

# The Perception of Anthropogenic Global Warming Modeled by Game Theory Decision Tables

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## Abstract

Society is living in fear of catastrophic climate scenarios, the so called Anthropogenic Global Warming (AGW) theory. It is a multi-disciplinary subject; this paper analyzes the psychology behind such thinking which is governing the perception and politics of the subject. It does this in so-called Game Theory decision tables for people's thinking. We come to the conclusion that current opinion in society will shift from 'active believer' to 'passive believer' to 'active non-believer' if evidence against AGW will continue to accumulate.

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**Keywords:** Climate change, global warming, psychology, beliefs, game theory, Pascal's wager.

## 1 Introduction

Predicting the end of the world has always been popular. That is well explained by Dawkins' Meme: An idea in society can survive and propagate because the host (the society) is receptive to it. Society is receptive to catastrophic ideas because the individuals are receptive to them, as will be discussed in this paper. While this idea is nothing new, we present here a numerical analysis in so-called decision tables.

Anthropogenic Global Warming (AGW) is not the first and will not be the last catastrophic model. Even if all of the previous ideas have been proven wrong, there is always room for new ones. Remember: Y2K (a.k.a. Millennium Bug), ozone, acid rain, H1N1, etc. The ideas go even further back. Christian religion has a history for predicting the end of the world; they name it Armageddon. Other religions and religious-like philosophical schools follow suit. Religions are overrepresented in this subject, because religion, by definition, is about believing things. Evidence is not needed for catastrophe ideas.

A summary of 170 documented end-of-world apocalyptic predictions

can be found on Wikipedia (Wikipedia 2013 c). There probably exists a multiple of this number of undocumented predictions. Some predictions are very time-exact. One even to the millisecond, namely the Millennium Bug (Y2K), an apocalyptic scenario that would take place when the computer calendar year changed from 99 to 00 in the year 2000. (Hence the name Millennium Bug, for being exactly one year before the end of the second millennium). Other scenarios were also rather exact, but were corrected by the prophets after not materializing at the first predicted date. The Ig Nobel Prize of Mathematics of 2012 was awarded to a set of people that predicted the end of the world, some of them repeatedly.

However, the most successful predictions, those that more easily propagate and survive in society, are those that are not 'exact' at all. It is still the firm belief of many Christians that one day Armageddon will come, although the exact day is not well known (a large number of predictions on the above-mentioned list are of this type). This way the catastrophic-scenario meme (CSM) can exist longer, it can be recycled over and over again, there where exact-date end-of-world memes become naturally extinct when their validity has expired.

This list shows that having apocalyptic thoughts is very normal to the human mind. Apocalyptic weather ideas are also nothing new. Noah's Ark is probably the most famous, but weather and cosmological (e.g. comets) events have always been seen as signs of the gods – e.g. the Nordic god Thor as the source of electric storms – and indications of bad times ahead. It is also not uncommon to attribute human influence on the weather and the climate. While mostly detrimental (the gods punishing mankind for its sins through the weather), also positive weather action is believed to be possible, with Native American rain dances probably the most famous example.

Generally speaking, pessimistic thinking – punishment for sin – is part of the human soul, and the weather does not escape from this phenomenon. As such, the AGW models are simply the result of how the human psyche works, and we should not be surprised about the conception nor the perseverance of these ideas in society. While the planet indeed has warmed up, the attribution to human behavior is dubious, but this attribution flows naturally from the human way of thinking. What the evolutionary psychiatrist J. Anderson Thomson describes as "We have a great deal of difficulty seeing anything other than human causation" (Richard Dawkins 2007). In other words, we have a need to explain everything as 'caused by humans'. Applied to climate changes: "It *must* be human-caused". In our seemingly rational society, believing is apparently still prevalent.

And any scientific analysis of the problem is met with extreme skepticism by the believers. Readily a conspiracy theory is invented to explain why the rest of the world is not believing the same things. The non-

believers are for instance normally accused of being paid by oil companies (But why should oil companies care about oil? They'll apply money where profit can be made and are in fact the largest investors in renewable energies). There is no room for a conspiracy anywhere, but it is invented anyway.

In his book "The Empire of Conspiracy", Timothy Melley explains that conspiracy theories are prevalent in society and are not limited to a tiny minority of lunatic 'psychopaths' (Melley 2000). Interestingly, Melley gives as an example how 37% of the American people believe Global Warming is a hoax. This deriding comment shows that Melley lives his own proof, since believing that AGW *is* true makes him a paranoiac person, steadfastly believing in a human-caused climate 'conspiracy', while for sure he has never seen any evidence to prove such claims. (He would not believe in them if he did understand the poor science behind such models).

The analysis can be extended and, apparently, many people even believe in contradictory conspiracies, which is possible because reason never entered into it anyway. As an example, according to Wood, many believe there is a conspiracy that Osama Bin Laden was already dead when his assassins entered his mansion, as well as that he is still alive (Wood, Douglas, and Sutton 2012). (Some kind of Schrödinger's cat being both alive and dead at the same time). Both facts being hidden from the people somehow in this conspiracy. Wood is fully right. Climate-conspiracy believers readily accept that the human-caused climate change causes Europe to both warm up and cool down (Liu et al. 2011). In fact, anything is readily seen as proof of the conspiracy. That is how the mind works. The more evidence is accumulated that the climate actually is on a cooling path, the more this must be proof of the conspiracy, and anything is believed to avoid the unpleasant cognitive dissonance. So, cooling down of our planet now is seen as evidence of a Global Warming (AGW) scenario. In fact, any weather event is seen as evidence for AGW. Global Warming is now being marketed as Climate Change to the general public. In this way, by being a vague theory, no fact whatsoever will technically ever be able to scientifically debunk the ideas.

