The Power of False Beliefs : A Modern Pseudoscience and Public Love Story

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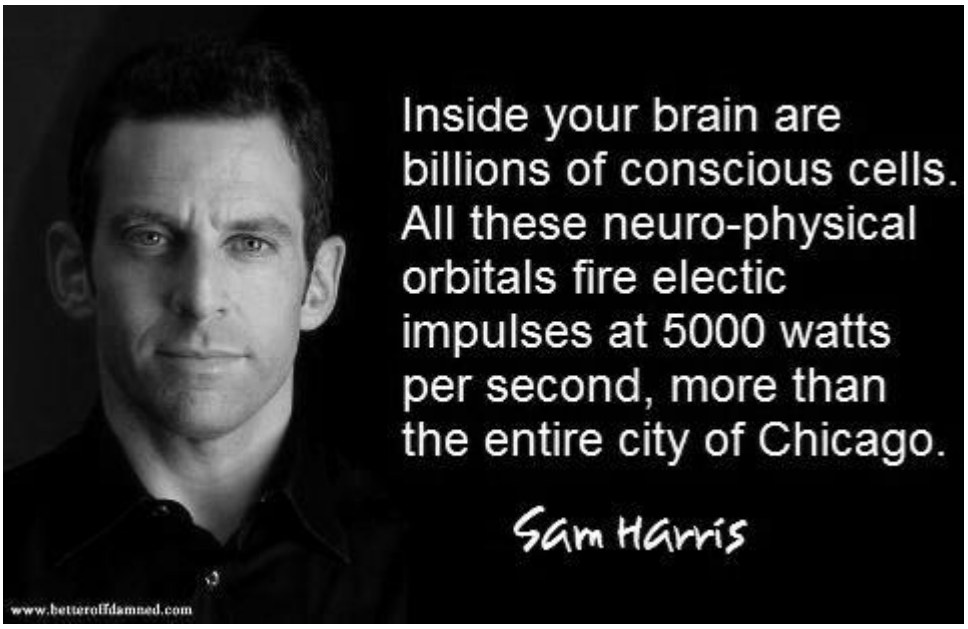

> "If a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties."
> —Francis Bacon

1 Why Good Explanations Matter

Since the dawn of man, our large brained species has been somewhat cursed with its vivid conscious existence. An existence, where from the beginning, it must have been painstakingly clear that the world was an endless field of ungraspable mysteries. We watched the sun rise and set. Witnessed the glow of the moon, stars and milky way. We saw the mountains, canyons, rivers and the vastness of life it harboured. Although the light of these magnificent sceneries filled our retina's in the exact way it would now, we did not understand what these spectrums of light meant. We had no clue about the sun and it's magnetic radiation, the formations of canyons over time by the exact same rivers we fished, or the massive grinding tectonic plates that gave birth to the mountains. Instead, we conjured up myths and stories, to explain the phenomena that we experience. We did this with the only tool we possessed - the splendid architecture of our brains - wired to do rather specific and basic things within our ecological niche. It is therefore no surprise to see that we explained the world in our own image, and limited frame of understanding. The way we were able to draw lines in the dirt under our feet where tiny animals rustled, so must our forefathers have mustered their own world to be created by something immensely bigger than themselves. For how else, would these grand things such as canyons exist?

The survival value and evolutionary advantage of such myths and stories must have been that they could explain unexplainable phenomena, which in turn reduces stress and henceforth anxiety. Almost all early mythology that aims to describe the universe, our world, its seasons, the weather and life around us, are explained by polytheistic pantheons of God's. These groups of deities were often attributed rich background stories and vibrant lives, which could account for the unpredictability within our surroundings. The sun is not shining? We better hurry with that human sacrifice, because apparently, our sun god isn't too happy with us.

Distinct groups of humans around the globe have conjured up a colourful range of mythologies, and although they differ a lot, they have all been invented as a tool for explanation, and in doing so, elicit great degrees of magical thinking. How could early humans possibly grasp the concept of the Sun or the changing seasons and weather? By interpolating the real answers with answers that we were at that time capable of conjuring.

Would these explanations eventually help a group of people improve over another group with different explanations? If the tool of explanation does not directly harm you, it might just do that in the long run. If it means that you should engage in biologically dangerous and irrational behaviour, such as sacrificing large numbers of your people to an angry sun god, it might be that you're trapped in a cultural, or memetic deadlock. The type or form of explanatory tool that is used thus seems to be of direct importance for success and survival.

A striking example can be found in the story of the unlucky people of the Easter Isles. It is often said to be a perfect illustration that man should be careful with its resources, as the natives gradually cut away all the forests needed to sustain the ecology of the remote island, which resulted in civil war and chaos. What people do not often mention, is why they cut so much wood in the first place. In *The Beginning of Infinity,* David Deutsch (2011) hypothesis that the answer lies not in the popular notion of human greediness, but that the Islanders believed erecting the famous Easter Island statues was of utmost importance for their survival. They needed large amounts of lumber and manpower to build and transport the statues. Their supernatural beliefs in the protective gaze of the statues that were meant to represent a deceased head of their lineage was stronger than their biological need to survive. In this heart-breaking hypothesis, trust and faith in faulty explanations proved to be fatal for many of the islanders. I could rant on about witch burnings and other cruelties performed by humans in the name of superstition, but I will hold myself from citing more stories or mythologies, as they are readily available online and in libraries. However, it is worth noticing that one can draw a common message from the gut-wrenching tales of the past. False beliefs and their respective explanations are more than *just* beliefs and can potentially have grave effects on those who harbour and spread them, whatever type of justification or positive effect they can concurrently harbour. In the case of the Islanders, if they sought more knowledge (and had not wasted their time in the construction of huge numbers of ugly and useless statues), they might have just been able to avoid their fate.

