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- *Articles*: Smith, L.J. (1990) An examination of astrology. *Astrological Journal*, **13**, 132-196.
- *Books*: Naranjo, X. (1902) *The End of the Road*. London: University of London.
- *Chapters*: Griff, P. (1978) Creationism. In D. Greengage (ed.) *Pseudoscience*. Boston: Chapman Publishers.
- *Electronic material*: Driscoe, E. Another look at Uri Geller. <http://www.etc.org>. Accessed 21 April 1997.

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EDITORIAL

Michael Heap

Chairman of ASKE

These days, most of my anecdotes begin with 'Many years ago'. Hence they are susceptible to all the distorting influences of long-term recall. They are also subject to the criticism 'You can't rely on anecdotes'.

Nevertheless. I increasingly find myself relying on anecdotes when writing, for the simple reason that anything else I might have to say is often based on information that is available to everyone on the Internet. Anecdotes don't usually suffer from this problem.

Here's an anecdote that is relevant to one of the papers in this issue of the *Skeptical Intelligencer*, namely Dr Martin Wallace's account of the placebo effect. Many years ago a woman wrote to me to ask if I could give her some hypnotherapeutic treatment for psoriasis. She had read an article by a medical doctor in the newsletter of an organisation for people with this condition. The doctor had some experience of treating psoriasis with hypnosis and he believed it to be beneficial.

To be frank, the research literature on psychological approaches to the treatment of psoriasis was pretty limited at that time and the outcomes hardly impressive. However on enquiry it transpired that this woman's condition only appeared when a close relationship ended several years previously (cue for Freudians to dip their oars in here). There is some evidence that certain medical conditions that appear to be associated with emotional distress may respond favourable to (though not necessarily be cured by) a course of relaxation and anxiety management.

After reading her letter I rang this lady to explain that I could not see her immediately but it was possible that a colleague would be able to do so. She then told me that since reading the article and writing to me, her psoriasis had been much better. She could hardly believe it and was obviously delighted. Of course, some conditions wax and wane over time so it might just have been that, purely by coincidence, she was going through one of her better periods. With this in mind I told her that I would speak to my colleague and if he was willing to see her I would get back to her.

The next time I rang her she revealed that her psoriasis had all but cleared up! This had never happened in all the years she had had the condition. She felt so confident about this that she declined the offer of any treatment but we left it that she could contact me again if the problem recurred. I did not hear from her again, but that in itself tells us nothing.

I recall only one similar case, a woman with insomnia who rang me before her appointment saying that since receiving her appointment letter she had been sleeping well. We nevertheless agreed it best that she should attend, and when I saw her she was delighted to tell me that her progress had been maintained.

So, psychological therapy is just placebo? At one of the early European Skeptics congresses I attended, an American Professor of Psychology gave a talk in which he opined that psychotherapists are 'placebo practitioners'. I recall that at the outset of his talk he informed us that some of his ideas were the outcome of useful discussions with his university colleagues over coffee in the academic common room. I believed him.

I can honestly say that for the most of the hundreds of patient and clients I have seen over the years, 'the placebo effect' has been an unanswered prayer. Take this typical scenario. Mrs Smith comes to you full of worry, anxiety and unhappiness. You spend the session listening to her and saying what you can to give her some hope. Next week she comes back smiling and says that since talking to you she has felt a lot better. Placebo effect? Maybe, but don't let all this go to your head. You spend the session planning what you are going to do and what the expectations and goals will be. The third session comes: 'How are you Mrs Smith?' 'Dreadful! Everything's gone wrong this week. Do you think I should try acupuncture?' Oh well! Fourth session: no Mrs Smith. Fifth session: Mrs Smith starts to tell you about Mr Smith and pours her heart out. Sixth session: Mrs Smith is inconsolable but full of rage; she has discovered that Mr Smith has been seeing someone else.

And so it goes on, two steps forward, one step back; one step forward, two steps back. But if you both stick at it Mrs Smith might arrive at the point where she can look back and say, 'I didn't think I'd have the confidence to be doing all this (venturing out more on her own, holding down a part-time job in a shop just down the road, going to aerobics with a friend….). Oh, by the way: Mr Smith is now seeing a psychiatrist.

Maybe Mrs Smith would have achieved all of this without seeing you. But let's not explain it all away as 'placebo'.

ARTICLES

DEMYSTIFYING SCIENCE

Michael Kirk-Smith

Michael Kirk-Smith has been a research advisor in industry and academia. He initially qualified in the 'hard' sciences (physics and molecular biology) and then in the 'soft sciences' (experimental social psychology) with research in human pheromones, and later worked in biomedical biotechnology and consumer and health psychology. He has also taught and published in research methodology and has a particular interest in the evaluation of complementary therapies such as aromatherapy, where physiological and psychological effects may interact.

Abstract
This article is intended to give a flavour of what scientists do and how they think, in short, to demystify the subject of scientific research for non-scientists. It describes the essence of the scientific method, what is special about scientific evidence compared to other evidence, the limitations of scientific explanation, pure and applied science and common misunderstandings about science.

Introduction
Science is important. It has delivered much of the quality of life we now have, but many non-scientists may not know what it involves or are suspicious of it. It is not surprising that this is the case given the power of science to change lives.

The intention of this article is to remove the 'mystery' of science by describing what the scientific method is and how it works, and also what is so special about scientific evidence.

The benefit of understanding science for non-scientist is that it can help them to ask cogent questions about the evidence behind claims and assertions, e.g., made by government and commercial organisations.

But first, a starting section on scientists themselves.

Scientists
There are many types of scientists, e.g., physicists, chemists, biologists, physiologists, pharmacologists, and hybrid ones like biochemists and biophysicists, etc. One group often has no clue about what another group is talking about.

Physicists have tended to see themselves at the top of the heap because of the accuracy of their methods and theories, an example of this is Lord Rutherford's quote 'There's physics and there's stamp collecting', meaning that physics explains why things are, whereas other sciences just describe things.

However, the one thing that is common amongst all of them is the use of the 'scientific method', or more precisely, 'the experimental method'.

The scientific method
Often one hears people claiming that a treatment works because 'I know it works because it definitely cured me/my patients/someone else'. The problem with this is that it is an opinion, since someone else could say in reply 'But people have a remarkable ability to get better anyway' or 'How do you know that it wasn't something else' and any of these might be true. The main purpose of the scientific method is to replace such matters of opinion by an agreed way of investigating things. Here is what this involves:

a. First, one's hunch about why something happens (in the jargon - 'the 'theory') has to be written down or put in a way that can be checked or tested practically, i.e., what your hunch predicts should happen ('the 'hypothesis').

b. Then a situation ('the experiment' or 'study') is set up to check (or 'test') the hypothesis. This involves planning and writing down the following:

1. What intervention, based on your hunch, that you think will change things ('the experimental manipulation')
2. Arranging for sensible before and after measures so that everyone can agree that a change has actually happened
3. Arranging for some sort of comparison situation ('the control') where you don't make any intervention but still take the measures so that you, and everyone else, are completely certain that any change noticed in the experimental situation is due to what you did and nothing else.

That's it. This may seem like common sense, and it is (Einstein said 'Science is refined common sense'). However, this way of learning about how the world works did not formally exist until around Galileo's time. The story goes that Galileo dropped a light and a heavy weight off the leaning tower of Pisa. The books and the authorities said the heavy one would drop much faster; the reality was that they hit the ground at much the same time.

It is the tactic of having a 'control' or comparison that makes the experimental method uniquely able to identify why something has happened, over all other ways of knowing about the world (i.e., intuition, experience, authority, religious insight, etc.).

The need for measurement also means that if something and/or its effects cannot be measured then it is probably outside the realms of science and in the realm of opinion or faith. For example, if something is claimed to be an '*energy*' in, say, a complementary therapy, but cannot be measured, then either it may not be there or the word is being used in some metaphorical sense.

Openness is the key - there is no place for secret ingredients or methods in the publishing of scientific research.

Note that the experimental method is very different from the interview and questionnaire survey methods often taught in research methods courses. These methods are organised ways of asking people questions and speculating about what the answers mean. People have done this since speech evolved and there is nothing wrong with it, but it is severely limited in its power to find out whether and why something works (e.g., see Kirk-Smith, 1998), basically because what people say may not be what is happening.

From this summary, you will see that a main aspect of science is observing what actually happens and testing it against what you or others predicted or expected - and not accepting other people's assertions at face value.