This is a form of what Leon Festinger called 'cognitive dissonance' in 1957 (Festinger 1957): A strong desire of people to keep things simple and to eliminate any dissonance if two cognitions are inconsistent, just to make sense of things. "It was discovered in a participant observation study of a cult which believed that the earth was going to be destroyed by a flood, and what happened to its members when the flood did not happen. While fringe members were more inclined to recognize that they had made fools of themselves and to "put it down to experience", committed members were more likely to re-interpret the evidence to show that they were right all along

(the earth was not destroyed because of the faithfulness of the cult members)” (McLeod 2008). This kind of behavior we now see in the 'cult' of climate investigators. Their beliefs are so strong that opposing facts are actually seen as proof. Unprecedented appearance of icebergs in front of the coast of Australia is an example (Malkin 2013).

As a technical background information, to put things in perspective, in the 2007 IPCC report, it was concluded that the world had been heating up in an accelerated way by about 0.8 degrees in the 20th century and that the heating was fully caused by human activity, with natural variations maximally only of the order of 0.2 degrees. The famous Hockey Stick presented as proof. See for instance Fig. 2.5 on page 40 of the IPCC 2007 report (Ref. (IPCC 2008)). Given the fact that human detrimental activity has not abated, there was "no room for doubt" in the models – none whatsoever – that the planet would heat up further in the future. In reality, the planet has cooled down since 1998 and this scientifically invalidates – falsifies – the models. However, in a Bayesian (i.e., non-scientific) way, the model was adjusted, the error margins increased, and the cooling down called a 'pause' in 2013. The belief in the ideas is so strong that facts seem to be ignored or treated with skepticism, even by scientists. Facts can no longer invalidate the theories and only belief remains. It shows all symptoms of cognitive bias (See Yudkowsky for the ten most important (Yudkowsky 2008)), things that prevent you from being rational. Mostly, the research suffered from what is called 'confirmation bias' (Nickerson 1998) which basically means looking for evidence of the hypothesis (Yudkowsky 2008), where science entails the opposite, falsification of hypotheses (Chalmers 1982). Science uses debiasing techniques (such as double-blind and triple-blind research most famous from the fields of pharmacy and psychology, areas where bias would otherwise be pervasive). As far as we know, no such techniques were ever used in climate research – we don't even see how that would be possible – and absence of cognitive bias can therefore not be guaranteed and is therefore even likely, since the research is performed by humans with all their cognitive errors.

The list of cognitive biases goes far beyond the ten given by Yudkowsky (Yudkowsky 2008). Many are strongly related to each other or even contradicting. A sheer infinite list can be constructed. We mention here some relevant ones that *might* be applicable to the belief in AGW (these biases are not the subject of study of this paper, but are given here as background in psychology):

- The belief in a catastrophic scenario is generally termed 'pessimism bias', the tendency of people, especially those suffering from depression, to overestimate the likelihood of negative outcomes. Contrasting, also 'positive bias' exists, which is exactly the opposite effect: being optimistic that negative scenarios will be unlikely to happen.
- Festinger's cognitive dissonance effect mentioned above is generally called the 'backfire effect', people react to disconfirming evidence by strengthening their beliefs (Nylan and Reifler 2010).
- A phenomenon that can also easily be recognized is the so-called 'irrational escalation' or 'escalation of commitment', which says that people justify increased investment in a decision, based on the cumulative prior investment, despite new evidence suggesting that the decision was probably wrong (Staw 1976).
- 'Negative bias' is the tendency to pay more attention to negative information than to positive (e.g., weather disasters) (Sanderson 2009).
- 'Gambler's fallacy', is the tendency to think that future probabilities are altered by past events, when in reality they are unchanged (O'Neill and Puza 2005). After repeatedly 'heads' coming out when flipping coins, the estimated probability of 'tails' is *increasing*. In contrast, 'hindsight bias', basically means to predict the past and is a complete area of science in itself: In so-called empirical forecasting it means copying the found parameters of the past (such as average and spread of the data) for a prediction of the future. After repeatedly 'heads' coming out when flipping coins, the estimated probability of 'tails' is *decreasing*. This effect thus always results in mere extrapolation of trends (as has always been the case in the history of climate research). It basically works like this: if temperature has gone up (down), and X seems to be the only thing that changed during this time, inevitably a model will be developed that explains the rise (drop) with agent X being responsible, and future increases of X will without doubt cause more rise (drop). The definition of empirical forecasting. The Black Swan theory is the real occurrence that a beautiful explanation was developed why swans *must* be white, and then a black swan was found when Australia was discovered (Taleb 2010).
- 'Illusionary correlation' (Chapman 1967), inaccurately perceiving a relationship between two unrelated events. In AGW, the forward relation between CO<sub>2</sub> and temperature is perceived, there where the data actually hint at a reverse cause-and-effect relation, i.e., the CO<sub>2</sub> lags behind temperature by about a thousand years (Indermühle et al.