To witness myself writing this essay is tantamount to saying that we've come spectacularly far from the Islanders situation. It does not matter whether you start counting at the prehistoric times, early farmers or first villages and cities. What does matter is that we have found more efficient tools for explanation. Religion bravely tried to climb the throne as an ultimate explanation tool and gently cracked open the windows of human ingenuity. However, it was not until science emerged that we could start to systematically capitalize on the deep curiosity that we find in humans. Founded upon its predecessors philosophy and natural theology, science is a tool that is out to find *true* explanations of the world, that

provide some kind of practical benefit or betterment in understanding, instead of providing just a comforting mythological story of explanation (in the case of the islanders, methods to increase forestation, instead of building statues that are supposed to protect you from harm).

Since the birth of the early scientific principles, there has been no other force capable of influencing so many human lives in so little time. Whereas it was once thought God's, spirits or miasma (read, foul air) decided over sickness and health, 1700's germ theory gave a more realistic account of why and how diseases actually spread. In line with germ theory, widespread vaccinations starting from 1800 solved almost all infectious diseases known to the modern world. From 1887, Radio Waves, instead of 'telekinesis', made it possible for human communication to hold over vast distances, dramatically increasing multiple functional aspects of human endeavour. Notably, one of them was the reporting on infectious disease outbreaks. The discovery of radioactivity and x-rays opened up dozens of opportunities in healthcare, whereas antibiotics made sure that we were no longer doomed to die once ill due to a lack of vaccination. Surely, within the field of bio-medical knowledge, science has proven to be a sturdy candidate to relieve us from once unexplainable disasters. One could keep going spawning such baffling advances in scientific knowledge from other scientific fields that have bettered the lives of many, but that would sooner or later become tiresome and overwhelming. On the other hand, one could also provide the case that science has brought us a lot of suffering. While it is obviously true that the atomic bomb wreaked havoc in Nagasaki and Hiroshima, killing many thousands, the same scientific field also brought us nuclear reactor plants that to this day provide millions with relatively cheap electricity. Technologies created by the scientific process can thus be viewed as a double edged sword, and it is often the politicians, generals and laypeople, not the scientists, that wrongfully use the sharp side of the blade.

Any well-read person can recognize the sheer quantity and quality of scientific knowledge and how it has improved many aspects of our society, skyrocketing us into the modern Western world. Ironically, the sharp edged blade turned against ourselves is even an example which illustrates that science actually works. This implicates that it is based upon bits and pieces of objective reality, whereas praying towards a God to smite a foe with divine justice probably won't get you far.

It might therefore be seen as quite a surprise, that more than 200 years have passed since the discovery of vaccination, and we still find millions of people who are strongly sceptical of vaccination or even oppose the *scientific method* altogether. This is striking, as through vaccination alone, an infectious disease like small pox which has approximately

killed 400 million people in the 20th century alone has been eradicated (Koplow & David, 2003). Such scepticism is even more remarkable when we realise that in many parts of the world, people are still suffering from polio and measles because of a lack in vaccines. Concurrently, why are there still millions 'flat-earthers' out there, who furiously defend the belief that the earth is flat instead of round. One could easily discredit such people as loonies or simply ignore them. However, an extraordinary variety of such false beliefs exist, and they might actually rise in popularity. Since false beliefs can have disastrous outcomes, as illustrated by the Islanders, these questions are worth asking and deserve further investigation.

2 Finding Good Explanations - The Scientific Method

So, what exactly is the *scientific method* that supposedly is so different as opposed to false beliefs*?* Before delving into this question, it is noteworthy (and also logical) to state that the scientific method has not always been the same throughout history and stems from a long tradition of innovation (Achinstein, 2004). However, this is not of great importance for the questions addressed within this essay, as we will focus on the general consensus on the modern scientific method (see appendix A). This method seeks to explain the events of nature in a reproducible way. For example, an explanatory hypothesis or thought experiment is put forward, as explanation, using principles such as parsimony, or *Occam's razor* and are generally expected to seek consilience. This constitutes that the explanations must fit well with other accepted facts related to the phenomena. This new explanation is used to make falsifiable predictions that are testable by experiment or observation. In order to obtain legitimate results, the predictions are meant to be written down before a confirming experiment or observation is sought. Disproof of a prediction is seen as evidence of progress. This is done partly through observation of natural phenomena, but also through countless of different experimental designs, which are needed in order to distinguish simple correlations from causality (a distinction that for most humans is harder to make than it seems).