Scientific evidence

So when can scientists accept anything done by other people as valid evidence? The short answer is when the other scientists' research has been independently checked by experts. Here is how it works.

Scientific evidence is different from other types of evidence, not just in the way it is collected (i.e., often using the experimental method), but also in the way it is presented and published. Once scientists have done their research (and they usually work in groups to get a mix or skills, ideas and opinions), the next step is to get it published and accepted as valid scientific evidence. This is done by writing up their study as an article (or 'paper') in a standard format, typically with the following sections:

Title with authors' names and addresses
The 'Abstract' (a summary)
Introduction (why they did the study and its aims)
Method (how they did it)
Results (what happened)
Discussion (what the results mean)
References (details of previous scientific research mentioned in the article)

Importantly, the article must be in enough detail so that the study can be repeated by someone else. Openness is the key - there is no place for secret ingredients or methods in the publishing of scientific research.

Then they submit their article to the editor of a 'refereed' journal which publishes research in the same subject. These journals are found in university and medical libraries and listed on web databases such as Medline. The editor takes their names and addresses off the article and sends it anonymously to several 'referees', each of whom is an experienced scientist in one of the research areas covered by the article. Each referee checks that the research is explained clearly and in sufficient detail and that the scientific method has been followed properly. They are nit-picking and will usually require changes and corrections to be made before it can be published, or they might recommend to the editor that the article be rejected outright. Incidentally, referees do not get paid for doing this exacting work. They see it as an obligation to ensure that scientific research is done to a high standard.

Reliable and unreliable evidence

The refereeing process means that when other scientists read an article in a refereed journal they know that experienced referees have 'put the boot in' to make sure the research was done correctly - it will not get published otherwise. They are therefore fairly sure that what is reported is reliable.

I was told that there was 'lots of research and evidence' that proved it worked. However, when I asked where it was no one could tell me.

This means that scientists consider anything published without such independent 'refereeing' or checking are simply unreliable or 'anecdotal' sources and therefore cannot trusted as evidence to base their own research on. It also means that books, magazines, websites, leaflets, advertising, or personal anecdotes of the 'It always works on my patients' kind, etc., are simply *not acceptable* as reliable sources of evidence by scientists. For example, a book might cite findings from a refereed paper, but do it inaccurately, so scientists only rely on what the refereed paper itself says, not on any interpretation of it by someone else.

You can use this reliance on checked evidence to advantage. For example, if someone makes an assertion about the efficacy of a certain therapy you might take a lead from the scientists and ask 'What is the actual evidence for these assertions?', and by 'evidence' what you mean is specific articles on its effectiveness published in refereed journals.

I did this recently. I was at an exhibition where several stands were selling emu oil. There were posters and advertising literature claiming that it could cure many ailments. I was told that there was 'lots of research and evidence' that proved it worked. However, when I asked where it was no one could tell me. So I did a Medline web search and found three articles (Medline is where refereed medical and health research is listed; you can search it for yourself at http://www.ncbi.nlm.nih.gov/entrez/query.fcgi). However, all these articles were on mice, not humans. Two (Yoganathan et al. 2003; Lopex et al. 1999) showed that emu oil reduced inflammation on the ears of mice that had been previously been irritated with croton oil, though olive, fish and pig oils also reduced inflammation. The third article (Politis & Dmytrowich 1998) showed that emu oil lotion *delayed* cut healing if applied immediately but helped healing if applied 48 hours later, this probably being due to the anti-inflammatory effect. However, pure emu oil had *no* effect. These findings are all interesting, of course, but this is not the same as 'lots of research and evidence' proving that it works on humans.

It is arguably better to check and be informed about actual research findings before parting with your money just on the basis of salesmen's assertions and opinions.

Of course, just because there is a lack of scientific evidence does not mean that a therapy does not work. Maybe no one has got around to evaluating the treatment yet. Or maybe the research that has been done is not relevant to actual treatment. Either way, it is arguably better to check and be informed about actual research findings before parting with your money just on the basis of salesmen's assertions and opinions.

Ignoring the scientific method

Ignorance is not always bliss. For sure, beliefs accumulated over centuries are useful, e.g., herbal medicines are used because many people's experience has shown them to be effective. However, beliefs are still a matter of opinion and can be wrong (who now believes in dragons, a flat earth or the sun going around it?). Also, this type of accumulated knowledge does not easily lend itself to development or improvement of the treatment. For this reason, conventional health and medicine practitioners are now taught the scientific research methods as part of their training as it is considered that they have an ethical obligation to their patients to evaluate their treatments so that they can 'remove what doesn't work and improve what does work'.

In contrast, complementary therapies, in general, appear to make little or no attempt to evaluate their effectiveness (i.e., by publishing research findings in refereed journals). There may be several reasons for this, e.g., maybe the assertions of effectiveness by authorities in the field are simply accepted, regardless of the actual evidence, or maybe they have the opinion that they can't be improved or maybe therapists just don't feel an ethical obligation to improve their therapies.

Arguably, users of complementary therapies should expect more than this, especially as an effective and well-proven method of evaluation - the experimental method - has been around for centuries. This is not a particular criticism of complementary therapies. Conventional medical treatments have only come under such scientifically-based scrutiny relatively recently, and this is now given the title of 'evidence-based medicine' (which makes one wonder what the previous basis was).

More on the scientific method

As well as the experimental method there are other aspects to the 'doing' of scientific research. Here are some which have a practical relevance.

Pure and applied science

Pure science identifies and understands phenomena. Applied science then takes these phenomena and finds practical uses for them. The process can be thought of as three stages, all of which use the scientific method to find out what is going on:

1. Is there an effect? This is an 'empirical', or practical question, e.g., does a therapy actually cure a certain ailment?

Once this is established the next question is:

2. What causes the effect? This requires some hunch or theory as to what the mechanisms are, which might involve testing certain elements of the therapy, perhaps in various combinations, e.g., testing whether placebo effects are important or interact with other elements.

Once the cause(s) of the effect are identified the next step is to:

3 Improve the effect. This is the practical application. Improvement can only be done once one knows what causes the effect. It is simply not possible to improve something if one doesn't know what causes it.

Some complementary therapies are not yet at Stage 1. That is, whether they actually work has not yet been established. Despite this, there may be statements made, somewhat prematurely, about the mechanisms involved in their action. I leave the reader to provide examples.

Occam's razor (or the Principle of Parsimony)

This is a powerful notion used by scientists to keep things sensible and not fancible (William of Occam was the mediaeval monk who first formulated it). It says that you are not entitled to invoke or claim a complicated explanation for something until you have excluded all possible simpler explanations.

For example, its application means that you cannot claim that spacemen built the pyramids until you have definitely excluded by practical tests all possibility that humans couldn't have built them (e.g., by using rollers, using sand ramps, floating the blocks on water, etc., etc.).

Until this is done, you can only assume that humans built the pyramids - and it's a waste of time to speculate otherwise.

You are not entitled to invoke or claim a complicated explanation for something until you have excluded all possible simpler explanations.

Similar thinking can be applied to areas of complementary therapies where complicated explanations are invoked for something (e.g., involving unmeasurable 'energies' as this is equivalent to saying 'the fairies did it') before all possible simpler explanations for a treatment effect have been definitely excluded (e.g., placebo or physical or pharmacological effects or even patients simply wanting to please the therapist by saying they feel better).

In short, always try the simplest explanation first.

Reductionism

This is a criticism frequently made about scientists and science. It means concentrating on how each small element of something works but ignoring how the whole lot works together as a system. For example, someone might just study the local and immediate effects of, say, a fertiliser on a crop plant, but not look at the (possibly bad) effects on other plants and wildlife. This is a valid criticism. But it is not solely due to the scientific method itself.

Scientists are well aware that the earth is a system. However, they have to stick to things that they can actually do something about. Also, they have to keep to the brief that they have been paid to do, and that can be narrow.

There is also a more fundamental problem. The scientific method is about making an intervention and seeing the effects, and holding other things constant. It also tends to seek simplicity (e.g., Occam's Razor). However, in a complex system where many things are interconnected it is hard to tell where causes and effects start and end. This limits the ability of a simple application of the scientific method to understand what is going on overall.

As a result, there is much research going on other ways of understanding the behaviour of complex systems. Thus far not much progress has been made, in part, because of a lack of agreement on what complexity is. However, if successful theories arise they will most likely have similarities to the scientific method, i.e. based on evidence and testing, rather than opinion.