- 2000; Stallinga and Khmelinskii 2014a).
- The 'ludic fallacy', a term coined by Taleb (Taleb 2010), is assuming nature is working in a probabilistic way (like 'throwing dice' all the time), and thus follows laws of statistics, which isn't necessarily true (Stallinga and Khmelinskii n.d.).
  - The 'curse of knowledge' is the effect that knowledge of a topic diminishes one's neutrality in the subject (Camerer, Loewenstein, and Weber 1989). Climatologist, cannot but think there is something wrong with the climate.
  - 'False consensus effect'. The tendency of people to overestimate how much other people agree with them (Wikipedia 2013 a). This is actually more than a psychological effect, but is data distortion. The consensus in AGW among (climate!) scientists was estimated to be 97% (Cook et al. 2013). Yet, this consensus does not represent the true level of agreement between people, but instead is a direct effect of the positive feedback of the peer-reviewing publishing system: 1) Referees are randomly taken from literature (more papers published, more chance of being selected for refereeing), 2) referees, victim of their cognitive biases like anybody else, tend to ignore scientific reasons and are inclined to accept more readily papers proving their beliefs than disproving them (and, the age-old question arises: Who controls the controllers? Apparently nobody. There are serious problems with peer-reviewing (Bohannon 2013)). Even if the effect is tiny, this makes that if 'belief A' has a slight advantage over contradicting 'belief B', B will be filtered out completely in a Darwinistic way, and in a society where it is publish or perish, people representing B are soon without a job altogether (Stallinga and Khmelinskii 2015). Related to it is what can be called the 'queue effect' (Stallinga 2010). Imagine a hundred people standing in ten queues. That is, one queue with 91 people and 9 queues with one person. Ask the hundred people what is their queue length, and you will find an 'average' queue of 82.9 people, while the 'real' average is 10.0. In other words, observations from within the system give different results than external observations. "Yes, we, from our belief, all agree with each other" are the only words uttered and found in literature. A false consensus.
  - 'Expectation bias' and 'selection bias', or "trust your model, facts can be disposed of", the tendency to select data that prove a theory and throw away data that disprove it. This is made famous by the ClimateGate scandal (Climategate 2013), and the effect of constructing a Hockey Stick by selecting proxies that prove AGW (and ignoring ones that are not consistent with it) (Loehle and McCulloch 2008). Generally the 'Simmelweis reflex', the tendency to ignore correlations

or to reject new evidence that contradicts a paradigm.

- "With 'sanctification bias', members of a particular group, be it political, economic, philosophical, or religious, believe (without supporting, demonstrable evidence that can be statistically confirmed) that their group is somehow favored; that they know 'the truth', that others are ignorant and want to attack that truth, and that any disagreement is because the 'others', the outside world, is inherently flawed, or evil, or misguided. Throughout all of history, the people committing the worst, most horrific acts have almost always believed they were somehow sanctified, providing mental protection as to the consequences of their behavior on humanity." (Kennon 2013)
- 'Availability heuristic' is the inclination of people to take readily-available information easier into a model of the world than hard-to-get data. In a positive feedback system, this can then lead to 'availability cascade', which is described by Nobel-Prize-winning Daniel Kahneman (Kahneman 2011) in his book "Thinking, fast and slow": "An availability cascade is a self-sustaining chain of events, which may start from media reports of a relatively minor event and lead up to public panic and large-scale government action". The media report was the article in Scientific American of Roger Revelle (Revelle 1982) in 1982 writing his pessimistic outlook on the climate to justify research grants, triggering the response of Nobel-Prize winning politician Al Gore. Kahneman continues: "On some occasions, a media story about a risk catches the attention of a segment of the public, which becomes aroused and worried. This emotional reaction becomes a story in itself, prompting additional coverage in the media, which in turn produces greater concern and involvement. The cycle is sometimes sped along deliberately by 'availability entrepreneurs,' individuals or organizations who work to ensure a continuous flow of worrying news." In this we can easily recognize the IPCC, thriving on the fear of climate change, which they then set out to prove. Without AGW, the panel would cease to exist. Kahneman: "The danger is increasingly exaggerated as the media compete for attention-grabbing headlines. Scientists and others who try to dampen the increasing fear and revulsion attract little attention, most of it hostile: anyone who claims that the danger is overstated is suspected of association with a 'heinous cover-up.' The issue becomes politically important because it is on everyone's mind, and the response of the political system is guided by the intensity of public sentiment. The availability cascade has now reset priorities. Other risks, and other ways that resources could be applied for the public good, all have faded into the background." Indeed, people dampening the worries are accused of

working for oil companies (as part of the cover up), voices are being heard that 'denying' AGW should be punishable by law as strong as denying the Holocaust. Now, three decades after the start of the idea, governments all over the world are implementing measures that are costly and that moreover have no significant effect on CO<sub>2</sub>. Unfortunately, politicians are now hindered by the 'escalation of commitment' mentioned above and there is no longer a possibility to keep them in check, since the populace at large is whipped into a frenzy and actually demands more measures from the politicians. Apparently, there is no limit to the availability cascade and can even reach pan-global economy-wrecking proportions.

Non-believers can be accused of some of these same cognitive biases as well. And they even have their own. For instance the 'omission bias', the tendency to judge harmful *actions* as worse than equally harmful *inactions*; in doubt, we prefer to do nothing. Actually, the opposite bias also exists ("It is better to do the wrong thing than to do nothing", Churchill). Or the 'normalcy bias', the refusal to plan for a disaster which has never happened before until it happens (and immediately 'hindsight bias' kicks in).

The 'ostrich effect' (ignoring a possible negative situation). 'Hyperbolic discounting' is the tendency of people to have stronger preference for more immediate payoffs relative to later payoffs i.e., have a near horizon, ignoring catastrophes that are possible far away in time. 'Reactance' is the urge to do the opposite of what someone wants to do, to not feel constrained in freedom of choice. We know we should do something to change the climate, but we prefer to *choose* to do nothing.

Finally, any researcher, including the authors of this paper, could actually possibly be accused of having a 'bias blind spot', the tendency to see oneself as less biased than other people. In fact nobody can be certain of not suffering from it. Assuming to be immune to bias is misplaced arrogance.