When a hypothesis proves unsatisfactory, it is either modified or discarded. If the hypothesis survived testing, it may become adopted into the framework of a scientific theory. This is a logically reasoned, self-consistent model or framework for describing the behaviour of certain natural phenomena. A theory typically describes the behaviour of much broader sets of phenomena than a hypothesis; commonly, a large number of hypotheses can be logically bound together by a single theory. Thus a theory is a hypothesis explaining various other hypotheses. In that sense, theories are formulated according to most of the same

scientific principles as hypotheses. Since most scientific knowledge is created by adhering to these basic principles, scientific knowledge often cross pollinates between fields and paradigms, creating new scientific fields. For example, cognitive science has emerged as a product of knowledge from psychology, computer science, linguistics and neuroscience, and these new fields of computer science and neuroscience are built upon…and henceforth. Since it is able to find strong new explanations by combining the individual parts of other strong explanations, one can state that the underlying truthfulness of the original pieces of knowledge must be high and most approximate some sort of objectiveness, otherwise combining them would result in mere chaos. Humanity has therefore been cultivating scientific knowledge cumulatively, instead of idle explanations that stand on their own and only influence that specific piece of mystery it is trying to explain but nothing else.

Like any human, scientists usually have a preference for one outcome over another, and so for science to work, it is a necessity to eliminate this bias. To do this, scientists carefully construct the most appropriate experimental design, and transparently put the experimental results and conclusions forward for peers to review. After the results of an experiment are announced or published, it is normal practice for independent researchers to double-check how the research was performed, and to follow up by performing similar experiments to determine how valid the results actually are. When this process has seen many cycles, scientists dare to say that they have found yet another piece of approximate objective truth, and feel more strongly that this truth can be used to design further experiments around. If after all that was not the case, one just takes a couple of steps back, and starts from the point where it still made sense. To conclude this, it seems that the scientific method, when following it's ideal form, allows humans to solve problems in a highly creative manner, whilst minimizing most effects of subjective bias on the part of those who propagate the theories (namely the confirmation bias). This last part is never to be overstated. Although one can argue that we can do without the scientific method and just use our reason and logic, when doing this, one already steps into the cognitive fallacy that our reason and logic, how much it might seem true in the eyes of the beholder, are to be trusted. And although at many times our individual reasoning and logic aid us dearly, we are extremely variable in our capacities to truthfully use logic and reason, and then too often (un)consciously resort to our most overrated ability ; that of blind intuition.

3 The Birth of Pseudoscience

Although the scientific method and it's claims are inherently fallible (as is every other piece of human knowledge) and prides itself for it, not all understand or see the beauty in the methodology described above. Like every piece of matter has its anti-matter, the birth of science as we know it might have had an unlikely brother. The cross pollination of different pieces of scientific knowledge, modulated by human intuition, produced *pseudoscience* in its wake. This is a concept that many will have heard of, but not many will be able to accurately explain. Let us therefore ask ourselves the question what pseudoscience entails. According to RationalWiki.com, pseudoscience can be described as:

"any belief system or methodology which tries to gain legitimacy and authority by wearing the trappings of science, but fails to abide by the rigorous methodology and standards of evidence that are the marks of true science."

Although many different descriptions exist, they converge on the fact that pseudoscience tries to look scientific in its presentation of itself, while it is not going to the same lengths in ensuring that the knowledge obtained is truthful. In that sense, it is radically different from mythology and theology, and deserves the attention from science - instead of neglect - as it is drawing plenty by itself.

Throughout the ages, we have seen many false prophets, charlatans and imposters that claim to have adequate or expert knowledge on various topics. Then how is this significantly different than the phenomena known as pseudoscience that we see in the modern world? More importantly, if a true distinction between *real* science and *pseudo*science exists, how can one successfully distinguish both camps?

According to the scientific philosopher Paul Feyereband (1975), there is no real distinction to be made :

"Science is much closer to myth than a scientific philosophy is prepared to admit. It is one of the many forms of thought that have been developed by man, and not necessarily the best. It is conspicuous, noisy, and impudent, but it is inherently superior only for those who have already decided in favour of a certain ideology, or who have accepted it without ever having examined its advantages and its limits. And as the accepting and rejecting of ideologies should be left to the individual it follows that the separation of state and church must be complemented by the separation of state and science, that most recent, most aggressive, and

most dogmatic religious institution. Such a separation may be our only chance to achieve a humanity we are capable of, but have never fully realized.

According to Feyerabend, science can be viewed as an aggressive, impudent, almost religious institution, for it rests on certain dogmas that cannot be rationally justified. Therefore, accepting the claims it makes requires a leap of faith. Although these accusations do not match well with the pursued and honest quest for knowledge as described by the scientific method (it's the core principle of science to evaluate advantages and limits, not be blind to it as Fayerabend suggests), this view resonated throughout society and it is thought to have had great consequences for the scientific community as a whole. According to Theocharis and Psimopoulos (1987), Feyerabend's view on science was one of "most fundamental and yet the least recognized cause" of the decline in science funding in the West.

In line with their reasoning, Shick (1997) argues that since most scientists are unable to quickly justify their methodology to of the scientific method towards sceptical inquirers,

"Feyerabend's claims have gone largely unanswered. As a result, Feyerabend's position has become prominent in both academia and the public at large. This has arguably led not only to the rise of pseudoscience and religious fundamentalism, but also to a shrinking pool of scientific jobs and research funds".

Although the naivety of scientists with regards to their ability to accurately express their own justified vindication might be a possible explanation for the rise of pseudoscience, this is not an entirely satisfactory one, as scientists have always struggled with this. Could the problem not only be the stuttering scientist, but the public opinion, and those that specifically aim to change this opinion for their betterment?

