015, Mathie et al. 2014). The main problem with these studies, however, seems to be their lack of repeatability.

For the authors of these studies, a simple theoretical explanation—in the sense of a causal mechanism—is out of sight; this becomes most obvious in the case of the homeopathy studies and the studies about spiritual healing. In both cases one is inclined to assume that a hitherto unknown physical effect leads to a measurable healing success without any conventional medical explanation.

The practitioner who applies homeopathy will discover that she or he is really successful in a great percentage of cases. Furthermore, since low dilutions in homeopathy may include causal effects, it can be expected from the third law of the MPI that this non-classical pseudo-machine creates large effects in real-life situations. Of course the practitioner does not measure this success according to the criteria that are necessary for a double-blind study. Those criteria are rigid but on the other hand rather secure methods to prove assumed causal relationships. If, however, feedback plays an important role in a treatment, then difficulties arise. During a homeopathic treatment, it is maintained that the physician observes the reaction of the patient and prepares his treatment and medication according to his observation. But this procedure is not possible in double-blind studies. With ME effects the same restrictions are valid, although due to different reasons. In this case the blind condition must be considered as a part of the system, and its influence on the whole system cannot be compensated. In the extreme, double-blind studies cannot be carried out without suspending the whole system. This means that the term "placebo" needs special consideration (Finniss et al.

2010): The clinical group as well as the "placebo" group may include both causal and entanglement processes that depend on the design (setting) and environment of a study.

Thus it is not a mistake to consider homeopathic treatment as a complex communication process among the physician, the patient, and the medicine, which cannot be separated into parts. This has been pointed out by Lionel Milgrom (2002, 2003).

Some theoretical models of homeopathy assume that the information of the effective substance is stored in the solvent—a hypothesis which is, from the point of view of physics, actually difficult to prove; there have been many attempts and they are theoretically possible, but very often not empirically viable—and can be described as an attempt to make the psycho–physical system separable. The MPI says that this is not only not helpful, but really hopeless.

From the viewpoint of the MPI the therapeutic ritual is of utmost importance and has to be considered as a relevant total system (Benedetti 2012). From this point of view there is a difference whether the medicine is produced in a lengthy production process (e.g., the homeopathic succussion) or a simple placebo is given. The production process and the whole treatment are essential parts of the pseudo-machines and they work—so to speak—as a "vessel" for ME. Again, we can recognize that a non-classical pseudo-machine shows a real effect but that the underlying mechanism is different from what the constructor of the machine believes it will be.[8]

This is quite an important condition, because it prevents the user from understanding the real working mechanism. The user starts from local effects, which means causal relationships able to be demonstrated in double-blind studies, but in this case the above-mentioned elusiveness will produce a decline of the desired effect. However, if this misjudgment prevents the user from misusing the ME correlation for a signal transfer, the second law of the MPI cannot be violated and the function of the pseudo-machines is optimal. This works rather well in homeopathic practice; however, it is not the case in replications of double-blind studies. In a replication study, it could be possible to use the knowledge that was received from the previous experiment to code a signal, for instance: recovery = medicament = 1 and no recovery = placebo = 0.

Therefore it is clear that pseudo-machines are not guaranteed to be long-lasting. The lifespan of classical pseudo-machines depends mainly on the psychological conditions and variables. The main factor is the slackening of fascination. However, it is possible that a sudden collapse of the system occurs if the function of the pseudo-machines is seen through by its user. In this case, the psychological conditions change instantaneously and the

function of the machine is reduced to its pure physical part.

Classical pseudo-machines are therefore reliable as long as the mechanism is not revealed and the psychological conditions are not changed. The exposure changes the psychological variables drastically but they can also change slowly if attention to and fascination with the assumed physical mechanism cease.

In contrast to classical pseudo-machines, non-classical ones are not reliable even if the apparatus, the setting, and psychological conditions do not change (decline and displacement effects). In this case, the exposure does not necessarily change the psychological variables if the OC of the whole system is not abolished. It would be a mistake to believe that skeptical persons would not be successful with psi experiments or would not have paranormal experiences, or, respectively, that homeopathy would not work for them. Very often the reverse is the case. The user who has no expectations that the machine will work is less able to violate the second law, because he or she does not really try to test the effect. He or she will not use the non-local ME correlations for a signal transfer. It is an essential condition, however, that the pseudo-machine is at least subconsciously fascinating for the user in order to establish the necessary OC.

As we have already described above, this means that the effect size of the pseudo-machines is a function (f) of the following systemic variables (device-specific variables are not under consideration here): the quality of documentation G, the number of repetitions N, the change of the procedure (novelty E), and "involvement" (dimensionality D). The effect size decreases if G and N increase and increases if E and D increase. It is important to note here that D depends on causal and potentially causal processes (Third Law of MPI). Since in homeopathy with low dilutions, causal medical effects (e.g., on the immune system)[9] may play a potential role, D may become very large and thus would lead to strong healing effects (see Table 1):

$$\text{Effect size} = f\,(G, N, E, D) \tag{5}$$

As a first approach, one could try the following attempt (theoretical estimate):