Continuing, the difficulty of being falsified makes AGW a very powerful catastrophic-scenario meme (CSM). A successful CSM is surviving in society if it cannot easily be refuted by facts. Refutable CSMs will not survive and will be replaced by ones that can percolate and survive in society. Even if eventually the facts overtake the models of AGW and prove them wrong, in the meantime there is always some Bayesian re-adjusting of the predictions possible. This is a phenomenon we now see taking place in our society. The cooling-planet fact is bent 180 degrees to again be proof of the ideas. However, the selling of the idea that cooling is also AGW has not caught on so well, and a cooling planet will sooner or later make people abandon this CSM. The best prediction for the climate is a cooling until 2055 and we might well wind up a full degree below current averages (and three



degrees below IPCC predictions) (Khmelinskii and Stallinga 2010). It is interesting to study when and how the mentality of the people on this subject will change. For that we define here a framework for the mental state of people, to make *predictions* of people's behavior in future.

In summary, the Global Warming meme is classical doomsday thinking and has all the properties of a successful version: It is catastrophic, it has a human cause, any prediction can be Bayesian adjusted (what is called retrodiction), and contradictory ideas are ignored or even incorporated into the ideas (to avoid cognitive dissonance). Moreover, by 'biased assimilation', information supporting the belief is accepted/incorporated more readily than information undermining it (or saying it in another way, people with a certain belief will more readily accept information that supports that belief than people who do not have that belief) (Hamilton and Stampone 2013). For instance, a year with relatively many tornadoes is seen as proof of AGW by its adherents, while subsequent years with less than average tornadoes are ignored. Or melting of polar ice is accepted more readily as a truth by AGW believers than by non-believers.

## 2 Results and discussion

We have studied this phenomenon of the AGW meme a little further and tried to determine what goes on in the heads of people that believe in the AGW scenario. This finding seems to be applicable to any CSM but specifically in AGW, since it is in our opinion of the type heaven-as-reward, as summarized by Blaise Pascal: "I do not know whether God exists, but I know that I have nothing to gain from being an atheist if he does not exist, whereas I have plenty to lose if he does. Hence this justifies my belief in God". We extend this idea here. It is based on the presence of fear and anxiety.

Of course, there can be other reasons why people believe things, apart from Pascal's Wager. While this paper is not about believing in itself and we do not criticize such a stance, we would like to mention here some alternative reasons why people might believe things.

The most obvious is 'evidence'; people believe things by seeing facts. "Seeing is believing!" (For instance, if the axiom of the laws of gravity can explain the trajectories of planets, these observed and predicted trajectories make us believe in the axiom). However, as discussed above and shown by Nylan and Reifler, this often backfires; Facts contradicting someone's belief actually in many cases strengthen it (Nylan and Reifler 2010). "The general idea is that it's absolutely threatening to admit you're wrong", according to Nylan. One of the strongest arguments heard for the existence of God is that He is *not* showing His presence ("Why is He not interfering if he is so almighty and benevolent? He is testing you!").

Likewise, people find proof for conspiracies ("hidden agendas") exactly by the fact that they are not visible. The erasure of evidence is part of the thing believed and therefore 'no evidence' is dialectically reversed into 'evidence'. Generally speaking, there is a huge difference between *acquiring* a belief and (Bayesian) *adjustment* of it (Dietrich and List 2012). Still, it seems reasonable to assume that exposure to facts can change a belief, and we expect AGW opinion to change if contradicting facts become available. As an example, once the public gets wind of the fact that in history the CO<sub>2</sub> was always lagging behind the temperature variations – a fact that scientifically falsifies the theory of AGW; there is no way whatsoever to explain this in the framework of AGW – we may expect that it will change its belief. It will then rapidly become fashionable to adopt an anti IPCC stance.

A simple reason why people might believe things is that they have evolved into a predisposed attitude of believing it. It is like asking, Why do people have black hair? While deferring the question how the mechanism works, apparently having a predisposition for a belief gave them a higher survival rate in the gene pool. Natural selection took care of the rest. One might even ponder over what it is that makes believing things profitable in terms of reproduction, but it seems obvious that adopting a popular opinion – basically following fashion – leads to more success than going against it.

Moreover, copying a belief of someone else saves a lot of energy. So, it makes sense that having a predisposition for copying fashion, including any fashionable belief, is advantageous and therefore it exists.

People can believe something because it pleases them. I can believe that I am beautiful. It would make me happy being beautiful or at least believing so. I like being happy, so I make sure that I believe that idea of me being beautiful.

People can believe things from 'inertia' or 'tradition' as it is commonly called, "Our people have always believed X". That means never actually having thought about the subject. And a successful propagation of the belief in society is therefore accomplished by installing it into young people at an as early age as possible, because a once-acquired belief is difficult to lose, and the social effect of "my society believes X, therefore I feel good believing X too, to feel part of society" is maximized. (Note: AGW teaching packages endorsed by the UNESCO exist for primary schools for this exact purpose (UNESCO 2013)). Another reason might be 'denial' (applicable to an already existing belief), the technique "to avoid the panic [cognitive dissonance] that would come from realizing things are not as you believed" (Kennon 2013). There are actually people *denying* AGW. (Note: Skeptics do not deny anything). Similar to denial is calling the source of disproving evidence a 'false prophet' (for example Antichrist, or calling

AGW-skeptics 'Deniers'); a way to "avoid unpleasant emotional side effects of cognitive dissonance is to shut out all opposing evidence by labeling any counter-evidence as malevolent" (Kennon 2013).