Misconceptions about science

Science can and cannot do certain things. Here are aspects that are sometimes raised:

Scope

The scientific method can answer many practical and technical questions about how the world works. Indeed, it has been spectacularly successful at doing this and is the best way we have found so far. However, it cannot address or answer questions of faith such as 'Does God exist', as faith is, by definition, belief without evidence and science is about evidence. Like everyone else, scientists can believe or not believe in God or be agnostic. Nor can the scientific method, by itself, answer moral and ethical questions such as how to treat other people. People who claim otherwise are considered guilty of 'scientism', i.e., overclaiming what science can do.

Note that scientific findings may open up ethical questions that had not previously been considered, e.g., research on the reactions of animals/fish to stimuli that might be considered stressful or painful, or on how similar other primates are to humans, may well lead to questions about how we should treat them.

Science and understanding people

'Hard-scientists' (those who work in laboratories and/ or study objects) tend to look down on 'soft scientists' (those who study human thought and behaviour, i.e., psychologists, sociologists and anthropologists). They question whether things like mood and attitude and situational factors can be measured or controlled well enough to use the scientific method to produce the predictive theories and laws that exist in the 'hard sciences'.

In a complex system where many things are interconnected it is hard to tell where causes and effects start and end.

However, despite these problems the scientific method has been adapted by social scientists to get an understanding of the social situations and complex factors underlying human thought and behaviour. These methods are well suited for the evaluation of complementary medicines. They have been used to develop effective psychological treatments such as cognitive behavioural therapy for depression, systematic desensitisation for phobias and behaviour modification for behavioural problems. These are based on quite straightforward notions; respectively, the stopping of habitual negative thoughts, the incompatibility of being mentally anxious and bodily relaxed, and that behaviour is affected by the immediate consequences (in non-technical language, rewards and punishments).

In contrast, there has been little or no progress in the understanding or explanation of more philosophical concepts such as consciousness or free well (as Noam Chomsky puts it 'We don't even have bad ideas'). In part, this is because of a lack of agreement over the meaning of terms such as 'explanation' and consciousness'.

Truth

If they are being sensible (and they are not always), no scientist really believes that they have 'the truth'. Scientists do not prove or verify theories, rather they accept the ones that they have not yet been able to falsify. However, what they may claim is that they have a better explanation (or 'model') about something than what went before. One reason is that they know very well that sooner or later some young whippersnapper will come up with a new theory or technology that shows their 'model' to be wrong or, hopefully, just inadequate.

'The universe is not only stranger than we imagine, it's stranger than we can imagine.'

Another reason is that whatever they find, they know that someone will come up with a further question that needs to be answered. Yet another reason is that scientists know that humans' limited thinking and imaginative powers restrict the questions we can ask about the universe, perhaps encapsulated by J.B.S. Haldane's saying 'The universe is not only stranger than we imagine, it's stranger than we can imagine'.

This view accepts change and that mistakes can be made and nothing is perfect. Understanding and things can always be improved. It can be contrasted with non-scientific disciplines where the 'wisdom of the ancient texts or founders' is perfect and cannot be questioned or improved on.

That said, there are some ideas that have proven to be so remarkably and consistently useful (e.g., atomic theory) and accurate (e.g., quantum theory), that they have come to be regarded as probably correct.

Morality

The scientific method is just an effective tool. As a tool, like a knife, it can be used for good or evil purposes. What is certain is that the use of the scientific method changes things. Whether this, of itself, is good or bad is a matter of opinion. For example, the results of scientific research may mean that the rules of a previous generation will no longer apply to the next generation (e.g., the effects of birth control on social morels and behaviour).

Scientists or science cannot always be blamed for misrepresentations by vested interests (whether scientists should expose these is not a scientific issue). For example, governments may say something about some newly introduced technology (e.g., genetic engineering) along the lines 'There is no evidence that it is harmful'. Most scientists shudder at this sort of thing as it is deeply ambiguous and thus misleading (though, being human, some might have vested interests and go along with it). It could mean that research has been done on its safety (which is what the politicians hope is implied) or it could be that no one has yet looked at safety issues, i.e., 'absence of evidence' is not the same as 'evidence of absence'.

Who can do science?

Anyone. It is just a way of planning and checking things that can be used by anyone and it does not depend on technology (that's why school kids can do perfectly good scientific research). Because of this, scientists have little or no interest in people's status, position or lists of qualifications and that's why they are not given in research papers (the situation is different for clinical journals). What matters to them is that the research is done properly and the results are interesting.

From my own experience, if I had to give any advice to give to a school kid about doing research, in addition to the experimental method, it would be:

1. Keep things simple. That way you and everyone else will understand it. The best research is usually clear and simple - or 'elegant' as scientists put it - though this will inevitably be the result of long and hard thinking and planning.

'If you fail to plan, then you are planning to fail.'

2. Spend as much time possible in planning. The maxim is 'If you fail to plan, then you are planning to fail'. It is too late to correct a fault in the study once the data have been collected (note that 'data' are plural!). In fact, the data collection can be quite a minor part of the process. And as part of planning, seek advice from, and work with, knowledgeable other people.

The main thing is to get everything as right as possible before you start so that no clever referee is going to point out something you didn't do right or forgot to do and then reject the research for publication.

Conclusion

With the proviso that these descriptions and illustrations about the scientific method are those by someone who just uses it rather than those of a philosopher of science, I hope that they give a flavour of how and why the scientific method is used, its limitations, and about the nature of 'scientific evidence'. And finally, that they will encourage further exploration into what science and scientists are about (e.g., Horgan 1996; Bryson 2004).

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THE PHYSIOLOGY OF THE PLACEBO EFFECT

Martin Wallace

Martin Wallace is a retired physician with special training in kidney disease and its management, and a degree in pharmacology in addition to the MB, Ch.B. Since retirement he has had time to resume his education in other fields

Earlier this year, Dr Tipu Aamir of the Auckland Pain Management Service drew my attention to something peculiar. In a double-blind, randomised, placebo-controlled trial of morphine after a standard knee operation, 30 percent of those receiving a placebo get pain relief. When those people are given a specific morphine antagonist (‘antidote’), their pain comes back! In the words of a former contributor at an annual conference of this society, this was an epiphany. I needed to know more.

After all, how could something that was ‘all in the mind’ be changed predictably by a substance with a known pharmacological action?

We skeptics are often happy to accept the explanation that if a response to some arcane practice is a placebo response, that settles the issue.

Any study of homeopathy raises the issue of the placebo effect. As a result of a meta-analysis in 2005 of a number of studies comparing homeopathic remedies with orthodox treatment, Shang et al stated in their conclusion that the effect of homeopathic remedies was no greater than that of a placebo. Not that they had *no* effect, but it was *no greater than that of a placebo*.

We skeptics are often happy to accept the explanation that if a response to some arcane practice is a placebo response, that settles the issue.

Over the last 30 years there has been a large amount of research into the undoubted effects of placebos. I thought it might be of interest to review this work in the context of our frequent use of ‘placebo effect’ to explain the unscientific.

Placebo is a Latin word for ‘I shall be pleasing, or acceptable’. It is the first word of the first antiphon of the Roman Rite of the Vespers for the Dead (!), Placebo Domino, dating from the seventh to ninth centuries. Chaucer called one of his characters Placebo in the Merchant’s Tale, because the word had come to mean a flatterer, a sycophant, or a parasite, by the 14th century.

> ‘Placebo seyde:
> Ful little need had ye, my lord so deare,
> Council to ask, of any that are here
> But that ye be so ful of sapience.’

He also uses it in the Parson’s tale: ‘Flatterers be the Devil’s chaplains, which sing ever “Placebo”.’

In the 1811 edition of Hooper’s Medical Dictionary, placebo was defined as ‘an epithet for any medicine adopted more to please than benefit the patient’. In a recent edition of Collins’ Concise Dictionary of the English Language it is defined as ‘an inactive substance administered to a patient to compare its effects with those of a real drug, but sometimes for the psychological benefit of the patient through his believing he is receiving treatment’.

However, placebos do benefit patients, and they are certainly not inactive in the context in which they are given.