$$\text{Effect size} = E * \sqrt{(D)} \setminus G * \sqrt{(N)} \tag{6}$$

In general, experimental tests prepare the system to exhibit causal relations of (mainly) physical variables. As a result, the studies which test pseudo-machines are not independent from each other and thus a different experimental approach would be necessary.
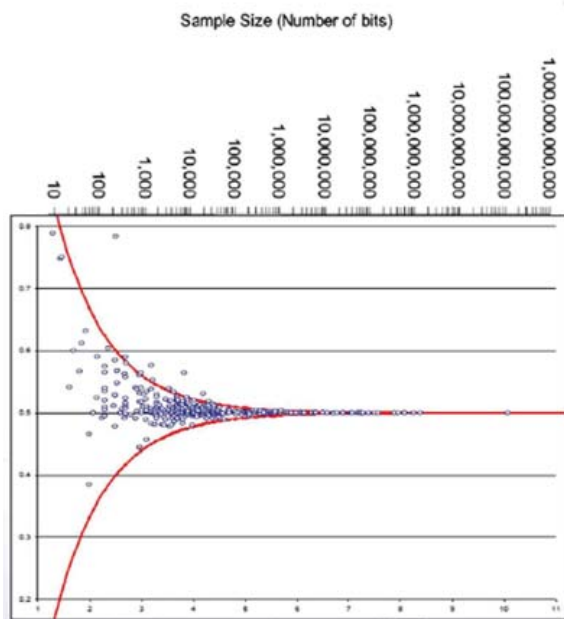
Figure 1. Funnel plot of 357 PK experiments and the predicted decline. Effect size ES 0.2–0.8 versus number of trials N (logarithmic scale).

Decline Effects

Whenever one deals with events or systems containing non-classical pseudo-machines or ME effects, the empirical results behave according to Equation (3) or (5). This means that decline and displacement effects will occur if the same situation or the same setting is being used in an attempt to replicate the previous results.[10] In parapsychology, the role of decline effects is a well-established fact. One could even say that it is the quintessence of all studies of a whole century of investigation (Lucadou 2001a).

The large database of published PK experiments (Bösch, Steinkamp, & Boller 2006) allows testing of the predictions of the MPI. From Equation (3) one can conclude that the accumulated deviation from the statistical expectation of a PK run must decline with the run length. Here we have made the assumption that the Z-score is a meaningful measure for the ME effect which means that it is used as a criterion for the experimental effect. Other criteria would of course yield different functional dependences in Equation (3).

A meta-analysis of 380 ME experiments (PK experiments, Bösch, Steinkamp, & Boller 2006) corroborates this prediction (Table 2). The

TABLE 2
Results of Meta-Analysis for FEM and MPI Theoretical Models

Method N = 380 studies, m trials	Weight of Effect Size	Z* (p, one-tailed)	Z** (correction for selective publication)
FEM (Fixed Effects Model) (Bösch, Steinkamp, & Boller 2006)	$G0 = n$ $= N \, xm$	−3.67 (.9999)	Not significant
MPI (Model of Pragmatic Information)	$G1 = \sqrt{n}$ $= \sqrt{(N \, xm)}$	13,1 (10^{-38})	10,5 (10^{-25})

funnel plot (Figure 1) shows overwhelming evidence for the decline of the effect size with the number of trials (c = 1.32 gives a good approximation in Equation (3), red curve in Figure 1).

Under the assumption that PK is a "signal," a "real deviation from expectation value" called "Fixed Effects Model (FEM)," the data do not show a significant effect (Timm 2007).[11] However, if the MPI model is taken into account by a weight of $\sqrt{n}$ in the statistical analysis of the above-mentioned meta-analysis, then the data show a highly significant effect (p $< 10^{-38}$).

The most impressive example of the decline effect after a strict replication is the replication study of the Princeton (PEAR) PK studies (Jahn 1981, Jahn et al. 2000). The authors write:

> A consortium of research groups at Freiburg, Giessen, and Princeton was formed in 1996 to pursue multidisciplinary studies of mind/machine interaction anomalies. The first collaborative project undertaken was an attempted replication of prior Princeton experiments that had demonstrated anomalous deviations of the outputs of electronic random event generators in correlation with prestated intentions of human operators. For this replication, each of the three participating laboratories collected data from 250 × 3000-trial × 200-binary–sample experimental sessions, generated by 227 human operators. Identical noise-source equipment was used throughout, and essentially similar protocols and data analysis procedures were followed. Data were binned in terms of operator intention to increase the mean of the 200-binary sample distributions (HI); to decrease the mean (LO); or not to attempt any influence (BL). Contiguous unattended calibrations were carried forward throughout. The agreed-upon primary criterion for the anomalous effect was the magnitude of the HI–LO data separation, but data also were collected on a number of secondary correlates. The pri-

TABLE 3
Effect Size of the PEAR Experiments and Its Replications
(numbers are from the figures in the references)
Effect size is defined as: $E_{hi-lo} = (T_{hi} - T_{lo})/n$, T = number of hits, n = Number of trials

First PEAR(1981) report	$E_{hi-lo} = 6000/13050$	= 0.46
All PEAR studies before replication	$E_{hi-lo} = 35000/834000$	= 0.042
Replication (2000) study	$E_{hi-lo} = 7070/750000$	= 0.0094

> mary result of this replication effort was that whereas the overall HI–LO mean separations proceeded in the intended direction at all three laboratories, the overall sizes of these deviations failed by an order of magnitude to attain that of the prior experiments, or to achieve any persuasive level of statistical significance. (Jahn et al. 2000:499)

If the results are compared with the first study of the Princeton group, which was published in 1981 (Jahn 1981), a strong decline of the effect size can be observed (Table 3).

It is evident that the effect size declines continuously with each replication. However, the "psi effect" does not disappear completely; it shows up in other variables in the post hoc evaluation. The authors state:

> However, various portions of the data displayed a substantial number of interior structural anomalies in such features as a reduction in trial-level standard deviations; irregular series-position patterns; and differential dependencies on various secondary parameters, such as feedback type or experimental run length, to a composite extent well beyond chance expectation. (Jahn et al. 2000:499)

See also Pallikari and Boller (1999), Pallikari (2001), Atmanspacher and Scheingraber (2000). This feature can also be found in a recent PK study (Maier, Deschamps, & Pflitsch 2018) with 12,571 participants where no PK effect could be found, but instead a difference between experimental and control data of fitted oscillator frequencies.