A strong effect is self-delusion, 'believing in one's own lies'. What started as a lie, by repeating it can make the liars themselves start believing in it. "The salesman always buys his own sales pitch". Especially politicians have long been known for this effect of self-deceit. That is because in their own world, the political arena, it is of utmost importance to appear convincing. The ability to fully believe in whatever is said is obviously a winning trait. Anyone not having this quality is soon eliminated from the political arena. Actually, social recognition enhances this self-deception. "In 1976, when Ronald Reagan was running for president of the United States, he often told a story about a Chicago woman who was scamming the welfare system to earn her income. [...] He talked about this woman, who he never named, in just about every small town he visited, and it tended to infuriate his audiences. The story solidified the term 'Welfare Queen' in American political discourse and influenced not only the national conversation for the next 30 years, but public policy as well. [The story] wasn't true." (McRaney 2015). The advent of social media exacerbated this effect which researchers call 'digital amnesia'.

Yet, the most self-consistent (philosophically solid) reason for believing is 'faith'. It is basically to believe to believe; any attempt to use reason and finding a justification 'why' or 'why not' is met with skepticism, because it is not sticking to the faith of the belief. As Martin Luther commented, "Reason is the biggest enemy that faith has". Once a belief has been installed, it is kept without ever going back to questioning it, not questioning it actually being part of the belief. In terms of evolution, it is energetically favorable for a species to believe to believe, to not waste energy in constantly questioning things. This is the anti-scientific stance; science's only task is constantly questioning things.

This gives immediately firm ground for another reason for believing, namely 'induction'. A person believes something, because it is the logical result of other things already believed. People saying "I believe X because it makes sense" is of this type. If I believe wood burns, and that trees are made of wood, I believe – "it makes sense" – that trees burn; I do not need to see them burn to believe it.

Another strong reason is 'authority'. Believing something an authority says, because it is the authority, so is assumed to know about the subject. "In the Roman Catholic Church, the pope is the most important person and people believe he must be right because he is the pope" (R. Dawkins 2013). Likewise, the fact that the climate message comes primarily from a pan-global political institute (The IPCC of The United Nations)

makes it more credible in the eyes of people.

A reason very much related to it is that people trust other people that they deem to be knowledgeable, the 'expert opinion' effect. To give an example, 69% of people in a survey of Edelman trust academic or expert sources, and only 36% trust government official or regulator sources (Edelman 2013). Trust is commonly the relationship between pupil and teacher, the former fully trusting the latter and copying his or her beliefs.

However, this effect is masked by the Dunning-Kruger effect – unskilled individuals suffer from illusory superiority, mistakenly rating their ability much higher than average (Wikipedia 2013b) – which then makes people (especially stupid ones) fall back to their beliefs and calling the knowledge of others stupid. 'Stupidity', defined as 'not knowledgeable', the estimation of the wisdom of others is then done in a self-referential way; A certain person is evaluated to be intelligent if he or she has the same beliefs. I can say "My neighbor is a plumber and when he says I should use half-inch pipes in my house, I trust him", copying him – believing him – in an area where I have no prior knowledge nor opinion. However, if my neighbor with a PhD in climatology says that there is no AGW (against my beliefs), I will ignore his opinion, and on top of that call him stupid or question his motivation ("He is paid by oil companies!") exactly *because* he has another opinion, and my dislike for cognitive dissonance forces me to assume he *must* be stupid. As Ronald Bailey paraphrases it in his blog, "Everyone who knows what they're talking about agrees with me. And everyone who doesn't, wears a tin foil hat" (Bailey 2013), summarizing a study of Kahan et al. that had as starting point the question "Why do members of the public disagree – sharply and persistently – about facts on which expert scientists largely agree?" (D. Kahan, Jenkins-Smith, and Braman 2011). In other words, the expert-trust effect does not work for a subject where we already have a strong belief – where we already made up our minds – because we use to estimate the level of intelligence and evaluate the statements of a person in the same time. In fact, trust in scientists (on the AGW subject) is waning, from 32% in 2007 to 26% in 2013 (Clement 2013).

Interestingly, the Dunning-Kruger effect also stipulates that people "recognize and acknowledge their own previous lack of skill, if they are exposed to training for that skill" (Wikipedia 2013b), which is why 66% of people need to hear things repeatedly (3 to 5 times) to believe something (Edelman 2013). This gives an excellent way for the scientific community, aware of its need to do so, to cause a shift in public opinion. In view of the (believed) urgency of the subject of AGW, it is justifiable, or at least understandable, that people spend effort on changing the beliefs of others.

An effective tool in this respect is then alluding to a 'consensus'. People are generally convinced into believing AGW by the idea of there

existing a consensus. Either by direct argument of social intimidation (“Who am I to think different than so many people?”), or by hearing more often news in favor than against a certain belief and thereby being trained to embrace it. Consensus (Cook et al. 2013) is actually the most-often-heard argument to convince the people, while we all learn in school that consensus itself is never a scientific argument. One researcher actually calls it the “heroic story of the consensus in AGW” (Reusswig 2013), a sentimental observation that is, once again, lamentable, but understandable. He also reveals a political agenda by stating “We – as scientists – will have to explain to policy makers ... that risks and uncertainties will grow”. Politicians sometimes even make quasi-religious statements – that is, Lutheran comments – such as that of Ereaut and Segnit, “The task of climate change agencies is not to persuade by rational argument ... Instead, we need to work in a more shrewd and contemporary way, using subtle techniques of engagement ... The ‘facts’ need to be treated as being so taken-for-granted that they need not be spoken. Ultimately, positive climate behaviours need to be approached in the same way as marketers approach acts of buying and consuming ... It amounts to treating climate-friendly activity as a brand that can be sold. This is, we believe, the route to mass behaviour change” (Ereaut and Segnit 2006). This sort of wording, if known by the public at large, actually may put the cause at risk. Even more so when we read, “This work was commissioned by the Institute for Public Policy Research as part of its project on how to stimulate climate-friendly behaviour in the UK”. People readily will start seeing conspiracies and will lose trust in their leaders.

