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DEBATE: ENTANGLEMENT AND HOMEOPATHY

Entangled—and tied in knots!

Practical consequences of an entanglement model for homeopathic research and practice

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The assertion that 'local' theories of homeopathy are traditional appears to be contradicted by Hahnemann's description of the action of homeopathic medicines as 'spirit-like'. Entanglement theory prohibits the use of entangled states to convey information. Experimental proof of entanglement can only come indirectly. The implications for clinical research include that positive results will probably be found only in large series and that studies should avoid imposing a causal framework. *Homeopathy* (2005) **94,** 96–99.

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It is with great satisfaction that we see Dr Fisher taking up the issue of theory in homeopathy, recognising the potential importance of the issue.[1] Although we are grateful for the open, scholarly, collegial and even humorous style, with which he handled the issue during various stages of submitting and refereeing, it is worth pointing out some potential for misunderstanding, as well as some important practical consequences, which have not been sufficiently recognised. This commentary is intended to further the debate, as well as bridge some gaps.

It is certainly not the case that the 'localists', who maintain that the presence of some information conserved in the remedies is responsible for homeopathic effects, are closest to the homeopathic tradition, unless one restricts 'tradition' to the last 40 years, when the hypothesis of information conservation in water structure was first put forward by Stephenson, Smith and Barnard.[2–5] Hahnemann seems to have been aware of potential theoretical problems, although he did not know of Avogadro's number when he experimented with high potencies. He always spoke of 'geistartige Wirkung der Arznei—spirit-like action of a remedy'. What else than an essentially non-local concept could such 'spirit-like' action be? Of course, one could use the modern concept of information to reformulate Hahnemann's model. But we have not yet made clear how information could be conveyed. If we go back to subtle material structures—hydrogen bonds, microclusters or clathrates and the like—we are back at material actions. Without taking refuge in a duality of mind and matter, which we certainly do not subscribe to,[6,7] it is worth noting that the modern localists are disregarding this first non-local attempt offered by Hahnemann, and that they do not represent the traditional way of theorising about homeopathy, but a scientifically viable modern version of it. It is sometimes useful to remind ourselves of the original concepts from which homeopathy grew. The modern non-local model is closer to Hahnemann's 'geistartiger Wirkung der Arznei' than any subtle-materialist hyposthesis.

Belon *et al*'s results using the histamine model are very important.[8] It is a repetition of earlier work and hence seems to suggest replicability. Mistakenly, however, they are seen as new data by some. Essentially they are a more complete publication of an earlier one.[9] In this publication it is for the first time possible to look at the data more closely. And a closer look is revealing: the significant result is due to pooling of all four research sites, and it is driven mostly by large effects in some of the experiments, while other experiments were negative with no effect observed, other experiments had small tendencies in the opposite

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direction! The variability of the data is huge, the difference from control is far from stable across experiments, and if our reading is not mistaken the effect is not clear-cut. This is not to negate the importance of Belon's *et al* findings. On the contrary: they are important, because they reveal the very structure that would be predicted by an entanglement model of homeopathy. This leads us to the practical consequences: The different structure and expectations of results within a causal testing mechanism such as a blinded RCT.

Most publications on the non-locality hypothesis of homeopathy have not made clear one of the most important and relevant points: If homeopathy is based on an effect or some form of entanglement then the effects cannot be treated causally.[18] If they are treated as such, they go away, change channel or do something crazy. The latter we partially observed in a recently published proving with three arms, one placebo, and two different remedies[10]: We saw significantly more symptoms typical for one of the tested remedies, *Calendula*, in the group that took *Calendula*. We also saw a tendency to more symptoms typical for *Calendula* in the group that took *Ferrum muriaticum*. The combined verum groups showed a clear difference from placebo. The effect was not observed in the placebo group, but was smeared across the two active groups. Again, this is only pilot data and was meant to study the effect more closely. But our recent proving reproduced one element of the effect: it was not restricted to the group actually ingesting the substance.