The most dramatic example of this that I saw in clinical practice involved a young man on artificial kidney treatment. When erythropoietin became available for the treatment of the severe anaemia seen so often in this situation, he was the first patient in our unit to receive it. Erythropoietin is a hormone made in the healthy kidney, which increases the number of red cells in the blood and the amount of the oxygen-carrying haemoglobin. The synthetic version has achieved notoriety as a performance enhancer in sport, for example in the Tour de France. We were all very enthusiastic about this improvement in management for our patient, and he was given his first dose with much interest from all of us. That night he went home, recovered his bicycle from the shed where it had been undisturbed for many months, and rode all around his town with great energy and pleasure. He hadn't heard the information that the drug took three weeks to act on the anaemia.

We are left with some questions. What was the physiology of his sudden ability to exercise at a 'normal' rate, long before there was any change in his blood count? What does 'it's all in the mind' mean? Was he somehow at fault, or was it me and the staff who were lacking in understanding?

I would like to consider:

- The psychological processes involved in the placebo effect
- The physiological mechanisms in the brain
- The site of this activity in the brain
- Why there is variation in the placebo effect from individual to individual
- What are the implications for the classical drug trial format?

Psychological mechanisms

Those who study the psychological processes of the placebo effect cite two major mechanisms

It is currently suggested that both conditioning and expectancy are active in the placebo effect.

Conditioning. Pavlov (1849-1936) showed that dogs given meals as a bell rang would subsequently salivate when the bell rang despite not being given food. This process has been explored in humans, who will experience pain relief when a placebo is substituted for a pain reliever when a sequence of active analgesia has been associated with an environmental cue. It is an unconscious process. At the nerve cell level, conditioning leads to a stronger and more sustained response.

Expectancy. This effect is seen when the patient has 'great expectations' of the substance being given. These are raised by the conscious or unconscious attitude of the therapist. It is a conscious process on the part of the patient.

It is currently suggested that both conditioning and expectancy are active in the placebo effect, and that in fact, as an inert placebo can have no effect per se, what we see is the effect of the *context* in which the treatment is given.

Neurophysiology of placebo pain relief

Over the last 30 years, there has been much interest in the neuro-physiological mechanisms of the placebo response.

In 1975, Hughes et al identified in the brain two related pentapeptides (a chain of five amino acids linked together) with potent opium-like action. There are many more now identified. These compounds act on specific receptors on the membranes of neurones, and via intracellular metabolic changes increase synaptic transmission. They are made in the pituitary and hypothalamus, and are called endorphins.

A digression

In pharmacology the term *agonist* denotes a drug with an effect, and *antagonist*, a drug which specifically blocks the effect of the first substance.

When I spent a year in the pharmacology lab in Dunedin (1959) it was becoming recognised that drugs exerted their effects by way of a specific receptor molecule at the cell surface. The actions of adrenaline, for example, were explained by the presence of two different molecules to which it could attach, which mediated different effects. Noradrenaline would latch on to only one, explaining its more limited range of action. With their usual desire for learned coherency, pharmacologists called them *alpha* and *beta* receptors. Antagonist molecules attach to the receptor molecule and block access by the agonist. Hence the term 'beta-blockers'. These are substances which block the action of adrenaline on its beta receptor. They are widely known for their action in the control of blood pressure, and recently for their unwanted effects when given to protect patients at risk of heart trouble when undergoing operations.

Agonists and antagonists are related by similarities in molecular size, shape, and charge.

Morphine antagonists have been available for some time. In 1961 as a house surgeon in casualty, I was asked to manage an opium addict, brought in because he was deeply unconscious, and breathing perhaps once a minute. He had been without the drug for some weeks, due to market fluctuations. When access was resumed, he used a dose which was the same as his habituated dose. This was much more than he could now tolerate. I had access to nalorphine, a specific morphine antagonist, and 30 seconds after an IV injection, the patient took several deep breaths, sat up, expressed considerable surprise at his surroundings, and then lapsed back into his former state. I was able to repeat this dramatic procedure several times until he recovered!

In 1978 a group of dental surgeons working in California (Levine et al) carried out the following experiment. Patients who had had an impacted wisdom tooth extracted were treated routinely with nitrous oxide, diazepam and a local anaesthetic. At three hours after the procedure they were given either a placebo or naloxone, a specific morphine antagonist. At four hours they were given a placebo or naloxone.

Those who had initial pain relief with the first dose of placebo (39 percent), when given naloxone had an increase in pain.

The authors concluded that 'this was consistent with the hypothesis that endorphin release mediates placebo analgesia in dental postoperative pain.'

The authors concluded that 'this was consistent with the hypothesis that endorphin release mediates placebo analgesia in dental postoperative pain.'

The elegance of this study lies in the unequivocal evidence that a supposedly psychological state (placebo analgesia) was reversed by a specific opioid antagonist. Note that none of the patients was given morphine. There must be a physiological cause for placebo analgesia.

This sort of study has been repeated many times, and always naloxone reverses placebo analgesia.

The site of action of opioids in the brain

The site of this process has been determined. The sites for opioid receptors in the brain can be found by specific cell staining methods and histology on brain tissue. But more exact, 'real-time' evidence comes from positron emission tomography (PET) scans.

Another digression

PET utilises short half-life radioactive elements which undergo spontaneous beta decay. In the process, they emit a positron, which collides with an adjacent electron resulting in mutual annihilation, and the generation of two high-energy photons at a near-180 degree angle. These can be detected, and with many, many such events, used to build up a tomographic picture of the source in relation to surrounding tissue. In the studies of the brain, radioactively-labelled glucose is injected, and congregates where activity (utilisation) is greatest. PET scans are used to monitor metabolic activity in specific organs. For example, the extent of heart muscle damage after a heart attack.

In 2002, Petrovic et al were able to show that both opioid and placebo analgesia are associated with increased brain activity in specific regions: the anterior cingulate cortex and the brain stem. There was no increase of activity in these regions with pain only.

Similar localised brain activity has been shown in placebo responses in Parkinsonism (dopamine) and some depressive states (serotonin).

I find these studies exciting and provocative.

Genetic predilection

A further question can be asked in the light of the evidence for a physiological mechanism for the placebo effect. Why does it occur in only 30-40 percent of us for a given situation? It may occur in a greater proportion of a population sample if the context is made more convincing. But why don't we all have the benefits? Variation in a physiological function begs the question of a genetic predilection.

De Pascalis et al (2002) have shown that individual differences in *suggestibility* contribute significantly to the magnitude of placebo analgesia. The higher the suggestibility score (there are several tests available) the greater the placebo analgesic effect.

As early as 1970, Morgan et al showed that there was a correlation of suggestibility between monozygotic twins but not dizygotic (fraternal) twins. (Monozygotic twins are the result of the fertilisation of one ovum by one sperm. The resulting zygote splits into two cells which each develop into an individual. These individuals have exactly the same genes.)

Wallace and Persanyi (1989) looked at hypnotic susceptibility and familial handedness. Subjects with close left-handed relatives scored lower in a test for hypnotic susceptibility.

At the 2008 conference, I carried out an experiment with a group of clearly non-suggestible skeptics. I asked those in the audience to raise their hands if they, or a close relative, were left-handed. If the hypothesis was correct, more than 10 percent of our attendees should have been left-handed. In the event, 22 of 84 attendees indicated they or a close relative were left-handed.

The control study should be done with a church congregation, Protestant or Catholic. In fact, we could do this on *both* and answer the question as to which is the less suggestible! I haven't had the nerve to ask.

	Identical Twins	Fraternal Twins
Religious fundamentalism	62%	2%
Broad religiosity	58%	27%
Right-wing attitudes	69%	0%

Correlation in attitudes of twins reared apart

Thomas Bouchard, beginning in 1979, has carried out a number of studies on twins who for a variety of reasons were reared apart. He compared correlations between identical twins and between fraternal twins. The studies from his group (in Minnesota) have shown a large group of correlations in identical twins reared apart, which do not occur in fraternal twins reared apart. The correlations differ very significantly. The table above shows some examples for twins reared apart.

Similar studies have given similar results in Australia and Western Europe.

Because the nurture of these twins is different, and identical twins have identical genes, the similarities must be genetic**.** This approach to behaviour has lead to the science of behaviour genetics.

(Physical attributes are of course also correlated more between identical twins reared apart, than fraternal twins reared apart.)

Amir Raz (2005, 2008) and his group in New York State have shown that a genetic polymorphism (more than one version of a specific gene) exists for a gene on chromosome 22, which codes for an enzyme active in the breakdown of dopamine**,** a neurotransmitter. One amino acid substitution (valine for methionine) in the gene alters the enzyme activity by a factor of four times. Since we have a copy of this gene from each parent, we may have val/val, or val/meth, or meth/meth genotypes.