Another researcher, Rudman, writes, “Our hope is that researchers will design persuasion strategies that effectively change people’s implicit attitudes without them having to suffer through a disaster” (Rudman, McLean, and Bunzl 2013). Note, ‘persuasion strategy’ is a euphemism for ‘(mind) conditioning’ or ‘brainwashing’. (The choice of words depends on your point of view) (Lectures on how people can design persuasive strategies exist and can for instance be found on readwritethink (Readwritethink 2013)). Indeed, politicians do have an (open) agenda, namely changing the beliefs of people in order to change their behavior, something that is believed necessary. A consensus in literature has been heroically established for this purpose and the effects are visible in society (but apparently not enough yet, considering the lackluster acceptance of the ideas. 64% of Americans do not think Global Warming is a threat in their lifetimes; Addressing the economy has highest priority, AGW only on the 8th place; While 69% think the Earth is warming, only 42% think it is mostly because of human activity (Clement 2013)). All psychological techniques are used. As an example, the consensus is not presented as “(with 100% probability) the planet will heat up  $x$  degrees”, but instead “with 95%

probability, the planet will heat up  $x$  degrees”, which makes use of the importance amplification effect called ‘affect heuristic’ (Yudkowsky 2008). (Apparently people believe the scenario more readily when presented with probabilities instead of as a certainty). We can conclude that there is a need, a driving force, and an effort to change the opinion of the people.

Yet, even so, an anti-correlation between intelligence and believing things exists. An example was shown by Lynn, et al. (Lynn 2008). They showed that the belief in God diminishes with I.Q. Below an I.Q. of 80, nearly everybody believes in God, above 100 it rapidly drops and by interpolation it can be shown that by a level of about 110 the belief is basically absent. And by extrapolation the all-knowing wise person with an infinite I.Q. then *knows* God does not exist. (This reasoning was used to ridicule extrapolation as an effective tool (Stallinga 2010)). In the belief in AGW we can see the same effect; an increased literacy diminishes the belief in man-made climate changes (D. M. Kahan et al. 2012; Hamilton 2009), “Members of the public with the highest degrees of science literacy and technical reasoning capacity were not the most concerned about climate change” (D. M. Kahan et al. 2012). Interestingly, the actual weather also has a strong impact on people’s AGW beliefs; obviously belief getting stronger after warm spells of weather and weaker after cold spells (Hamilton and Stampone 2013; Rudman, McLean, and Bunzl 2013; Deryugina 2013). This is an example of ‘hindsight bias’, modeling the future based on experience of the past (Yudkowsky 2008), combined with ‘availability heuristic’, a proximity effect where close-by – ‘fresh’ – data have more weight in the modeling than stale data.

Coming back to our main contribution, the basic idea we present here is that people make an expectation-value probability-distribution analysis in their heads similar to concepts used in Game Theory. It is as follows: AGW can in the end be correct or can be false. A person can believe in it or not. There are thus 4 possibilities in total: Person X believing in it while it is true, believing in it while it is false, not believing in it while it is true and not believing in it while it is false. Each, in the head of the test person, has a probability, but also a final reward. This reward occurs during life, or can also be after-life if the person believes in that. Note that it can also be negative, i.e., punishment. And this immediately shows the similarity with other religious beliefs. As an example, a person not believing in heaven during life, will go to hell after life, and this hell is a punishment place, i.e., negative reward. “Better to be safe than sorry” and believe in heaven.

Now, an ignoramus, somebody that knows absolutely zilch about the climate, will be inclined to believe these ideas. For the simple reason that the expected yield is higher when believing in them. That because the rewarding is highly asymmetric. See the decision table presented in Table 1. In this

table a 'good citizen' behavior (having believed in AGW which was true) is eventually rewarded by 10 moral coins. (The numbers are rather arbitrary, but serve to make our point clear). Similarly, we can attribute a 10-coin reward to a good behavior of not having believed in erroneous, silly models.

It can be argued that this reward is actually much less than 10 (nobody ever gets rewarded for adhering to a non-belief), but for the sake of simplicity we will attribute symmetric rewarding for correct believers, since for the moment anyway it does not make much difference if rewards for correct believing are symmetric or not. The punishment for *wrong* believing, however, is dramatically asymmetric. For people who erroneously believed in AGW, there is as good as no punishment. A mere shrugging of the shoulders and going on with life. "No harm's done". A payment of one moral coin. (Imagine the similar case of having believed in a heaven that turned out to not exist; by definition there is no reward whatsoever, 0, for lack of an entity to receive it). On the other hand, not having believed something that turned out to be true is severely punished by 1000 moral coins, the equivalent of eternally staying in hell. 1000 coins is probably an underestimate. And a punishment, -1, for AGW adherents is also an upper estimate. Actually, they will eventually say "... but we have learned a lot", turning it into a positive reward anyway. But that happens after the theory is debunked and thus does not enter into the heads at this moment and is not part of this psychology analysis. We assume a tiny punishment here for wrong believers.

**Table 1: Ignoramus**

	X believing *	X not believing	probability
AGW true	+10	-1000	50%
AGW false	-1	+10	50%
Expected reward	4.5	-450	

\*: winning strategy

An ignoramus, for not knowing anything of the subject, will assume a 50-50 probability between the two scenarios. As can be seen, the high asymmetry between the expected punishments for people that erred will then shift the balance towards believing. "In the survey of a random sample of 1,045 adults aged 18 and up interviewed April 2013, 63 percent said they believe global warming is happening" (UPI 2013). (Note the word 'believe'; for sure, not even 1% of these 63% has studied the subject in some detail and can make an educated estimate of the probabilities involved). None of them knows anything about the subject, but the risk of it being correct and the moral punishment associated with it makes people lean towards believing.