Let us first come back to the former question. Why is pseudoscience any different from the charlatans and imposters of the past? They are different in the sense that, when mythologies, religions and folk beliefs emerged, there was no science to act as a rational counterweight. There was no alternative that consequently provided answers that were as resistant to scrutiny as the answers that the scientific method conjures. There was no rational judge that wanted fallibility as a norm. Everyone was dipping it's toes into the pool of collective ignorance. Not surprisingly, all these things still readily exist alongside the scientific method in our present society (and although science is impudent according to Feyerabend, it has presumably done less harm than belief systems before it). Most religious, mythological or spiritual beliefs are entirely incompatible with the scientific method and its

results, and at least for now, are capable of sustaining themselves inside their own worldview without too much head-on collision. Since pseudoscience is wearing the trappings of science, and is claiming to provide the same explanatory power obtained as one would see when closely following the ideal scientific method, there is no way possible way to live side by side. Pseudoscience seems to aim at taking over the evidence based, explanatory role of the honest scientific method, and discards the principles it is built upon, with wide-spread doubt and mistrust within the public opinion as consequence. As Theocharis & Psimopoulos (1987) wrote,

"Having lost their monopoly in the production of knowledge, scientists have also lost their privileged status in society. Thus the rewards to the creators of science's now ephemeral and disposable theories are currently being reduced to accord with their downgraded and devalued work, and with science's diminished ambition".

Thus, for the uninformed public, pseudoscience and true science are hardly distinguishable. This difficulty is further illustrated on by Oreskes & Conway (2001) in their book and documentary Merchants of Doubt, where they show how multimillion dollar companies and governments with crooked agenda's readily make use of deliberate pseudoscience in order to sway or nudge the public. They are aware that most laypeople simply cannot tell high quality from low quality information, and instil false beliefs in them for their own profit. Noakes (2008) amusingly plays around with this idea, and shows how water bottling companies could hypothetically create an entire market out of thin air by spreading pseudoscientific beliefs about the benefits of bottled water. False beliefs, that in the current day and age, do not even need to be marketed, as people spread these lies themselves (un)knowingly.

The public opinion is of course heavily influenced by the reports of mainstream media on scientific topics and discoveries. Due to the fact that important discoveries have to be understandable by all, it is no wonder to see that most of the scientific jargon necessary to convey it's nuance and hesitance is absent in such reports. On top of that, the sensationalism and greed with which certain media outlets report on typical discoveries have certainly chiselled away at the trust of laypeople in science (Moynihan et al., 2000). It is often seen that in a short period of time, many paradoxical findings about a given subject are presented within the public domain (Drinking wine is incredibly bad for you – drinking wine is good for your heart!). For scientists, this is nothing out of the ordinary, as such proofs and disproof's ultimately lead to a satisfactory theory or conclusion. For those who do not

understand the workings of science, this might come off as if the knowledge is not valuable at all. Since many take ‘scientific discovery’ or ‘scientists found’ as a literal translation of ‘I need to update my entire belief system because whatever a scientists says is true’, this viewpoint can have grave consequences for science. People will lose trust in scientists all together, because if even the ‘truth holders’ can’t agree, than who can? Ransohof & Ransohof (2001) explain this phenomena of sensationalist science reporting, from which it seems that both sides, science and the media, are often liable for the sensationalism found, whether this is intently or not. All these factors have attributed towards a decline in the authority on knowledge production that science has and have enabled pseudoscientific information to flourish and spread.

4 Clearing up the Fog - When Does Adventurous Science Become Pseudoscience?

Not everybody is as happy to discard pseudoscience as the evil painted by many. According to McNallystates (2003),

‘‘The term 'pseudoscience' has become little more than an inflammatory buzzword for quickly dismissing one's opponents in media sound-bites" and "When therapeutic entrepreneurs make claims on behalf of their interventions, we should not waste our time trying to determine whether their interventions qualify as pseudoscientific. Rather, we should ask them: How do you know that your intervention works? What is your evidence?"

Keeping logic in mind, McNallystates is a little confused with the order of questioning here. We should indeed very much ask them how they know if their inventions work and what their evidence is. However, if they fail to provide any of this, or they fail to convince or move any experts in the field based on their hypothesis or theory, then we can start to hint towards pseudoscience, until more reasonable evidence emerges to restart the cycle of evaluation.

Some pseudoscientists would not find this satisfactory, as there still exists a grey area that needs to be addressed. This grey area, also known as the Galileo Gambit, or adventurous science, often finds its way back into debates. Galileo made significant scientific discoveries, documented the evidence for them, and was still reviled by certain authorities, but eventually honoured (although this is a gross overgeneralization of what actually happened, as illustrated by Biagoli (1993) in his book *Galileo Courtier*). Pseudoscientists often resort to some variation on this analogy as to explain why their beliefs and ideas are perfectly justified and

just need more time to be accepted. Pseudoscientists or those who entertain false beliefs are therefore supposedly vilified in the same way as Galileo. One can then falsely state that every novel crazy idea that is incompatible with the current paradigm of thinking (in this case, the authority of the scientific method, instead of the Catholic church), is worthy of being a candidate for the truth. Besides the rather farfetched analogy that is made over different centuries and cultures, these novel crazy ideas are not by definition vilified by anyone if they follow some basic logical assumptions. Since pseudoscientific theories meet some of these, but fail to meet many others, it is hard for the untrained or simply lazy eye to distinguish pseudoscience, from truthful but adventurous, Galilean science.