Val/meth heterozygote confers the greater suggestibility. The enzyme is called COMT or catechol-o-methyl transferase.

Brain pathways in which opioid receptors are active are linked to those in which dopamine is the transmitter (nerve to nerve). If there is genetically conferred variation in dopamine activity it is likely that this will influence the result of changes in activity in the opioid pathways.

We must remember that we are talking of a genetic predisposition to be suggestible, and not a gene for suggestibility. It is not that 69 percent of identical twins vote Republican, but that if one does there is a 69 percent probability that the other one does too.

The implications for drug trials

In 2003, Benedetti and his colleagues in Turin examined pain relief in patients after thoracotomy. Patients were allocated to either open infusions of morphine, with information about the efficacy of the drug, or to receive hidden doses of morphine by infusion without any information and without any doctor or nurse present (the open / hidden model for drug trials).

With the same dose, same infusion rate, same timing and same drug, pain relief was less in the 'hidden' group.

In the 'open' group, the 'meaning-induced' expectations had enhanced the drug effect.

This research group has gone on to postulate that in all drug treatment the effect is the sum of actual physiological effect and the effect of expectations. This means that the placebo effect will always cause part of the usual 'physiological' response to active drugs.

They say that the classical double blind randomised placebo-controlled trial does not allow for expectation effects, and may suggest that a drug has a specific effect greater than it actually has. They suggest an 'open/hidden paradigm' will give more meaningful results.

Although placebos are inert and cannot have any effect on the healing processes, their meaning and the context in which they are given can.

Conclusions

- The analgesic placebo effect is accompanied by a distinct, observable, and locatable physiological event in the brain.
- Susceptibility to the placebo effect varies in the population at large.
- This susceptibility is at least in part genetically determined.
- It may be possible to harness this facet of human behaviour for the benefit of individuals, and to prevent its on-going exploitation by charlatans.
- Although placebos are inert and cannot have any effect on the healing processes, their meaning and the context in which they are given can.
- All drug effects include some placebo effect, except when the drug is given surreptitiously. This should alter the classic clinical trial structure.

We have come a long way from the Vespers for the Dead!

Placebos are inert substances but the context in which they are given can alter neurophysiology in such a way as to cause subjective *and* objective effects.

This is not due to the 'molecular memory'of water, nor to strange force-fields as yet unknown to physicists. It is due to our human nature, how we react to our environment, and the relationship, between our minds and our bodies.

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Note

Since Dr Wallace's article appeared some related research has been published on the neurophysiology of the placebo effect which may be accessed at http://www.timesonline.co.uk/tol/news/science/medicine/article6877064.ece

Call for Contributions

If you have attended a conference or presentation, watched a programme, or read an article or book that would be of interest to readers, why not write a review of this, however brief, for the *Skeptical Adversaria* or the *Skeptical Intelligencer*?

MAGNETIC UNDERLAYS: WHAT'S THE ATTRACTION?

This article appeared in the Autumn 2009 issue of the New Zealand Skeptic *(No. 91)*. It is reprinted here with the kind permission of the Editor and author.

Ian Luxmoore

Ian Luxmoore is a lecturer in Resource and Environmental Planning at Massey University and is currently doing a PhD in macroeconomic exergy modeling.

I hear and see advertising for the BioMag Underlay on a regular basis in New Zealand media. They advertise extensively on TV and radio and have become a very well-known brand in this country. They produce a wool bed underlay that includes magnets which are promoted as providing pain relief. There are several other brands of magnetic underlay in the market in New Zealand and the conclusions here most likely apply to those as well, but for simplicity I focused my efforts on the most popular one.

The fact is that mainstream pain relief *does work*. It works effectively, time and time again, in clinical trials beyond count and in day-to-day life.

The first step is to see what the BioMag actually claims and in the age of the internet the best resource for this is usually the company's website http://www.biomag.co.nz/. In this case Bio-Mag have a pretty good site which is easy to follow and has a lot of information on it.

While their claims are restated in several different ways in different parts of the website, this premise really stood out:

> 'For years, the mainstream medical establishment's response to pain has been to throw a pill at it.'

While there is some evidence that drug prescription rates are higher than necessary, any doctor trivially throwing pills at a problem would soon lose his or her practising license. The fact is that mainstream pain relief *does work*. It works effectively, time and time again, in clinical trials beyond count and in day-to-day life.

The website's claim looks like an attempt to trivialise mainstream medicine so that people will be more inclined to consider the BioMag. This is not an uncommon tactic amongst alternative medicines and it also builds on the cynical view of drug companies held by many. They promote the BioMag as drug-free pain relief for a variety of ailments from arthritis to sciatica and numerous other causes to take advantage of this.

It is important to note here that nowhere do they say that the BioMag *cures* anything but it does claim to reduce the pain from various ailments. Some magnetic healing devices claim to cure cancer or other serious ailments and I think it is clear these are fraudulent, but the Bio-Mag does *not* claim this as far as I can tell.

How does it work?

So how is BioMag supposed to do what it claims? There are a myriad claims on the website. The main one however is that circulation is improved, and the connection between magnets and iron in the blood is invoked to explain this. They go on to explain:

> 'It does this by drawing trace elements, for instance, iron, towards the magnets. The human body contains about 5 grams of iron, much of it in the form of haemoglobin which plays a vital role moving oxygen from your lungs around your body.'

Firstly if the magnets do attract the iron in your blood won't that just draw the blood towards the bed and hold it there? Logically one would expect it to do the exact opposite of increasing circulation. However that proves to be irrelevant because the iron in the body is locked up in haemoglobin molecules and is so diffuse that it is incapable of forming any kind of magnetic attraction. In fact it turns out that haemoglobin is actually slightly *repelled* by magnetic fields.

Perhaps the best response to the claim that magnets affect blood however was made on a blog entitled Crap-Based Medicine:

> 'The last time you got an MRI, did the enormous magnets tear all the blood out of your stupid body?'

MRIs are magnetic resonance imaging devices at hospitals that use very powerful magnets (0.5-3.0 Tesla) to create 3D images of the body. To put the power of these magnets in context, the BioMag magnets are probably around the 0.01-0.05 Tesla mark so if anything was going to move blood an MRI would!

The second claim the BioMag makes is that the magnets stimulate nerve endings:

> 'The general consensus is that the magnetic force stimulates nerve-endings to improve blood flow to injured or swollen joints, causing the blood vessels to dilate.'

There are numerous papers exploring the impact of magnetic fields on nerve actions, and the results are quite variable. One common thread though seems to be that the mechanisms are largely unknown. One paper I found that *did* find an effect made the point that the strength and nature of the magnet need to be quite specific to have an impact on isolated mouse nerve impulses.

Even if the nerve endings are stimulated by magnets and this does lead to increased blood flow, if there is pain there then the nerves are *already* stimulated and the blood flow is already increased! The magnet has no work left to do. Moreover it seems very unlikely that a general magnetic field from the underlay would stimulate nerves only in places where there are injured or swollen joints – in fact one might expect the magnets to dilute this effect given that, if it does stimulate nerve endings, it would stimulate them *everywhere*. All told this line of reasoning simply doesn't add up.

The BioMag site also claims that increased circulation increases the delivery of trace elements and nutrients around the body and aids in the removal of toxins. Both of these are irrelevant to the main claim of pain relief and are also highly suspect.

Other claims include influences on melatonin production (to aid sleep) although a 2003 paper by Touitou et al discovered large magnetic fields had no effect whatsoever on melatonin levels.

Finally they claim that the BioMag can correct excess acidity or alkalinity to bring the body 'into a position of natural balance'. There is no obvious connection between magnets and pH levels, and it is worth noting that various parts of the body have varying pH levels for different purposes so one would hope these levels aren't all affected.

Evidence

I can find absolutely *nothing* on the website or elsewhere that indicates the product itself has been tested for efficacy in pain relief and sleep improvement. The BioMag site offers some journal papers and anecdotal evidence. I will deal with the anecdotal information in the next section.

The main reference on the site is to a 1997 paper entitled 'Response of pain to static magnetic fields in postpolio patients: A double-blinded pilot study', by Vallbona et al. There are a few points to note about this paper. Firstly it is a pilot study which is a rather tenuous basis for an entire product line. Secondly they only applied the magnets for 45 minutes which is quite different to sleeping on them overnight. Thirdly there was no follow-up so while this paper is potentially interesting, it doesn't really tell us very much at all.