It should be mentioned here that on the basis of the MPI, a clear-cut prediction about the outcome of the replication study was made in advance (Lucadou 1987d). It was kept in the minutes before the final evaluation began, but, unfortunately, it is not mentioned in the final research report.

It had been objected that the review of the chronological sequence of the PEAR REG data (Jahn et al. 2000, figure 12 and associated discussion) shows a strong early effect, a decline to null performance, followed by an increase to strong effects again, which seems to be in stark contradiction to the assumption in Equation (3). In contrast, this is what is to be expected from the MPI and the GQT. 'No signal' does not mean that an extra-chance effect cannot occur, but the data must behave in such a way that they cannot be used to 'reconstruct' the initial conditions (HI, LO, BASELINE) on the basis of the random data alone. If in the second epoch (see figure 12 in Jahn et al. 2000) the data would have been the same as in the first epoch, an identification of the three conditions would have been possible. Therefore a return to a zero effect has to be expected by the NT axiom. As a result, in the third epoch such a criterion is missing and thus allows a "recovery effect."[12] And even a weaker criterion that would be available by combining the first two epochs is ruled out by the fact that in epoch three, the BASELINE condition cannot be distinguished from the HI condition. From this consideration it is clear that the given Equation (3) holds only for very simple situations. In real studies, it can be used only as a rule of thumb, which, however, fits astonishingly well. To make a more precise prediction, it would be necessary to know the history of each experiment and the development of the signal criteria, which can be derived from the data. This also includes changes in the setting during the experiment.

From the MPI perspective, both REG data—experimental and control (BASELINE)—differ by their pragmatic information. The meaning and the associated expectation (criterion of the NT axiom) are different: In the experimental situation one "wants" to get a deviation from the expected value—which, however, the NT axiom is preventing. On the other hand one does not want to get "deviations" with the control data but hopes that all statistical tests on randomness are passed (otherwise the REGs would be faulty!). This means that there are two different so-called WIENER processes that are affected in different ways by the NT axiom. Or psychologically speaking: There is a "meaningful" difference between an individual and a collective setting (embodiment) of the used random processes (see also Figure 3 below).

In homeopathy decline effects can also be observed (Walach et al. 2004, Walach, Michael, & Schlett 2018:202), and it is reported that the clinical effect changes to the placebo group in a replication study (Walach et al. 2000). An obvious example is presented in Figure 2: In four comparable replication studies, mainly two dependent variables can be used to measure the therapeutic effect: 1) The subjective visual analogue scale, and 2) Different objective measures such as histamine concentrations and nasal
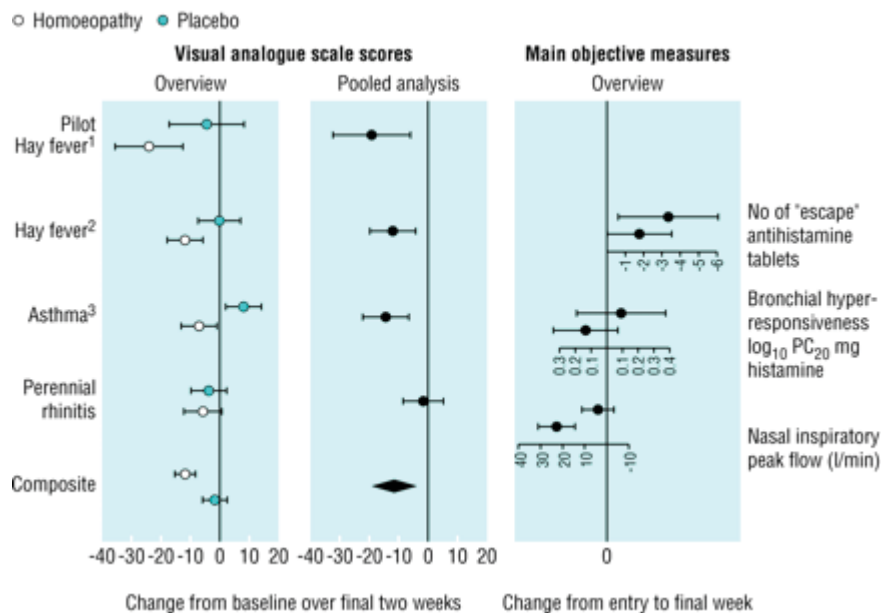
Figure 2. Decline and displacement effects in homeopathy (2000, *BMJ*, *321*, 471).

inspiratory peak flow. From a theoretical point of view, it is important that for all studies variables have been used that are comparable with each other and, alternatively, also non-comparable variables. If the model is correct that non-local ME correlation plays an important role, the MPI makes the following prediction (Lucadou 2001b). Due to the homogeneity of the studies it can be assumed that the OC of the whole system and herewith its non-local ME stays constant over the four studies.

1. *Decline effect*: The therapeutic effect measured with a comparable variable will decline during the replication studies in the same way that the statistic reliability of this variable rises due to the increasing number of cases (n).

2. *Displacement effect*: The therapeutic effect measured with non-comparable variables will rise and so to speak compensate for the decline of the effect size of the comparable variables—according to the third law of

the MPI—because the certainty to make a prediction in future studies does not increase with n for non-comparable variables, as the direction of the effect is unknown.

In general, the question arises whether decline and displacement effects may be nothing but random variations. Indeed, they look very similar; however, they are "stronger" (e.g., $c > 1$ in Equation 3), which means that they exhibit significant deviations "more often" than expected (see the Correlation Matrix Method, CMM, below). One could describe them as properties of "super-fluctuations."