If homeopathic effects are due to some form of entanglement, we need to change our research approaches. The reason is similar to Pascal's wager: Pascal reasoned that we cannot prove God's existence. But if we are to bet it is safer to bet on His existence than non-existence. Because if He does not exist, we don't lose much by living a life that honours His existence, but if we live according to the bet that He does not exist, we may lose much, if He in fact does exist. We do not suggest that the phenomenon in question has anything to do with God or His existence. The point is: if entanglement is at the base of homeopathic phenomena, but we treat them like causal and local signals, we lose a lot. But if in the end the entanglement hypothesis turns out to be bogus and our reasoning and instruments too crude to have discovered a subtle local process, and the entanglement hypothesis receives the IGG-Award of the Journal of Irreproducible Results (and it has already received the attention of The Guardian's 'Bad Science' column), we have not lost anything, except some paper and important hours of life thinking about it.

This has to do with the nature of entanglement phenomena. It was observed rather early in the debate around quantum entanglement, by Eberhard[11] (quoted by Burns[12]), and subsequently by Wootters,[13] that entangled parts of a system must not be used for signal coding, and all potential for signal coding must be avoided, otherwise entanglement is broken and disappears. This seems to contradict practical attempts at using quantum entanglement for teleportation and cryptography, which have shown it to be possible.[14,15] The basic idea is the following: suppose I share pairs of particles with a friend in another galaxy. Whenever I measure something on earth, a particle drops instantaneously into a definite state in the other galaxy, which is dependent on my measurement. The correlation is perfect, but meaningless, because we do not know the meaning of the measurements. Quantum teleportation or other applications of quantum entanglement need a classical channel, a code that defines what is meant by the entangled measurements. As long as the information about the meaning of the code is contained in a separate channel, all is well. As soon as one tries to use the entangled particles themselves to also provide the code, entanglement breaks down. In other words: as soon as one tries to treat entangled elements causally, entanglement is destroyed. Otherwise time-reversal paradoxes could be created, and entanglement could be used to transmit faster-than-light messages, contradicting special relativity. We could construct scenarios and paradoxes in which I use backwards in time messages, kill my own grandmother and prevent my own birth, etc.[16] It is not necessary to grasp all the details except one, we can call it the information-transfer prohibition theorem[17]: It is prohibited to use entangled states for conveying causal messages.

A clinical trial can be seen as an attempt to discover a causal signal: controls are seen against treatment, and we extract extra information from the treatment group. For the first trial this would not matter, since we do not know what to expect. But, once we have the results of the first trial we could use the results to code a message: We take the mean of an outcome measure. Everyone above the mean we call a hit (treatment), everyone below we call a miss (placebo), and we have an elementary code. Using more replications would distill the code more clearly, because the margins of error become smaller. Hence, if homeopathic effects are due to entanglement, and *if* trials or experiments are repeated, they could be interpreted and used as causal signals and hence—theoretically—used for coding messages. This violates the information-transfer prohibition theorem. The entanglement hypothesis predicts—at least for replications—that effects disappear, switch channels, do anything to avoid message coding. Put bluntly: The effect refuses to replicate the harder we look for it. This is, as everybody familiar with the homeopathic clinical trials literature knows, is exactly what is seen. First attempts are very often promising. Second attempts less so, further replications very difficult; no single finding has been reported with a direct replication and positive results after the second attempt. David Reilly's series of trials of isopathy uses an ingenious trick, probably not even consciously: In every trial a slight

modification is introduced allowing it to be seen as a new trial.