Good science is built up on as many studies as possible in order to give us the best possible picture, *especially* in highly subjective areas like pain. Twelve other papers are listed on the site but to save time I went hunting for any meta-analyses of static magnet therapy. A meta-analysis is where the author compiles the results from as many studies as he or she can find and determines if there is an overall benefit to be found given the breadth of studies conducted.

'Overall, the meta-analysis suggested no significant effects of static magnets for pain relief relative to placebo.'

I found a 2007 meta-analysis that looked pretty thorough entitled 'Static magnets for reducing pain: systematic review and meta-analysis of randomized trials', by Pittler et al. This paper pulled together 29 studies, including the Vallbona study and most of the other references listed on the site. Their conclusion is telling:

> 'Overall, the meta-analysis suggested no significant effects of static magnets for pain relief relative to placebo.'

They did note that for one ailment (peripheral joint osteoarthritis) the 'evidence is insufficient to exclude a clinically important benefit' but for all other ailments their conclusion was that there was no significant effect over placebo.

At the very best one can say that the literature is uncertain about the impact of magnets. What we can say is that there appears to be no peer-reviewed research about the BioMag products specifically and therefore its clinical efficacy rests on the somewhat inconclusive (and mostly negative) evidence for magnets in general.

The anecdotal evidence

While clinical evidence for the BioMag's efficacy is sparse at best the anecdotal evidence is all over their website and advertising campaigns. Anecdotal evidence is much harder to take seriously than clinical evidence because it is uncontrolled and wide open to placebo, misinterpretation and even manipulation.

The BioMag site particularly emphasises the celebrities that endorse the product. While not an uncommon tactic amongst both legitimate and illegitimate products, ask yourself this: is a rugby star any more qualified than anyone else to comment on the efficacy of a bed product? Celebrities they may be. Sleep experts or medical doctors they are not. Their opinion is no more or no less valid than any other lay opinion.

Looking through the testimonials page we find videos of several prominent celebrities doing promos on Murray

Deaker's radio show plus numerous written endorsements on the site. I read through all the testimonials I could find and noted that, while every single testimonial mentions improved sleep, less than half specifically mention pain relief. In fact most of the video testimonials didn't even mention pain, but they did spend a fair bit of time on how nice the wool is! Notably almost none of the testimonials made any specific mention of the magnets.

I am strongly inclined to believe that the magnets do not contribute to any of the benefits of using the BioMag underlay.

Explaining the anecdotal evidence

On the surface the anecdotal evidence seems convincing but it doesn't take too much thought to find a logical explanation for most of it.

Firstly the BioMag is a luxury woollen underlay for a bed and relatively few people that already had a high-quality woollen underlay on their bed would actually purchase a BioMag. This means that the *majority* of people purchasing one are actually significantly improving their bed's comfort and luxury. This in itself would be enough to account for a better night's sleep, the most common reported benefit.

Secondly a lot of people suffer problematic pain in bed. Once you are comfortable and asleep you don't feel pain so anything that makes your bed more comfortable and makes it easier for you to sleep will effectively alleviate pain. Also it is fairly well known that good sleep gives your body a chance to recuperate and that well-rested people are more likely to be motivated and lively. This builds a powerful explanatory scenario for the observed pain relief due to the BioMag.

Thirdly, a lot of people that buy this product *expect* to receive pain relief and better sleep. Given the cost, celebrity endorsements, and supposed science behind it, there cannot be a better environment for the placebo effect to manifest itself. Given how subjective pain is, if you curl up in a warm comfortable bed that never used to be that soft and comfortable it is no surprise that you'd think it was working and that would potentially increase the effect that the good sleep already has.

Conclusion

I think it is safe to say improving sleeping conditions is beneficial to people with all sorts of problems so it is most likely a benefit to installing a luxury wool underlay on a bed without one. However given everything I have read, the nature of the benefits of using the BioMag, and the general conclusions of the magnetic healing literature, I am strongly inclined to believe that the magnets do not contribute to any of the benefits of using the BioMag underlay.

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BOOK REVIEWS AND COMMENTARIES

13 Things That Don't Make Sense: The Most Intriguing Scientific Mysteries of Our Time

by Michael Brooks. London: Profile Books, 2009, pp240, ISBN 1861978170/ ISBN 978 1 86197 817; and New York: Doubleday, 2008, pp256, ISBN 978-0-385-52068-3.

Dave Hughes

When I first read the synopsis of the book I expected to be dismayed by the tide of ancient ancient regurgitated woo that would obviously be between the pages of a book pointing out all the things that, being cloistered away from the 'real' world in their ivory towers, the poor baffled scientists do not understand. So I am delighted to report that I have been disappointed in this regard.

Michael Brooks' latest work is sectioned into the eponymous 13 chapters each one examining a particular issue of deep scientific mystery and also of significance to the world at large.

The prologue sets out the stall with a delightful anecdote in which three Nobel Laureates are struggling with a rather baroque elevator in a rather swish Belgian hotel, pointing out the actually comforting observation that scientists are, like the rest of us, human and suffer on occasion from similar foibles and lapses.

The treatment of some of the scientists involved in some of the scandals that have surrounded the more controversial subjects I found particularly disgraceful.

Each of the chapters begins with a lucid and very succinct summary of the current (as it can be) status of the title's subject. The topic of each chapter is swiftly and accurately summarised in the first several pages, after which the author goes on to challenge some of the well-known 'facts' about the subject. Many of these I was unaware of and some I was appalled by. The treatment of some of the scientists involved in some of the scandals that have surrounded the more controversial subjects I found particularly disgraceful.

However, this is how science operates. The ruthless pruning of ideas that cannot support themselves with evidence. If there is some evidence for something consensually agreed to be bizarre then the evidence must be of good quality and the experiments repeated all around the world. Meet these criteria and be accepted; fail and opprobrium is your lot. Sometimes deservedly, sometimes not. Only the facts, evidence and repeatability can decide.

Brooks has done his homework well. He has tracked down, found and spoken to the actual scientists involved in most of the topics and obtained their first-hand accounts of what actually happened and the real story behind them. Their stories are fascinating, especially that of Gilbert Levin, the man who designed the experiments on board the Viking Lander that were intended to search for evidence of life on Mars.

It is a minor point to make but I found some of the chapter sub-headings to be sometimes quite sensationalist. If my fears regarding the potential woo content of the book had not been assuaged I would have let this pass without comment. But the book engages one with the facts and examines each of the issues, making critical points. Hence I found some of the sub headings to be at odds with the excellent sceptical content of the main text.

For example, at the beginning of the second chapter dealing with the so-called Pioneer Anomaly, the sub-heading remarks, 'The two spacecraft are flouting the laws of physics' which does convey the message that there is a significant issue at hand. However it is really a little too 'Daily Mail' for my personal taste. Perhaps we can't expect perfect scepticism; after all editors must be satisfied and the book must sell.

On to the main content.

In Chapter One we encounter what is possibly the outstanding problem of cosmology and astrophysics in the guise of the universe's missing mass. Where is it all and why do we think it should be there? The puzzlement that this issue has engendered in the hearts and minds of questing scientists is driving a tremendously focused search for more data. New telescopes are being commissioned with the intention of providing greater insight into the distribution and nature of the universe's mass. This sort of puzzlement at a situation that is not yet understood is really the central force in the mind of anyone with a thirst for knowledge and a desire to find out how the world actually works. There are new theoretical models which go some way to explaining the anomaly without resorting to exotic types of invisible and undetectable matter but they do require one to throw away or at least modify the cherished laws of Newton.

The subject of Chapter Two is the Pioneer Anomaly which can be simply stated by saying that the two Pioneer spacecraft are not behaving as they should. Newton's laws and the relativistic and gravitational refinements made by Einstein give us very precise information regarding the predicted path of the two spacecraft as they wend their lonely way further into interstellar space. The problem is that they don't appear to be behaving themselves.

Brooks tells us that NASA originally planned the long-term missions to be a test of Newton's laws and that, according to the data, those laws have failed that test. So shouldn't we be taking that failure seriously?