Is Homeopathy Nothing but a Placebo Effect?

The usual opinion of skeptics about pseudo-machines is that they are nothing but swindle and deception and that in the interest of consumer ethics and protection one should debunk them. This position might be understandable as far as the providers maintain that a causal mechanism is responsible for the desired and promised effect of the pseudo-machine, because the promised effect is not reliable and will decline and finally disappear in any case; however, many inventors and producers of pseudo-machines behave honorably, in my experience, because they do not understand the real mechanism of pseudo-machines. And they are firmly convinced that they have invented a good product. Empirical studies, double-blind studies, and epidemiological investigations and meta-analyses are expensive and troublesome, and also experts make mistakes. One should be critical about pseudo-machines, but one should not make a claim of fraud against the producer. Fraud may also happen with real machines (e.g., diesel cars) and in this case there exists consumer protection. For non-classical pseudo-machines things are more complicated. There exist at least on the part of classical science massive prejudices, which brings many users into deep conflicts (Lucadou 1992a).

Usually they find out that the machines really work even under objective tests; on the other hand they do not understand why such strange displacement and decline effects as described above occur. This leads to so-called "rat-catching" (Lucadou 1994a). The concerned person cannot help but consent to the claimed "miraculous forces," which, however, have strange properties, such as one has to believe or one has to be gifted, or has to obey certain rules. Such arguments are often used by sects or cults and used as a self-immunizing strategy: If the machine does not work, the user has "blocked it mentally."

The important point is that non-classical pseudo-machines compared with normal machines work with quite different principles, namely
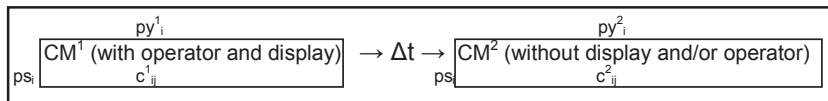
synergistic, collective, non-local, and holistic ME processes which are not worthless but which, however, cannot be described on the basis of classical stimulus–reaction chains. Often specific side effects occur which are still unexplored (Lucadou 2002a). From the viewpoint of the MPM, there are a lot of arguments to systematically investigate the application of non-classical pseudo-machines that may offer new possibilities. In any case it would be a mistake to believe that the small effect size that has been found in studies up to now would remain small if the mutual reinforcement of causal and entanglement processes were to be taken into account in future studies (Lucadou 2000b). The following paragraph may be regarded as a proposal on how causal and entanglement processes can be investigated with a combined method.

The Correlation Matrix Method (CMM)

The Correlation Matrix Method derives from the Brunswik's lens model (1956), where many psychological or physiological variables are measured and compared with many variables of behavior, in order to allow predictions of human behavior in psychology.

Similarly with CMM, many psychological variables are measured simultaneously before or during a PK experiment has started, and correlated afterward with many physical variables of a physical (random) process, which are also measured simultaneously during the PK experiment. This is done in two different settings, namely with and without feedback (control).

Only the number of significant correlations (due to a predefined criterion p) between psychological variables and physical variables of the PK experiment are counted and compared with controls (runs without feedback or runs without subjects). This can be described by the following schematic:

$$\begin{array}{|c|c|} \hline py^1_i & py^2_i \\ \mathrm{CM}^1 \text{ (with operator and display)} \to \Delta t \to & \mathrm{CM}^2 \text{ (without display and/or operator)} \\ ps_i \qquad c^1_{ij} & ps_i \qquad c^2_{ij} \\ \hline \end{array}$$

CM^1, CM^2 are the correlation matrices of a set of psychological variables ps_i and a set of physical variables py^1, respectively py^2 (same physical variables under condition CM^2). For CM^2 the same set of psychological variables ps_i is used as in CM^1. Δt is the experimental time interval between experiment and control.

The PK effect (entanglement correlation) shows up in the difference of number (and strength) of the correlations (CM^1–CM^2):

$$D = CM^1 - CM^2 = \Sigma m^1_{ij} - \Sigma m^2_{ij} \gg 0 \text{ (significantly)} \qquad (7)$$

$m^{1,2}_{ij} = 0, 1$: "1" means significant correlation $c^{1,2}_{ij}$ of the matrix cell (ij) according to pre-specified criteria: p (significance level of c^1_{ij}, c^2_{ij}, Spearman's ρ); n (number of runs/subjects). The matrix cell (ij) contains the correlation value c^1_{ij} of Spearman's ρ between the psychological variable ps_i and the physical variable py^1_j for all n experimental runs or operators, respectively. The same holds for the control data c^2_{ij}.

Since no signals are involved in the case of entanglement correlations, it is important to realize that both CM^1 and CM^2 can be "affected" by PK and thus they don't need to fit with the "theoretical" expectation values. For instance, it may well be that CM^2 (the so-called "control") shows smaller values than theoretically expected. Both CM^1 and CM^2 belong—so to speak—to the experimental setting and thus to the OC of the system. The maximal difference Dmax between both cumulative distributions of $CM^1(p)$ and $CM^2(p)$ for all $\rho \in \{0,1\}$ (of Spearman's ρ) gives an impression of the consistency of the effect.