This is further amplified by the social effect that people want to belong to the group and repeat what is socially dictated to them. There are no anti-AGW prophets or institutes, and no anti-AGW doctrine to adhere to, so the social effects against believing are minimal; there is no anti-AGW social network. However, no social aspects are analyzed here, but only individualistic behavior decision tables.

Actually, the table needs a third column, "believing and acting", convincing other people of the faith gets a multiplication of the rewards, see Table 2. Like the prototypical Jehovah's Witnesses acting and annoyingly knocking our door (or UNESCO's AGW-teaching packages, or the political mind-steering programs mentioned before). Try to see it from their point of view (that is, decision table). The stake is upped by their behavior. Maybe tenfold, the wrong believing now gets a punishment of -10 (being considered annoying by the rest of society), but imagine the possible reward if correct, saving souls ... at least 100 moral coins, if not more. It further distorts the asymmetry towards believing, +45 versus -450. Including an active anti-AGW stance column in the table with an equal multiplication of the stakes by a factor of ten will create the final decision table as presented in Table 2. It is obvious that an active AGW stance is the winning strategy for an individual ignoramus (+45 expected yield). The worst is an active anti-AGW stance (-4500 expected yield).

**Table 2:** Passive or Active Ignoramus

	X believing Active *	X believing Passive	X not believing Passive	X not believing Active	probability
AGW true	+100	+10	-1000	-10000	50%
AGW false	-10	-1	+10	100	50%
Expected reward	+45	+4.5	-450	-4500	

\*: winning strategy

A wise person can study the climate and can get a better estimate of the probabilities. This sounds easier than it is, because who will pay for this study? Why should somebody do that? A good – but ignoramus – citizen will not easily part with money to be used against the current belief, the moral reward being higher if action is taken in favor of the belief and reduced if effort is spent on contradicting it, as shown above. In this setting, it is difficult to study the subject in true objectivity. It is much easier to just ride the waves and make a career in a related field and then, if the theory is debunked, to "... have learned a lot". Play on the safe side. For instance, study the local nature with a justification of climate change and then, AGW turning out to be wrong or not, the knowledge anyway being useful for science and society. This is the psychological approach of nearly all of our colleagues. It is an opportunistic stance.



And even if an educated person will find that AGW is "probably false", this person will continue to bet on it, see the decision table for an academic person that more-or-less knows the models are flawed with 95% certainty (Table 3). However, as can be seen, no longer a pro-active stance is rewarded better than a passive stance, -4.5 vs. -0.45. The amount of climate fanatics is indeed much smaller in the academic world. See for instance the Oregon Petition, a petition to urge politicians to abandon disastrous climate policies (Petition n.d.). This petition has tens of thousands of academics subscribing it, including many PhDs and engineers. This number is staggering and overshadows the number of members of the official political intergovernmental panel on climate change (IPCC) which is estimated to be about 2500. Similarly, a Manhattan Declaration on Climate Change presents the worries of a large number of scientists of all fields (Declaration n.d.). All in all, it is obvious that among academics, the adherence to AGW ideas is minimal, but it is also obvious that these scientists are by far not as well organized. For the moment, that is.

**Table 3:** Passive or Active Academic

	X believing Active	X believing Passive *	X not believing Passive	X not believing Active	probability
AGW true	+100	+10	-1000	-10000	5%
AGW false	-10	-1	+10	+100	95%
Expected reward	-4.5	-0.45	-40.5	-405	

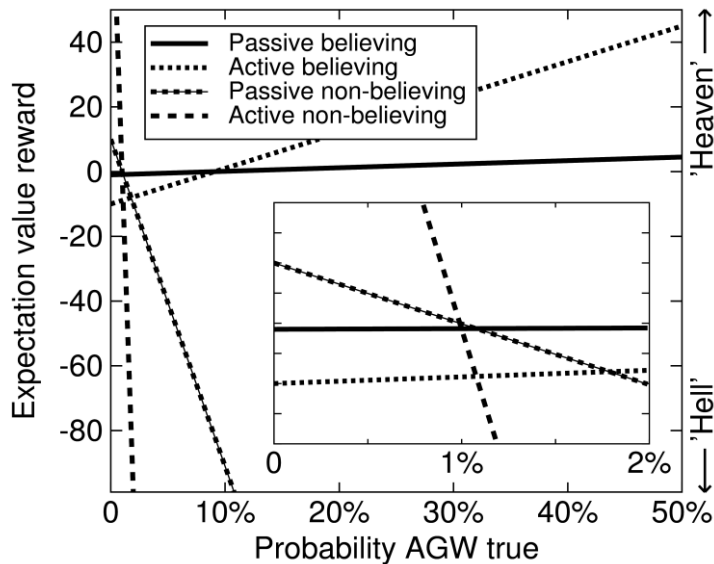
\*: winning strategy

The more educated a person is, and the more this person realizes the errors in the AGW thinking, the more the balance is shifted towards *passive* believing in the models, up to a point where actually non-believing becomes more 'lucrative' and eventually even a pro-active anti-AGW stance becomes the optimal strategy. We can expect a change of mentality in society when the proof against AGW becomes so overwhelming that no longer an AGW belief is the optimal choice and, aided by the social effect that paying climate research stops to be considered 'paying the devil', rapidly more proof is accumulated and the balance shifts towards an active stance, an individual trying to convince people that AGW is erroneous. For the decision table presented, the shift from believing to non-believing is nearly immediately accompanied by switching from a passive to an active stance, because the interval of probabilities where a passive non-believing stance is winning is tiny, namely only when passively not believing has a reward from about -1 to 0. (In this numerical example it occurs when the AGW has a probability between 0.99% and 1.07%). The switch to active non-believing occurs when non-believing has an expectation value that is positive. That is, for the rewards presented, when the probability is less than about 0.99%. From that

moment on, suddenly in society everywhere people will pop-up that say that they always thought the AGW models were nonsense. That is also amplified because now the sociological effect works *against* the AGW beliefs, where it before worked in favor of them. Figure 1 summarizes this table as a function of probability (in people's heads) of AGW being true.