In the third chapter we encounter the possibility that the constants of the universe might not be so constant after all! This is a stunning idea and has caused consternation amongst physicists and major headaches for astronomers trying to obtain quality data with which to confirm or rule out various hypotheses. Some of those data, Brooks shows us, concern the constant Mu (usually accepted to be the ratio of proton mass to electron mass) which appears to have been very slightly different in the distant past of the universe. There is evidence suggesting that the Fine Structure Constant Alpha, which determines what happens when photons interact with matter, also had a different value for the early universe. These observations call into question the foundations of our view that the laws of the universe are unchanging.

These observations call into question the foundations of our view that the laws of the universe are unchanging.

Chapter Four moves onward to discuss the cold fusion debacle. I have some rather vivid personal memories of when this story first broke at a press conference and the announcement was made that humans had finally cracked the 'unlimited energy' problem. I read it on the BBC Ceefax teletext service and remember sinking to my knees in front of the TV thinking 'It's all over, we've done it!' Such was my enthusiasm that I thought the semi-utopia of Star Trek was only moments away and that as an 18-year-old computer and science geek I would have a place in it. I was too youthfully naïve to see that it was too good to be true. Then afterwards, of course, came the crashing disappointment as the news spread of the flaws and the failures to reproduce the experimental results.

In this chapter Brooks makes the point of explaining that because Julian Schwinger, albeit in the twilight of his career, considered cold fusion to be an idea worthy of his time, it is an idea that should be taken seriously. Now I'm sure most of the readers will be familiar with Julian Schwinger and know that he shared the 1965 Nobel Prize for physics with Richard Feynman and Shinichiro Tomonaga. I am also sure that everyone has spotted the problem: The Argument From Authority logical fallacy that seems to have been missed by the author.

Science proceeds from repeatable results that are published in high quality peer-reviewed journals. Papers are not released first to journalists at press conferences.

I'm sure this would not be an issue for another reviewer but as this is a review for a sceptical magazine and I flatter myself (outrageously) thinking that I am also a reasonably sceptical person, this failure stood out like a man standing in a lake with a small painted wooden duck on his head. It is a shame because it colours the analysis of the two central characters in the cold fusion circus, Martin Fleischmann and Stanley Pons. It leaves them with a 'get out of jail free' card by proffering the conclusion that they were "simply curious". Apparently.

Seems a pretty obvious description of any scientist I would think but in this case it is really quite unacceptable.

Scientists know that peer review is everything. It is far from a perfect process but its great redeeming feature is that it works. Science proceeds from repeatable results that are published in high quality peer-reviewed journals. Papers are not released first to journalists at press conferences.

It is really an indictment of the politicisation of science and academia that the University Of Utah heaped huge and unyielding pressure upon Fleischmann and Pons to hold that press conference before the peer-review process had returned a verdict. Simply because they wanted to crow to the world that their university had saved us all from ourselves. The university deans and the politicians who influence them could probably benefit from some sceptical training and critical thinking skills. Fleischmann to his credit regrets deeply the decision to release the paper to the press. Pons is now a recluse and speaks to no one and especially not to journalists.

The next chapter covers another fundamental question in science: What is life and how do we define it? How do we decide that something is alive or not?

This might seem like an obvious question when one looks around. That cat is alive, the spider on the ceiling is alive, the plants in the park and the fish in the sea are all alive obviously. But what about a bacterium? A virus? A computer program? It is possible to write code that replicates all of the characteristics usually used to define life including that of replication. Conversely what about a sterile animal or human? They can't reproduce so should they be considered not to be alive? It is a thorny question when the facts are examined. It is easy to say that something is alive but incredibly hard to show what it is that makes that thing alive. This chapter is full of questions, as well it should be as it examines possibly the most difficult question in biology.

Next up in Chapter Six is the Viking Lander anomaly in which the experimental package returned a swift and clear indication that there was indeed life on Mars in accordance with the parameters laid down previously. This result was not however backed up by the other experiments on the craft but there are significant questions regarding the ability of the other experiments to return clear and unambiguous results that persist to this day. Hence the controversy.

We must wait for further missions to Mars and the results of painstaking scientific experiments before coming to any tentative conclusion regarding life on the red planet.

Gilbert Levin, the designer of the labelled release experiment that returned the positive result, is a very cautious and careful scientist who seems to have all his ducks in a row and has, after some years, found the courage to say to the community at large that he does indeed have his science right and seems willing to take on all-comers. However astrobiology has moved on and there are significant hurdles to overcome in deciding what actually constitutes life and even how to define it before going on to design experiments to detect it on other planets. We must wait for further missions to Mars and the results of painstaking scientific experiments before coming to any tentative conclusion regarding life on the red planet.

Chapter Seven concerns itself with the famous “Wow!” signal received on Earth in 1977 by the Ohio State University’s Big Ear radio telescope. The signal is next up for analysis and Brooks gives a fascinating insight into the circumstances around this event, almost none of which I was previously aware of, including the fact that at the same time as the signal was received, Elvis Presley was coincidentally breathing his last. Or maybe the signal was something transmitted from the flying saucer that came to pick up Elvis.

The Big Ear picked up the signal in the first of its two receivers, but just three minutes later, as the second telescope rotated onto the same sky coordinates, the signal had gone. There has been, to date, no repetition of the signal.

I found almost horrifying the information that after the data on the telescope’s 1-megabyte hard drive had been printed out, the drive was wiped clean by the technician so it could be used again. In those days hard drives were amazingly expensive; none of this modern day 6p-per-gigabyte we’re used to now. Oh the loss!

Next up is one of the strangest things I’ve heard of: Mimivirus. A bizarre throwback from deep history discovered in glamorous Bradford by Tim Rowbotham of the Public Health Laboratory Service and initially mistaken for a bacterium on account of its phenomenal size. A virus is many times smaller than the normal size range of bacteria and is arguably not even alive as it contains none of the machinery for replicating itself and instead relies upon its hijacking skills to take control of a host organism’s replication facility to spread itself around. Usually around the sinuses of my colleagues, I note.

Brooks gives us a fascinating insight into the implications for our understanding of the origins of life that many scientists seem to think Mimivirus will have. Particularly that it may solve the problem of where the nucleus of the cell came from. Many other structures of the cell certainly seem to have at one time been independent organisms that have been co-opted by the cell owing to selection pressures so why not the nucleus itself? It may in fact shed light on the reasons why organisms die.

Which is the subject of the next chapter: Death.

Why do we eventually break down, our cellular machinery becoming less and less efficient, eventually failing and not being replaced? Why do things die? An obvious question that many a small child has asked. Unfortunately, for the most part there has been a deafening silence in response to this innocent query. Brooks takes us through the two main competing hypotheses; the genetic switch idea in which cells are pre-programmed to die after a certain time and the accumulated defect scenario where errors in replication reduce the ability of an organism to repair itself until it fails completely. There is plenty of evidence in support of both camps and plenty of contradicting results. So basically no clear picture is emerging, which is characteristic of a very hard problem. There is a third way in which Brooks tantalises us with Cynthia Kenyon’s studies of genetically controlled biochemical regulation which seem to be indicating that, as the old adage goes, death is something to do with sex.

Why hasn’t asexual reproduction taken over the planet? Especially when sexual reproduction is so fraught with potential pitfalls.

Here in the next chapter, entitled ‘Sex’, the author takes us romping naked and carefree through one of the most bizarre developments in evolutionary history. Why bother with sex when there are much better ways to reproduce? Why hasn’t asexual reproduction taken over the planet? Especially when sexual reproduction is so fraught with potential pitfalls. Finding mates, fighting off other ardent suitors, running after the escaping potential mate as she attempts to find an empty taxi.

Sex could well be a by-product of another evolutionary adaptation or perhaps something more socially driven. The simple arguments of gene shuffling do not appear to hold much water when they are considered against the advantages of asexuality. And yet, in experiments mimicking complex and varied environments, sexual reproduction wins out over asexual. Perhaps it requires a certain degree of environmental selection pressure to engender sexual reproduction. There is simply no consensus.

Why hasn’t asexual reproduction taken over the planet? Especially when sexual reproduction is so fraught with potential pitfalls.

In the next chapter Brooks turns his attention to what is perhaps the most disturbing subject of all. Especially to those people who think they are in control of themselves. The evidence seems to be mounting that free will in the traditional sense is completely illusory. Of course it would be easy to fall into the trap of the false dichotomy in which one immediately moves to the polar opposite of the position one has been forced to abandon by logic and evidence, namely that all your actions have been pre-programmed and that you are simply a biological puppet of either the electrical impulses in your brain or some magic grandfather in the sky.