Dmax can be used to compare different experiments (replications), with CM^1 denoting the number of significant experimental correlations, CM^2 the number of significant control correlations, and NC the total number of correlations in the matrix.[13] It has been proposed by Hartmut Grote (Grote 2015, 2017) to evaluate the α-error (H0/H1) with a Monte-Carlo simulation (MC). MC permutes the physical data for each experimental session and calculates the correlation value (Spearman's ρ) with the non-permuted psychological data for all permutations. The position of the experimental number of correlations CM1 in the distribution of CM^1 for all permutations gives the α-error (H0/H1) of MC. This method, however, may be useful for causal correlations but may underestimate H1 in the case of entanglement correlations. Due to the NT axiom, they create additional internal correlations (between the experimental sessions), which cannot be truncated by MC. Furthermore, MC may create additional spurious correlations: While the experimental data may not reach the so-called Van der Waerden limit (a measure for the appearance of regular patterns in a random sequence, see Calude & Longo 2016), it may well be that the MC data surmount it. In addition, the spurious correlations are stable, while this is not the case with entanglement correlations, but the latter cannot be distinguished algorithmically from the others. Thus, MC could lead to an overestimation of the α-error because entanglement correlations also contribute to the distribution of H0.

The cumulative distributions of $CM^1(p)$ and $CM^2(p)$ for all $p \in \{0,1\}$ can be regarded as a kind of "Bell's theorem"–shaped curve with two fixed
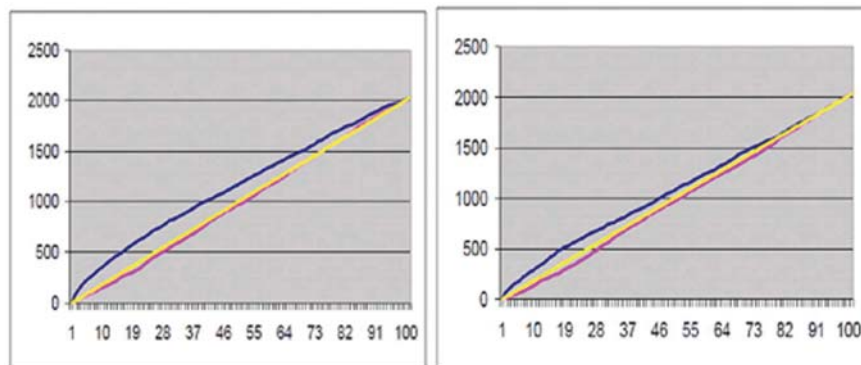
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Figure 3. **The cumulative distributions of CM¹(p) (blue, top line), CM²(p) (pink, bottom line), and CME(p) (yellow, middle line) of two subsequent experiments with identical settings showing decline and displacement. It shows that the control data CM² can exhibit fewer correlations CME than expected after an identical replication. x-axis: p ∈ {0,1} (of Spearman's ρ, in percent); y-axis: number of significant correlations (of NC = 2025 possible correlations).**

points, (0,0) and (1, number of all correlations), which allows us to see the effect of entanglement on both the experimental matrix as well as on the control matrix in comparison with the expected curve CME(p) for H0. In Figure 3 two identical replication studies are shown: It can be seen clearly that in the second study CM¹(p) is smaller than in the first study (decline) and due to the NT axiom CM²(p) is smaller than CME(p), which means that in the control matrix there are fewer correlations than expected by chance (H0) (displacement), while Dmax between CM¹(p) and CM²(p) remains almost the same as in the first study.

It is very important, though, to understand that the CMM precludes the interpretation of these effects as causal correlations or signals. Rather, they should be understood as non-local, generalized entanglement correlations, following the model of GQT. The necessary framework conditions can be construed as follows: There is a connection between physical and psychological or intentional systems, or the random process and the human operator. Both are joined together in the systemic OC in the sense of Varela (1981) of the experimental setting. The latter is created by the experimental instruction, by the participant consenting to take part, and the physical process that is attributed to by the meaning of the instruction. The matrix describes the correlations of the psychological variables of the experimental runs with the physical variables of these runs (see Figure 4). Theoretically,
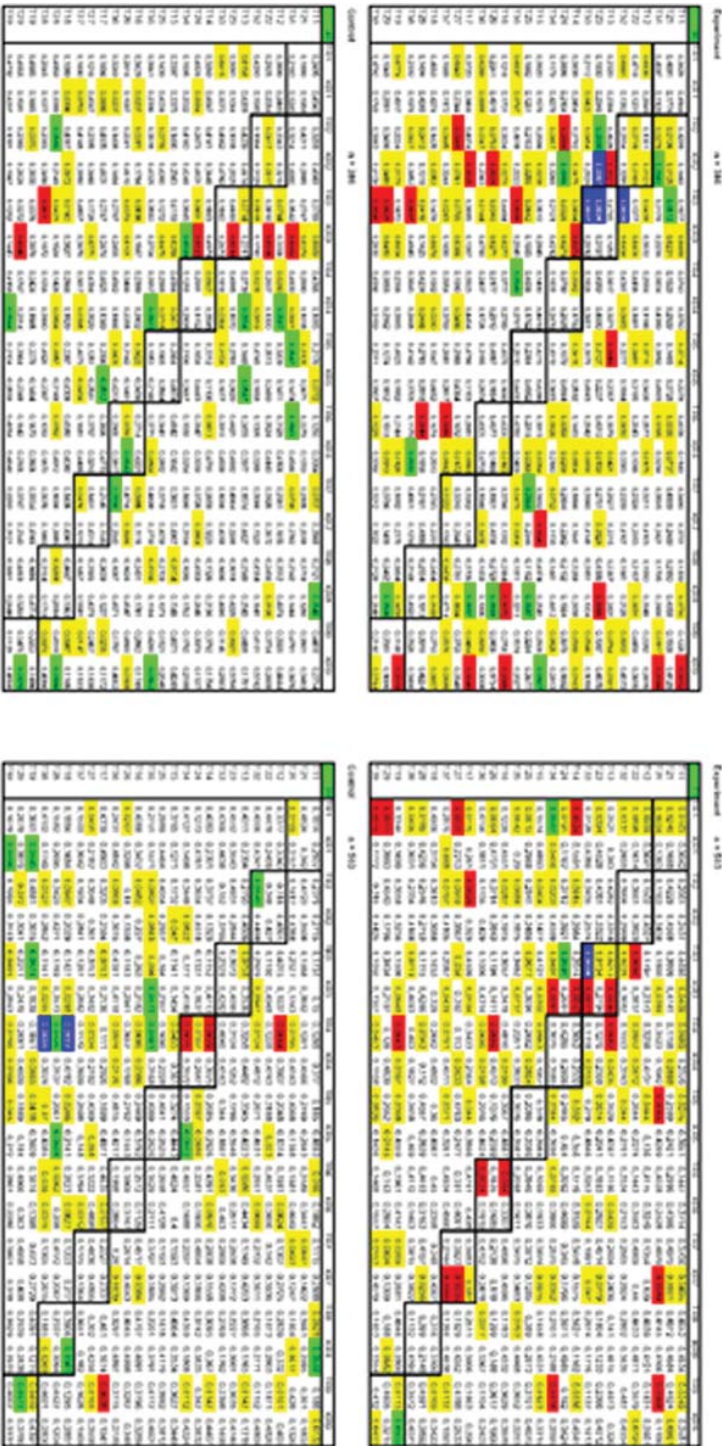
Figure 4. Identical replication of a PK experiment (Lucadou 2006). The upper right experimental matrix CM1 shows the significant correlations between psychological variables (rows) and physical variables (columns). The lower right matrix CM2 shows the same for the control condition. The left two matrices show the same variables of a replication study (part of Walach et al. 2016, 27 variables excluded) for comparison.