Although the Galileo Gambit acts more as an illustration of quasi-logical reasoning, Bunge (1984) was more fruitful in dividing science and pseudoscience. He did so with an elaborate formula that frankly is too long and complex to explain here. However, it boils down to list of 10 interactive phenomena, that give rise to a cognitive – or scientific – field. Whether or not a cognitive field is successful in attaining truth, power, understanding or popularity depends on what characteristics it shares with other cognitive fields, which are stored within the 10 phenomena. In the paper, he uses this system to show how one can systematically fill this formula until all boxes have been answered (for this case, parapsychology, which in 1984, was quite the big deal and not yet widely discredited as pseudoscience). Based on these logical steps, one can approximate if the idea or framework that someone is spreading is worthy of being called scientific, non-scientific, or even pseudoscientific Bunge demonstrates that in pseudoscience, there is often no honest attempt to follow the scientific method, provide falsifiable predictions, or develop double blind experiments. Although pseudoscience is designed to appear scientific, it lacks any of the substance of science, and is often based solely on repeated anecdotal evidence backed by a handful of pseudo-scientists. Thus, although not all may agree, we have concluded that there can be an actual ideological difference between science and pseudo-science, however hard it might be too see the distinction. In case there still exists any lingering doubt whether or not something applies as science or pseudoscience, Coker (2001) provides 22 points on how to distinguish the two.

So, like belief systems we've seen in the past, pseudoscience seems to be based upon beliefs that celebrate the adherence to static, authority-based beliefs of the in-group. Evidence is based on tradition and it does not seek progression, but conformation of beliefs. Of course, such authorities also exist within science in the form of certain paradigms. However, these paradigms are based upon an accumulation of knowledge carefully crafted by the work of

thousands of scientists in the past. If one were to carefully demonstrate why such a paradigm would be wrong and provide proof for it, these paradigms will be gradually adjusted. This is in contrast with a pseudoscientist flat-earther, who is more likely to respond to such scrutiny in favour of a conspiracy by the attacker. Science therefore seems to be more innovative as it aims at infinitely revising what it knows. Like Deutsch (2011) states in *The Beginning of Infinity*,

"Problems are inevitable, but solutions will always exist provided the right knowledge is sought out and acquired"

In the last paragraphs, we have investigated whether or not there is an actual difference between science and pseudoscience. To conclude, I would like to take the position that such a difference exists, and is identifiable with the use of a number of criteria. Due to the complexity of the phenomena that both science and pseudoscience try to explain, combined with the broadness of scientific endeavour, this maintains a tricky part. In the next part, I would like to investigate that what I would like to call modern pseudoscience, the increasingly big role the public plays in the existence of it, and what its implications could be for society.

5 Modern Pseudoscience - Why the Public is Hooked

If knowledge is lacking, people (un)knowingly adopt beliefs that cannot possibly be true. Singer & Bernassi (1981) describe this as occult beliefs, of which many fall within the domain of pseudoscience, and note that there has been a substantial rise in such beliefs since 1960. They argue that the rise of such beliefs on a societal level are due to media distortions, social uncertainty such as the social shifts in religion and gender roles and deficiencies in human reasoning. Furthermore, they explain how occult, or false beliefs, can only form under two conditions. Environmental uncertainty and low cost of the superstition (which is often the case, as it relieves anxiety). This means that people are more likely to form superstitious beliefs whenever they cannot control what they are doing due to a lack of knowledge. In that sense, one could even state that men's love for the easy explanations that occult beliefs and pseudoscience provides can be traced back to the dawn of religion, was it not for the great prophets that first capitalized on men's eagerness to find relief and comfort in explanations. Like Bernassi & Singer, Pence (2013) argues that there might be a relationship between the decline of religion and the rise of pseudoscience, he states that,

"However, it's a bit of a concern to notice how we're using 'gremlin' logic at the societal level for how we're screwing up more broadly. Pseudoscience is filling the vacuum, created by the loss of religion, for dealing with complex questions. Pseudoscience uses a similar explanatory structure to religion. Some foundation 'facts' are held as self-evident truths, based on an unchallengeable 'authority'. An evidence structure is proffered that cannot be challenged, but which feels true because it echoes some facets of our unexplained individual experience. A logic that embeds desire in some form (just as religion embeds our desire not to die) and is in some sense circular ('you've got to believe'). It also explains away, or spuriously simplifies, the actual complexity of phenomena, so that we feel we 'understand' them"

Strangely enough, in the 21st century we are due to the Internet not confronted with a lack, but an abundance of knowledge. In 2006 alone, an estimated 1.3 million scientific papers have been published (Bjork et al., 2009), of which the majority are also published online. Google handles around 1.2 *trillion* search inquiries a year. In 2014, the internet contained about 1 billion websites. One would therefore expect, that such environmental uncertainty would decline, as for every observation of it, there probably exists an answer. The problem is that lay people, as well as experts and scientists, find these numbers simply staggering. With our old biological brains, not everybody has the skill or time to functionally interpret such a vast amount of data. However, many of these pieces of data do actually reach people, only to be misinterpreted due to cognitive limitations or tampering of the media and other channels of communication.