This does not mean that the effects cannot be captured experimentally. However, one has to respect the boundary conditions: the number of degrees of freedom of the system have to be large for the effect to occur; it is best not to use a single outcome variable and one-sided testing but an index that combines different measures; a meta-statistic is probably even better. Since we do not understand these effects well, it is difficult to formulate clear guidelines at this point, except those we know comparatively well, what not to do: placebo-controlled trials and experiments that force the effect into a causal framework. Some other experimental suggestions and predictions including possible experimental tests have been made.[18] This analysis indicates that the production process may play an important role. We have shown that such effects can be captured experimentally, although in a completely different experimental setting, which seems to be reproducible.[19,20]

Experimental proof can only come indirectly, ie not accessing entangled states directly, but through some experimental set-up that leaves the effect undisturbed. This is what happens in routine practice: No one tries to code a causal signal, and this is probably why it works well. As everyone who practices homeopathy knows, homeopathic remedies are not completely reliable, and sometimes don't work, when they should in theory, and sometimes work very well, when they should not. This might be due to practitioners trying to 'prove' to themselves or to their patients the local-causal nature of remedies, for instance by predicting effects. This is the same as coding a message through the effects of a clinical trial, and has the same consequences: the effect becomes unreliable, goes away altogether, or does something weird.

The history of homeopathy is full of examples where initially stable effects became unreliable. Through a change in theory or practice, which re-establishes a broken entanglement, the original or even stronger effects can be observed. This was true for Hahnemann himself, who until the end of his life experimented with new ways of applying and preparing homeopathy, without a really consistent rule. It is true for today's practice, where practitioners with a wide variety of apparently incompatible prescription habits have similar and good effects. New theories of homeopathic practice continually emerge and seem to be successful, until even those new miracle cures break down to be replaced by other ones. This is not to say that homeopathy does not work. It does. But it's 'mechanism', if one takes the phrase with due caution, is not based on causal and local, but on non-local processes. The earlier we take this option into account the higher the chances that our practice and research will be more effective.

So, is there a chance for research to find effects on the long run, or will this always be a race between a tortoise and a hare? There is a chance. Here are some rules of thumb:

- Statistical significant effect against a blinded placebo control will probably only be detectable across long series of experiments in a meta-statistic. Therefore, one should opt for many replications of easy-to-do, relatively cheap experiments, which can be readily repeated.
- Because clinical trials are expensive and complicated, it is not likely that a clinical model will, in the long run, be able to prove homeopathy superior to placebo.
- If, for political or scientific reasons one wants to repeat a placebo-controlled study, one should avoid pressing the effect into a causalist framework. Using multiple variables to form an index, using multivariate statistics, shifting main outcome criteria across sequential studies, not defining predefined magnitudes or domains for effects.
- The best strategy in clinical research, however, would be not to probe the causal-local nature of remedies at all, ie bracket out the placebo question. This can be done by pragmatic trials comparing the homeopathic approach against a conventional one, by cohort and observational studies in routine practice, or even by combination remedies, where the effect cannot be exactly traced. But even here we will eventually hit the same wall.
- In an experimental model, one option to avoid the causal trap would be to use a system with many degrees of freedom, not defining the direction of the effect—ie using two-sided test-models and two-tailed statistical tests. In an EEG model we have found correlated EEG-signals of separated persons—an analogue to a generalised entanglement set-up.[19] This model was successful in demonstrating such an effect, and it remained stable in replication.[20] The reason for this is very likely that the set-up is not useful for coding a causal signal, because a second, classical signal has to be accessed to extract the information from the two entangled series of data. To implement this strategy in an experimental model of homeopathy research, one could, for instance, use a second line of coding that defines, after the experiment has been performed but before analysis, which parts of the data to use, the rest should be destroyed physically. This could be done by running multiple controls, for instance, and deciding at random which control group to use, then destroying the rest of the data. Thus, no one could tell from only looking at the data, which data-point is likely to belong to the treated and control group, and hence no signal-coding would be possible.

We recognise that the procedures suggested here rest on very shaky ground. They are based on a wager: if the foundation of the bet is true, we win a lot. If not,

we do not lose much. But we submit that a lot speaks in favour of accepting the wager.

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