To summarize up to this point: with changing probabilities, due to accumulating evidence against AGW, we can expect a shift in society from predominantly 'active believing', where all media and politicians jump on the bandwagon (current state), to 'passive believing', where people don't seem to care much and where it is not high on the agenda of politicians, to (immediately) 'active non-believing', where (the same) politicians will now advocate climate 'sense'.

We have personally studied the AGW scenario in depth and have written several papers and reports on the subject (Stallinga 2010). Our estimation is that AGW is very likely incorrect. A passive stance in our opinion is then not possible, as follows directly from the tables presented above; if the expected reward gets positive, it immediately gets even more positive for an active stance that has a multiplier effect. We could be accused of being an example of our own decision-tables analysis.



**Figure 1:** Expectation value of reward for the four stances towards AGW for an ignoramus (50%) to an academic (Table 3 presents the values for the 10% case). As can be seen, for accumulating evidence against AGW, the public stance will switch from active believing (ignoramus, 50%), to passive believing (for instance at 10%) to (nearly immediately) active non-believing at around 1%. The inset with a zoom-in of the low-probability zone makes this clearer

Moreover, we even studied the effects of measures combating climate change and came to the conclusion that the estimations of the reward parameters are gravely wrong (here, and in people’s heads). The punishment for adhering to a false AGW belief is severe, much more severe than that for erroneously not believing it. Implementing anti-climate-change measures will cause death and misery for billions of people, while fighting climate change symptoms is a triviality and has as good as no human cost. In fact, rising temperatures and increased atmospheric carbon-dioxide concentrations are beneficial for plant growth and food production, as has been shown over and over again in history. All heydays of civilizations occurred at relatively high temperatures, evidencing the beneficial effects of warmer climate. The effect of carbon-dioxide is demonstrated by the fact that a lot of crop in moderate-climate areas is grown in greenhouses where CO<sub>2</sub> is injected into the air, not to increase the green-house effect, but to stimulate plant growth, in a method called CO<sub>2</sub>-fertilization.

This we can call the skeptic stance, since most climate skeptics think this way. Their decision table is summarized in Table 4, from where we can see that an active anti-AGW stance is the optimum strategy for an educated skeptic that has a good estimation of probabilities and rewards.

**Table 4:** Skeptic

	X believing Active	X believing Passive	X not believing Passive	X not believing Active *	probability
AGW true	+100	+10	+10	+100	5%
AGW false	-10000	-1000	+100	+1000	95%
Expected reward	-9495	-949.5	+95.5	+955	

\*: winning strategy

Scientists use another 'decision table' in their heads. Because, for a scientist, there is absolutely no moral harm in being wrong, as long as you have used the Scientific Method. There is no 'reward' for being right or wrong. It does not matter if at the end things are correct or not. What matters is that you did not *believe* things at all – in the above text, "X not believing AGW" in fact is "X believing not-AGW" – but used systematic research and rigorous discussion of ideas and scientific deduction in trying to find out the truth. The probabilities do not enter into it. They are completely irrelevant, see Table 5. A citizen can be worried about the state of the planet and its future. A scientist never is. Or as Einstein said it, "Anyone who thinks science is trying to make human life easier or more pleasant is utterly mistaken." Einstein, who got a Nobel Prize for the photoelectric effect. Something that Millikan tried to scientifically prove wrong all his life, an effort that also gave him a Nobel Prize. We have summarized the Scientific

Method recently in another publication (Stallinga and Khmelinskii 2014b). We are well aware that the true scientific stance is very rare indeed.

**Table 5:** Scientist

	X believing (AGW or not-AGW)	X not believing anything *	Probability
AGW true	-1000	+10	$x$
AGW false	-1000	+10	$100\% - x$
Expected reward	-1000	+10	

\*: winning strategy

### 3 Conclusion

To summarize, we have presented here some kind of numerical analysis to show what is going on in people's minds. Why are people often quite fanatic about a thing they know little about? The less they know, the more fanatic they seem. Note that we did not include calculations beyond the ignoramus (50%) mark because most people that we know that advocate AGW, are of the type "It is *possibly* true, and the consequences would be too severe to not act on this hypothesis" (in other words, exactly our ignoramus decision table, see Table 2). We know of no people that think that AGW is likely (more than 50%) true. (If people *say* that they believe that it is very likely true, it is because they are taking an active stance). Nothing changes in the 50%-100% region anyway, where an active stance remains optimal. We have no idea whatsoever how one can determine the exact probabilities and, even less, the reward parameters in the tables. We present the ideas here only phenomenologically. The only thing that is important, though, is that there is a punishment (negative reward) for wrong beliefs and that this punishment is asymmetric, as in typical CSMs. As long as that is in the heads of people, the behavior will be as explained.

We would like to challenge our colleagues from statistical psychology to find a way to determine the exact parameters used here, since it can give a hint at how, when and how fast public opinion will shift in society. Yet, it seems unavoidable that public behavior will shift from believing directly to active non-believing, if facts continue to accumulate against the ideas. Interestingly, it seems in the last years the storm of pro-AGW news items has abated, from which we infer that the first step has already been taken, namely from active believing to passive believing. We predict a flow of anti-AGW news items in the near future.

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