As Trench (2008) describes, the birth and growth of the internet was mostly due to scientific research communities, as the sharing of information was not something laypeople frequently did (besides lending each other books, magazines and articles). Through the growth of the internet, it has not only become an incredibly important mean for professional and private scientific communication, but also for public communication of science and technology. Through these online developments, the boundaries between professional and public communication have become more porous, facilitating public access to previously private spaces, and therefore turning science communication inside-out. This is exemplified by the rise of peer to peer knowledge sharing and user generated content (UGC). The examples of online-activities given in the last paragraph are primarily knowledge containing entities that are somewhat controlled and regulated (most google inquiries directly bring you to pages that have been rated highly by Google's algorithms that select sites based on how

faithful the website is to it's content). However, social platforms like Facebook, YouTube, Twitter and Instagram, let users upload their own UCG. Whereas the flow of 'to be trusted' information used to be mostly vertical (from expert to layperson) and then spread horizontally by word of mouth, people are now more easily becoming 'experts' themselves, or at least have the capability to independently spread information deemed personally worthy of spreading. Most of these platforms where people create UCG have little to no quality control, and only moderate the most extreme forms of user generated content (porno, extreme violence, racism).

It seems that the advent of the internet and the popularity and gratification users obtain from viewing or creating UGC which is described by Shao (2009), have given birth to online echo chambers of islands-on-their-own-knowledge (Vicario et al. 2016). This knowledge can come from private spaces (online scientific journals), can be picked up on by the media or someone with access to such papers, is more than often misinterpreted, and then spreads through public spaces, acting as legitimate knowledge from such private spaces. An example of such a process is given by Ladle et al., (2005), who describe what happened after a large study on climate change was published. The media grossly inflated the results, which made the findings look more catastrophic and gave a shorter time scale for imminent changes. On the other hand, they found multiple variations of the article online that were primarily overly critical, sceptical and even paranoid in tone, dismissing the found results and replacing it with explanations that did fit their view. Within such online echo chambers, (pseudoscientific) ideas are able to thrive and are free to flourish without being subjected to rigorous scrutiny. In the long run, this can lead to parallel reality bubbles of truth about certain subjects are created that flow from the echo chambers into off-line conversations and spread throughout the population, giving more merit to the pseudoscientific ideas. Although all people have at least a couple of pseudoscientific beliefs that do no harm whatsoever, one can see the possibility wherein false beliefs are deliberately injected within such echo chambers, creating further falsehoods that fall within a pseudoscientific domain, only to be spread by unbeknownst people who belief themselves to be a little bit wiser.

But why are so many as gullible to accept such (un)obvious false beliefs of others? Probably, because they do not recognize that they are. The average human is not very sufficient in self-knowledge or meta-cognition, but is very inclined to hold onto its current set of beliefs. This happens due to what we know as cognitive dissonance. Straying too far away from what you belief or think you need to belief causes a great deal if distress. These psychological underpinnings of attitude change have been delightfully described and

summarized by Petty & Brinol (2004). People generally enjoy confirmation of what they already know, dislike being wrong or to be presented with conflicting information. Since most of the subjects that people now hold (pseudo) scientific beliefs over are highly complex and contain great environmental uncertainty, such as the meaning of the universe, environmental issues, the brain, human physiology and politics. It is therefore almost impossible for a non-expert to form a justified belief based on truthful knowledge, as it would imply a long and painful trip of being wrong, whilst being wrongfully right is much more appealing. The exact opposite of low cost.

As we've now seen, it seems to become harder for actual valid, non-sensationalist scientific knowledge to find its way towards laypeople, and even if it does, only a tiny percentage of the human population has the skill to analyse scientific papers for their contribution. However, people readily stumble upon the echo chambers on the internet when browsing for the explanations that they are trying to find in order to solve the uncertainties or questions that they have. Take for example a woman who is feeling very tired, but cannot pin-point why this is. Let's assume that the woman is in fact a heavy smoker, and due to her long addiction has been experiencing fatigue. As she googles "Why do I feel tired all the time" one might end up at an actual informative Wikipedia page about fatigue, where the woman sees that heavy smoking can cause fatigue, accompanied by a bunch of references. On the other hand, she might end up on a page like TheSpiritScience.net. Consequently, she might find the answers that she finds on the latter webpage to be more in tune with her current knowledge base (something about her Chakra's being misaligned with the quantum states in her soul, or the lack of Hydrogen Perioxide in her body), as she already had a couple of 'spiritual' friends who she heard talking about such subjects. Although it would have been better for the woman to accept the more truthful information (your fatigue is caused by a lifetime of heavy smoking), instead she now attributes her fatigue by adapting an explanation that is completely wrong. Although by mere placebo effects, her fatigue will feel less by drinking lots of expensive Hydrogen Peroxide bottles, she will probably continue to smoke, and consequently, return to a life of fatigue until the next pseudoscientific fad presents itself.