these correlations could be of causal (local) origin. This, however, is impossible due to the physical separation of the subject and the shielded random event generator. It is not to be expected that a kind of "psi signal" (tracer) can be isolated (Lucadou 1986a,b, 1987b,c). However, it cannot be excluded that under certain conditions a kind of "pseudo-signal" could be found (Lucadou 1989a).

One can clearly see that the significant cells of the matrices (indicated by colors) change their position in the matrix with the identical replication of the experiment. A split, half-evaluation (see below) of each study shows that no signals or causal links could be found in either study. However, in both studies "psychological variables" button-pushes during the course of the 9 runs were used (for details see Lucadou 1986a,b). This leads to the possibility that subjects may be able to memorize the previous trials in order to achieve more hits. Although this possibility is rather unlikely and no indication could be found in the data,[14] this could be considered as a "potential causal link" in the sense of the third law of MPI. Therefore it can be expected that the diagonal of the experimental matrices (and to some extent the cells below the diagonal) show more and higher correlations than the upper part (above the diagonal) of the matrix. It can clearly be seen in Figure 4 that indeed this part of the matrix shows more and higher correlations. Only the upper part (above the diagonal) can be considered as a proof for ME correlations. But since no indication for real causal signals could be found, this can be interpreted as the amplifying effect of potential causal links for entanglement as predicted by the third law of MPI. This is exactly the situation homeopathy has to deal with.

A clear indication for entanglement correlations in contrast to causal correlations is a result of the NT axiom: If the experiment is repeated under the same conditions, the value of single correlation c^1_{ij} (matrix cell) cannot be maintained but must change if and only if it shows up to hit the predefined significance criterion ρ. Since the overall matrix entanglement does not disappear, the significant correlation has to show up at a different matrix cell c^1_{kl} in such a way that the number (and strength) of all significant matrix cells is preserved, $CM^1 = \Sigma m^1_{ij} = const.$

In order to minimize the variance of the investigated correlations, classical experiments with many psychological (and physical) variables aimed to use only factorized (orthogonal) variables. This, however, does not hold for non-local entanglement correlations.[15] In this case, using "superpositions" of variables (non-orthogonal variables) is of advantage, because only then can a difference between a local and a non-local correlation be measured. In other words: The Bell inequality in physics is only meaningful for correlated and not for orthogonal variables as

orthogonal variables are by definition unrelated. This means in the context of the CMM: If the psychological (and physical) variables with the CMM are dependent on each other, it is easier for the NT axiom to shift the correlation from one matrix cell (ij) to a different one (kl):

ps_i not orthogonal with ps_j
py^1_i not orthogonal with py^1_j

ps_i (respectively py^1_i) is correlated with ps_j (respectively py^1_j) to allow
a shift due to the NT axiom in order to maintain:

$$\Sigma m^1_{ij} >> \Sigma m^2_{ij} \tag{8}$$

As a consequence, the use of orthogonal factors fs^1_i and fy^1_i derived from the psychological variables ps_i and the physical variables py^1_i would lead to a much smaller difference Dmax of number (and strength) of the correlations ($CM^1 - CM^2$).

This can be used to test for non-local entanglement correlations, because the signal model of psi would predict a larger difference due to a reduction of variance. Furthermore, the displacement of non-local entanglement correlations with any identical replication of an experiment and the fact that even rather strongly correlated variables do not exhibit the same entanglement correlations leads to a different understanding of the term "correlation" in this context: ME correlations do not primarily exhibit "dependencies" and "processes," but rather "patterns" and "fluctuations" within the organizationally closed system.

This might sound as if the MPI predicts that repeatable psi experiments or homeopathy studies are not possible at all, because they violate the second law in any case. However, that would mean "throwing out the baby with the bathwater." On the contrary, the decline effect is at least partially avoided by circumventing the NT axiom, but a certain elusiveness cannot be avoided in principle.