The traditional view of free will in which the human has complete autonomy and where every action taken is a direct result of conscious executive power is apparently not supported by the evidence. Instead it appears that our actions are the result of myriad tiny influences all of which go to make up the final action that we perform. There is no decision to take that final action, it is simply a result of that which has preceded it. Whether it is picking up a pencil or buying a new house there are many things that have gone before that final decision that make it highly predictable. So if we can predict the action, does that mean we don’t have free will?

It would seem so in the traditional sense of the idea. Brooks quotes Guy Claxton saying that it’s OK to believe you have free will if you don’t try to do anything complex like control everything in your life.

This is a fascinating chapter and the results of the current research in the field will have the most profound effect upon our societies and lives.

The last two chapters of this fascinating book examine the placebo effect and homeopathy, two subjects which I think we all consider to be inextricably linked. The placebo effect is being studied intensively all around the world and who could not be fascinated by a study that shows the efficacy of a drug is reported to be highly influenced by the packaging, paraphernalia, instruction and ritual surrounding its administration. For example, Brooks takes us through some of the research which paints a picture of a difficult landscape covered by pitfalls for the unwary that can ruin the relevance of a clinical trial if the placebo effect is not properly controlled for. The results of placebo research are often contradictory and Brooks does an admirable job of setting out the broad picture with the critical highlights and conclusions drawn from the experimental results. Such research has wide repercussions for medical ethics and drug prescription policy for doctors the world over. He also makes specific note of the critical points that placebo treatments, though attractive to some, cannot cure cancer nor can they protect against malaria or prevent pregnancy. And that some alternative practitioners have perhaps unwittingly embraced placebo treatments as various types of cure-all and have patients beating a path to their doors for miracle cures, wallets in hand.

Thus far in the book there have been few points that have raised my sceptical hackles enough to wish to comment on them specifically but I’m afraid there’s a big one in the last chapter on homeopathy. It all starts off swimmingly with an excellent introduction to the origins and methods of homeopathy and the implications of the claims made regarding the mechanism of homeopathic effectiveness. Brooks points out that the claims made are all highly implausible but then goes on to give homeopathy a ‘get out of jail free’ card a third of the way down page 194.

I was also surprised at the credence given to the term ‘allopathic’ as a genuine description when medicine is being described in contrast to homeopathic treatments.

I was also surprised at the credence given to the term ‘allopathic’ as a genuine description when medicine is being described in contrast to homeopathic treatments. ‘Allopathic’ is a term invented by the originator of homeopathy that is used to describe evidence- and science-based medicine. It basically makes it very easy for the homeopath in conversation with a client to dismiss the entirety of medicine with one word.

Perhaps I am being a little harsh with my criticism of Brooks for his seeming credulity in this chapter, but there are several good sceptical points to be made, especially regarding the author’s propensity in this chapter for allowing anecdotal reports to take the place of data.

It is the final few pages of this last chapter where I feel that, without any warning at all, the wheels come off the wagon. Frankly this annoyed the hell out of me after reading such excellent material prior to this point.

In conclusion, then, I feel that *13 Things That Don't Make Sense* is on the whole an excellent book. It is fast paced and covers the topics in salient and concise detail. It provided me with insight into subjects I knew next to nothing about with the broad range of topics on offer. The last chapter aside, the book is a joy to read and completely accessible to the lay readership and also really very funny in parts. I recommend it highly.

There were times when my sceptical hackles were raised at a matter I felt was not treated sceptically enough, but I suppose we can't expect perfect scepticism from the author or their editors and publishers. Or me for that matter.

Here endeth the review.

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The Incredible Human Journey: The Story of how we Colonised the Planet

by Alice Roberts, London: Bloomsbury Press, 2009, pp 379.

Mark Newbrook

This book, linked with a recent BBC TV series, is an exciting travelogue-cum-intellectual detective story in which Alice Roberts very ably discusses the matter set forth in her title. Some of the major associated issues now appear to be nearing resolution, notably the question of whether *homo sapiens* ('we') evolved from our immediate forebears once only ('Out of Africa') or several times and in different locations ('multi-regionalism') – although well-informed dissenters remain (see below). And, while some other points of contention are still very much 'up in the air', the time for such a book, scholarly but accessible to non-experts, has arguably arrived. Roberts herself is an evolutionary anatomist with a PhD in palaeo-pathology, and this aspect of her work is naturally especially strong; but she has informed herself well on other relevant subjects and has used her academic contacts most effectively in drawing off expertise across this entire multi-disciplinary field of enquiry.

Genetically and physiologically, *sapiens* displays little diversity; all 'interracial' physical differences are superficial.

In the wake of the earlier expansion of *homo erectus* (in East Asia by 1,000,000 BP), *homo sapiens* was established throughout the entire habitable world by 1000 CE (New Zealand was the last sizeable land-mass to be reached); indeed, in many areas remote from our African cradle (including Australia; now also the Americas, e.g. at Monte Verde in Chile) the archaeological/palaeo-anthropological record displays a much longer settlement history (20,000-60,000 years). During this process, other hominin species (including *erectus* and the Neanderthals) were, it appears, completely replaced (though see below).

Genetically and physiologically, *sapiens* displays little diversity; all 'interracial' physical differences are superficial. On the other hand, the unprecedented ability of *sapiens* to learn, reason and speculate during its lifetime, and to transmit this acquired information to its offspring, has led to the enormous cultural diversity which distinguishes human communities – including the existence of many divergent religions and world-views, many forms of art and symbolism, and thousands of mutually unintelligible languages. Other species can of course communicate, but none – even our closest primate relatives – are known to have art, religion or language as such. The origins of religion and language remain obscure, because of the ephemeral nature of most of the empirical evidence in these domains before the recent invention of writing; but with increasing sophistication in the relevant disciplines – now including genetics, especially work on mitochondrial DNA, and various new (and in some cases still controversial) methods of dating – much can now be learned about the prehistoric stages of these characteristically human behaviour patterns and their subsequent early differentiation. All human groups also share crucial tool-making abilities not found in other species; and tools (and other artefacts) have themselves diversified very considerably, as the archaeological record shows. And all of this varied information is grist to Roberts' mill.

Roberts traces the origins and history of *sapiens* as revealed by the ever-growing tradition of scholarly work, and also the history of that tradition ('lumpers' vs 'splitters', etc). She recounts meetings with advocates of all the relevant mainstream standpoints, including for instance her adventures with Robert Bednarik – one of the few remaining advocates of multi-regionalism – and with

Chinese scholars, some of whom have posited a startlingly strong version of multi-regionalism in the context of the origin of their own population. And she includes a fascinating excursus on the newly-discovered 'hobbits' of Flores, which some scholars regard as a **non**-*sapiens* population which became extinct only a few thousand years ago. (See Kenneth Krause's article in *Skeptical Inquirer* 33:4 for an update on this debate.)

Roberts is not afraid of addressing politically sensitive topics, such as the issue of the role of *sapiens* in the extermination of the Pleistocene megafauna in Australia (also relevant in the Americas). And, while she does not tangle with the fringe proper, she cheerfully deals with the better-informed minority theories involving surprisingly early transoceanic links between the Americas (generally thought to have been settled mainly via Beringia) and remote areas (Africa, Australia and the European sites of the 'Solutrean' culture).

As a historical linguist, I might have liked to find in this book a somewhat greater focus on linguistic matters. The highly specific and vastly complex details of language data often furnish key evidence in the assessment of historical and archaeological theories; and, although much of the period surveyed by Roberts is pre-literate, such comparative evidence as may be gleaned from known (or reconstructed) languages, spoken or written, is still important. Roberts does include an interesting (though, it must be said, somewhat naively-expressed) discussion of 'click' consonants (technically, velaric ingressives) in a range of African languages, comparing their distribution with genetic data and suggesting (with others, and not unpersuasively) that the development of these phones may well have pre-dated *sapiens* expansion from Africa. She also rehearses the diffusionist geneticist Stephen Oppenheimer's ideas about links between the distribution of alpha-thalassaemia and early language community boundaries in South-East Asia; these, again, carry a degree of conviction, though Oppenheimer's linguistics itself leaves something to be desired. But more along these lines, and more palaeo-linguistics generally, would perhaps have been welcome.

Roberts writes well and clearly, and obviously with passion as well as scholarship. Overall, the work cannot be recommended too highly to all with an interest in these matters.