This of course, is merely an example, and many different scenarios can be put forward, including more dangerous situations where decisions have to made with regards to cancer and its treatment (evidence based treatment or alternative medicine). The underlying problem is that whereas people used to have a more narrow band of consensus on who and what was supposed to help you (people usually spoke with their doctor about their ailments, and hopefully, the doctor was a conscientious person and tried to help them with the best of

knowledge he possessed), nowadays, anything or anyone that seems persuasive enough becomes an on-line expert. Since these false beliefs are more easily accessible and understandable than an actual meta-analysis of a given problem, they will spread more efficiently through the population, whether it holds truth or not. The un-moderated internet itself makes no distinction on whether an explanation is good or not, as for the web browser there are just a series of 0's and 1's that constitute the message. It all comes down to the judgement of the person viewing that information, and only a person that can tell the difference between a justified and an unjustified belief can truly appreciate the value and reach of scientific knowledge and it's explanations.

6 The Dangers of Modern Pseudoscience

Although some philosophers see the term pseudoscience merely as a reaction from science towards not like-minded people in order to protect its legitimacy and authority as discussed by Still & Dryden (2004), there are also those who warn us for the dangers of pseudoscience (Bunge, 1984, Sagan, 1996). Sagan wrote about the in 1656 published book A Candle in the Dark by Thomas Ady,

"Any illness or storm, anything out of the ordinary, was popularly attributed to witchcraft. Witches must exist, Ady quoted the "witchmongers" as arguing—"else how should these things be, or come to pass?" For much of our history, we were so fearful of the outside world, with its unpredictable dangers, that we gladly embraced anything that promised to soften or explain away the terror.

Ady also warned of the danger that "the Nations [will] perish for lack of knowledge." Avoidable human misery is more often caused not so much by stupidity as by ignorance, particularly our ignorance about ourselves. I worry that, especially as the Millennium edges nearer, pseudoscience and superstition will seem year by year more tempting, the siren song of unreason more sonorous and attractive. Where have we heard it before? Whenever our ethnic or national prejudices are aroused, in times of scarcity, during challenges to national self-esteem or nerve, when we agonize about our diminished cosmic place and purpose, or when fanaticism is bubbling up around us—men, habits of thought familiar from ages past reach for the controls.

Lakatos (1970) was even harsher on pseudoscience, and wished to establish legislation to control it, for it could,

"destroy our cultural environment even earlier than industrial and traffic pollution destroys our physical environment".

Lakatos and Sagan were clearly on to something, as 20 years later pseudoscience and superstition do indeed run rampant through society. An active and frequent internet user myself, I am more than daily baffled by the downright absurdities and misinformation that are being spread as truths. Such absurdities are often dismissed as 'little pseudoscience', bizarre and cranky ideas that one should not worry about. To defend the population against infection of such little pseudoscience, Gardner (1952) wrote the book *Facts and Fallacies in the Name of Science,* which tackled 24 popular misconceptions. He also stated that pseudoscience is a problem, but is not yet dangerous, since most pseudo-scientists work in almost total isolation from their colleagues and tend to be paranoid. When viewed from the perspective of our hyper connected 21st century, these words seem to reflect something more. Pseudoscientists or those that propagate pseudoscientific ideas and false beliefswere not dangerous, as they often lived in isolation, and had lacked a platform to spread their attractive, yet bad explanations. The internet however, has given them just that, which means that 'little pseudoscience', can now evolve into 'big pseudoscience' by mere replication. Since we have established that pseudoscientific information is almost indistinguishable from science for many, it might not take long for Ady's words, "the Nations [will] perish for lack of knowledge", to become a dystopian reality.

With regards to big pseudoscience, we can clearly see how strong pseudoscientific beliefs in much of the population can do us harm. Although the consensus on anthropomorphic climate change has been growing strongly for decades (Keller, 2006), many Americans still view climate change only as a moderate risk, effecting primarily geographically or temporally distant people and places (Leiserowitz, 2005). This can be a problem, as the public's opinion and their perception of risk influences the development of policies and regulations, as well as their social engagement in acting upon such regulations.

To prevent such dystopian things from happening, it is crucial to invest in communication. Since most of the public gets its opinion on science through means of mass media instead of actually buying subscriptions to journals and reading lengthy papers themselves, there should be more communication between the scientific institutions and the media in order to accurately report on the significance of the discovery, as propagated by Holtzman et al., (2005). They also argue that scientists should resist their urge to exaggerate their own results, and that media outlets should have specialized science writers in order to be

able to report on scientific discoveries. Even with improvements, we cannot expect every news article to be as long or accurate as the discussion page of a scientific paper. Therefore, we will accordingly have to teach laypeople to judge knowledge on its worth, trustworthiness and validity. While Lakatos suggested to legislate research programmes and paradigms, it is ethically impossible to legislate beliefs, as this will only result in a thought-police filled Orwellian Dystopia. However, teaching our future generations the basic principles of the scientific method is possible and could improve individual resistance towards accepting false beliefs. This could impair the spread of pseudoscientific ideas until they return to their state of pre-internet isolation. As Sagan (1996) states,

"If we teach only the findings and products of science—no matter how useful and even inspiring they may be—without communicating its critical method, how can the average person possibly distinguish science from pseudoscience? Both then are presented as unsupported assertion"

If none of this happens, and scientists and laypeople proceed in (un)knowingly discarding modern pseudoscience as something ludicrous or non-existent, we might risk missing out on the benefits and explanations that the scientific method has brought us, and could bring us in.` the future. It could delay real science in actually combatting enormous societal problems (eradicating disease, famine, poverty, no-access to education, global warming, depletion of natural resources), however noisy and clumsy it might act in the process of getting there. Pseudoscience and misinformation will continue to spread doubt in untrained people about and misdirects them into not seeing what science has accomplished so far, reducing consensus and goal directed problem solving behaviour. We must all learn to live with doubts, to find certainties, instead of the other way around.