In Table 4, all experiments where CMM was applied are presented. The psychological variables (Lucadou 1986a,b, 1993, 1994a,b, 2006, 2011, Lucadou, Lay, & Kunzmann 1987, Radin 1993) were measured before the PK experiments (Lucadou 1986a,b, 1991c) by standard personality questionnaires. Only in the last two studies (Lucadou 2006 A,B in Table 4) were the psychological variables behavioral variables (pressing of buttons, for details see Lucadou 2006). The physical variables were several statistical test values, which describe properties (such as mean value, variance, autocorrelation, etc.) of a binary random sequence (Markov chain) produced

TABLE 4
Results of All Correlation Studies

Publication	Subjects	Psych	Phys	N_{cor}	N_{sig}	N_{cont}	N_{expt}	D_{max}
Lucadou 1986a,b Markov	299	24	23	552	34	11	55	23
Lucadou 1986a,b Schmidt	299	24	22	528	11	4	53	7
Lucadou 1986a,b Reanalysis	299	63	32	2016	1413	1322	1371	91
Lucadou 1991a,b	307	16	8	128	28	13	13	15
Lucadou 1991a,b Reanalysis	307	43	56	2408	2019	1937	1999	82
Radin 1993	1	16	23	368	32	17	37	15
Lucadou 2006 A	386	27	18	486	161	105	49	56
Lucadou 2006 B	386	27	18	486	42	40	49	2
Braeunig & Faul 2010	22	24	9	216	17	10	22	7
Walach et. al. 2016*	503	45	45	2025	■	249	■	101
Grote 2017	20	6	5	30	6	1	3	5
Jolij 2016	105	10	60	600	82	52	60	30
Flores 2017, 2018*	213	45	45	2025	■	340	■	269
Flores, Watt, & Tierney 2017*	200	45	45	2025	■	254	■	224
Flores, Tierney, & Watt 2018*	201	45	45	2025	■	371	■	198
Kirmse 2018	64	45	45	2025	907	805	830	102

Psych = number of psychological variables,   Phys = number of physical variables,
N_{cor} = number of correlations, N_{sig} = number of significant correlations (p = 0,1),
N_{cont} = number of significant correlations in control experiment (p = 0,1),
N_{expt} = number of expected correlations (p = 0,1), D_{max} = max Difference;
* The details are hidden, because these studies are still unpublished.
The overall significance for all studies is rather high: ($CM^1 - CM^2$) < 0,0001.

by a quantum physical random event generator. The physical random event generator was carefully shielded against any physical influence on the subjects.

It turned out that in all studies, the overall distribution of the physical variables showed no deviation from the theoretical expectation values for both experimental and control conditions. Several techniques were applied to find a PK signal (tracer) within the experimental random sequences, but none was found. This is a strong argument for the assumption that

indeed no signal transfer between the observing subject and the random event generator was involved. Nevertheless, the number of (significant) correlations between the psychological and physical variables is increased for the experimental runs, compared with the number of correlations of the control runs.

Dmax depends primarily on the OC of the system. This can mainly be seen in two experiments (Lucadou 2006 B in Table 4). Both studies had an identical design and were carried out in parallel. The latter (2006 B), which was not significant, was performed by unselected subjects with low motivation (during an exhibition), whereas all significant studies (Lucadou 2006A) were performed by highly motivated subjects, who came to the lab because they were interested in taking part in a parapsychological experiment. A more detailed analysis shows, however, that the unselected subjects (2006 B) were not completely unsuccessful. A subgroup, which showed more innovative behavior, had an increase in correlations. The studies by Walach (2014), Walach et al. (2016), and Walach and Horan (2014), and the three unpublished studies by Flores et al. in 2016, 2017, and 2018 that are direct replications of the Lucadou (2006) study.

Although no "PK signal" could be found in individual random sequences, the excess of experimental correlations in Table 4 seems to constitute a "signal" at first glance. One could, for instance, use the difference D to code a signal by repeated studies. This would, of course, be very difficult, but cannot be excluded completely.[16] However, this argument is only true if, and only if, the individual correlations between a given psychological and a given physical variable were stable when the experiment is repeated. But in accordance with the MPI, this is obviously not the case (e.g., see Figure 4). The "signal" is only a pseudo-signal. This fact, however, does not exclude the possibility that certain pairs of psychological and physical variables show stronger correlations which occur more frequently with replications. This means that certain regions in the correlation matrix may show a somewhat predominant structure, indicating certain characteristics of the psycho–physical system in question, but it does not mean that a signal is hidden in the matrix.

Conclusions

With CMM, one could even try to include causal processes within parapsychological experiments. In nature, entanglement and causal processes create and support each other in organizationally closed systems (third law of MPI), and this mixture has of course the a priori structure of making it impossible to use entanglement correlations separately and only for potential signal coding. In parapsychology one tries to isolate entanglement

processes in order to prove a "psi effect." In homeopathy and CM such an approach of isolating entanglement is counterproductive. But CMM gives us the opportunity to separate the causal correlations from the entanglement correlations.[17] Whereas the causal correlations in the experimental matrix remain stable at the same place and strength in the matrix, the entanglement correlations change their place (variables) and/or strength. For this reason one could even set aside control experiments.

For homeopathy studies, CMM can easily be adapted: The psychological variables (usually considered as "independent") will be replaced by "treatment" variables, such as type of diseases, of medicaments, dilution, doses, duration and frequency of application, therapeutic conditions, expectation, attitude and compliance of the patient, expectation and attitude of the therapist, and so on. The physical variables (usually considered as "dependent") will be replaced by all clinical variables that may be a measure of the success of the treatment. Figure 2 may serve as an example: The treatment variables would be "hay fever," "asthma," "perennial rhinitis," "dose of remedies," and the clinical variables would be "escape of antihistamine tablets," "bronchial hyper-responsiveness Log_{10} PC_{20} mg histamine," "nasal inspiratory peakflow(l/min)," etc.