Does all of this mean that the scientific method is an infinitely virtuous tool to find explanations with everything else in life discredited as pseudoscience? Definitely not. Does every kind of problem that we encounter need the rigorous problem solving method of the scientific method? Not at all. We should however be more wary for faulty science, false beliefs and downright pseudoscience. On top of that, scientists themselves should be equally wary, as there are enormous problems that need to be solved within science. Publication bias is rampant throughout the scientific world (Ioannidis, 2005). There are many ties with commercial industries which makes it harder for independent science to exist and easier for pseudoscience to reach the public. The emphasis on hasty publications in order for universities to make money and the fighting for research grants are filled with bureaucratic

artefacts that hinder the advancements of science. However, with David Deutsch in mind, there might always be a solution to these problems when one engages them in a truthful and scientific manner. Rightly so, the existence and persistence of demonstrable false beliefs in the form of pseudoscience can only be a burden for those who will engage on those future quests.

Appendix A

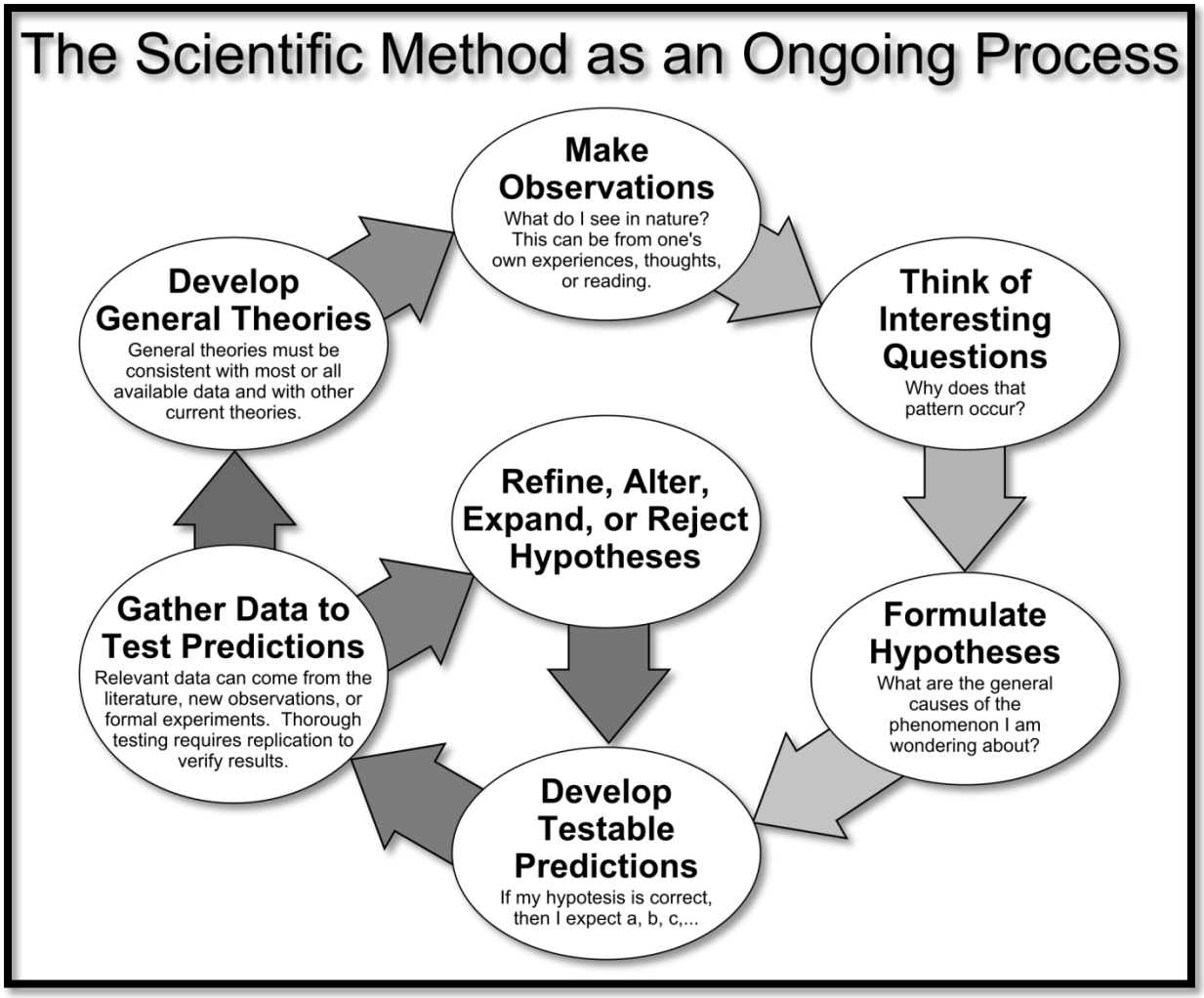

figure 1. The Scientific Method as an Ongoing Process. Taken from Theodore Garland Jr (2015)

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