It is obvious that this will abandon the traditional experimental strategies of parapsychological studies because "normal" processes are not excluded, and of clinical studies because entanglement processes are included. In historical, qualitative, naturalistic experiments in parapsychology, "cues" and "flaws" were difficult to rule out, but to some extent they provided "big" effects. In homeopathy and CM it is obvious that causal processes cannot be ruled out, but with CMM they can be separated from the entanglement correlations. Thus CMM can also be used as a new and efficient tool for drug testing and in therapy research: Specific causal effects can be isolated from specific entanglement effects. These are the causal correlations.

Notes

[1] Meanwhile the theory has been further generalized and simplified (Filk & Römer 2010). Observables can be reduced to complete spectral families of compatible propositions. There is no need to define an action of observables on states, defining an action of propositions suffices.

[2] For this purpose it would be necessary to show that for instance the observables "novelty" and "confirmation" are complementary, or for example the pair "magical belief" and "embodiment" (see below).

[3] This makes the MPI—among others—a generalized quantum theory, as the impact of measurement on the measured object is both the defining

feature of a quantum system and the reason why incompatible observables are present.

4 In the meantime, von Weizsäcker's idea of pragmatic information has had an increasing influence in many fields, as the whole issue of the journal *Mind and Matter*, Volume 4, Issue 2, 2006, demonstrates.

5 Some critics of the MPI maintained that the concepts of the model are too vague and do not allow operationalization and falsification. Several experimental studies (Lucadou 1986a,b, 1993, 1994a,b, 2006), however, demonstrate how this can be performed in detail.

6 This is also a limitation that may be important for the IDS model (May, Utts, & Spottiswoode 1995).

7 This depends on criteria: If a set of multiply replicated studies of one intervention in one disease is required this condition is often not met; if just a generic study and meta-analyses across different types is taken, then it is proven.

8 It is interesting to observe that Hahnemann, the inventor of homeopathy, seems to have sensed this as he spoke decidedly of a "geistartige Wirkung der Arznei," a "spiritlike action of the remedy."

9 It is important to note here: Through the succussion process in glass there is always a robust amount of solutes such as silica, borate, etc., in the solution, equivalent to about 10E-6/8 which may also represent a global causal immune stimulator. This has been formulated formally into the silica hypothesis of homeopathic effects by Anick and Ives (2007).

10 An "experiment" in this context is a situation where the comparator is generated within the experiment itself, i.e. through a control group, while in naturalistic situations or in the entanglement experiment of physics there is no comparator except either theoretical expectation or life experience. This is also the reason why naturalistic settings such as simple remote viewing studies show little or no decline.

11 Only for the FEM is a symmetric funnel-plot to be expected, because all deviations from the assumed "real PK-effect" are statistical fluctuations. This is not the case for the MPI because there is no such "PK effect." Thus the heated rebuttal in the same journal about selective reporting is of less importance from the point of view of the MPI. With FEM one could also assume that the velocity of the trials causes a decline, but this would roughly be proportional to $1/n$, if the time for a single experiment were always the same.

12 The recovery effect and its opposite, the Meta-Analysis Demolition (MAD) effect (Houtkooper 1994), which describes the failure of replication after a meta-analysis, cannot be understood by the FEM (Table 3) unless some ad hoc assumptions about psychological factors are made.

[13] However, D_{max} cannot be used to estimate the α-error, as Hartmut Grote could show (personal communication). Therefore the difference $\alpha(CM^1-CM^2)$ of the α-error (H0/H1) of two Monte Carlo simulations (MC) for both experimental and control data is given in Table 4.

[14] The details of all these experiments show indeed that the 9 hit variables, for which feedback is given, show rather weak correlations on and below the diagonal (backward correlations), and if they do, they are not stable. The other 4*9 physical variables are not visible for the subject and thus cannot be used to achieve causal correlations; nevertheless, they show stronger entanglement correlations.

[15] One might argue that the value of Dmax is overestimated in the case of non-orthogonal variables, for instance using the same variable several times would give an $r = 1$ correlation among these variables; for completely independent variables $r = 0$. The MPI predicts (third law) optimal values for $CM^1 - CM^2$ for variable correlations of about $r = 0.5$. This could be tested in future experiments. In fact, the data show that even rather strongly correlated variables do not exhibit the same ME correlations. Since only CM^1 and CM^2 are compared, any causal effect (which could surmount the shielding) will appear in both non-orthogonal variables simultaneously in CM^1 and CM^2 and thus can be identified.

[16] A possible decline would, however, be located at a meta-level and therefore its functionality could be smaller than $1/\sqrt{n}$. However, since no signals are involved in the case of entanglement correlations, it is important to realize that both experimental and control matrixes can be "affected" by psi and thus they don't need to fit with the "theoretical" expectation values. As shown in Figure 3, it may well be that the so-called "control" shows smaller correlation values than theoretically expected. Both belong—so to speak—to the experimental setting and thus to the OC of the system.

[17] In the two correlation matrices CM^{1a} and CM^{1b} of the split data (a, b), the number and strength of causal correlations remains stable in relation to the selected p criterion, whereas a decline can be observed with the entanglement correlations when the p criterion is sharpened. By comparing the two correlation matrices CM^{1a} and CM^{1b}, one can identify those correlations in the two matrices that are located at the same cell c^{1a}_{ij} and c^{1b}_{ij} and which do not change the correlation value of Spearman's ρ when the p value is lowered. These are the causal correlations.

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