How to lie with statistics

Report

Debunking myths effectively

Submitted By :
Karl Thyssen

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1 Introduction

1.1 Overview

Misinformation has always been a problem in societies throughout history, whether due to a simple absence of correct information or the wish to mislead. In a modern, globalised society this is no less true. In such a society, it can be argued that correct and corrective information can be disseminated more easily to all misinformed and uninformed peoples. However, the issue remains, whether intentionally or unintentionally, misinformation can be spread at the same rate as the facts (and perhaps faster if the misinformation is more engaging).

This phenomenon of misinformation spread is no less prominent for scientific facts such as the earth being spherical, or the lack of a connection between the MMR vaccine and autism. Both concepts are well established in science and yet are widely disputed by the general public. Such examples of large scale misconceptions are accompanied by conspiracy theories under the umbrella term of "Myth".

Unfortunately many of these myths do not come without their dangers. The myth of the MMR vaccine and its connection to autism has snowballed into an international health risk (to the herd immunity against many vaccine-preventable diseases). Such a reduction in vaccination rates has caused "Vaccination Hesitancy" to rank 8th in the World Health Organisation's greatest threats to global health in 2019[1].

In order to understand how these myths come into existence and how they propagate through the population, it is important to understand their origins and motivation behind them. Fiction (for example L. Ron Hubbard's texts and lectures spawned Scientology), rumours, political motivation and of course a vested financial interest can all, intentionally and/or maliciously disseminate misinformation and myth. It is also important to observe and understand how people receive and "learn" information, whether true or false, including how they asses its validity.

The purpose of this report and the accompanying seminar presentation is to examine the mechanisms of debunking myths themselves and countering the misinformation they are based on. To achieve this, it is important to analyse how people react to new, conflicting and corrective information and misinformation. Due to the emotional factor that exists both in challenging beliefs and being challenged in held beliefs, it is easy to trigger defensive or aggressive behaviour. It will later be discussed how and why the naive, brute force approach to challenging held beliefs is more likely to backfire than succeed. Essentially it becomes clear that there are some techniques and mechanisms that increase peoples receptibility for corrective information which should be applied to maximise the impact of debunking.

1.2 Some popular myths and their origins

The myth of MMR vaccine and Autism

In 1998, Dr.Andrew Wakefield wrote a short paper that showed a strong link between the MMR vaccine and autism. This caused a large-scale media frenzy and consequently, widespread panic. The paper was irreproducible, with no study since having found any such connection. Wakefield was later found guilty of professional misconduct and had his medical licence revoked. He had been found to have conducted the study unethically as well as having failed to disclose a lump sum of money he had been paid to conduct the study; by lawyers constructing a lawsuit against the MMR vaccine. Despite this well documented and public process, the message of the paper has continued to circulate globally causing the vaccination hesitancy crisis. MMR cases are at the highest rate since 1992 in the US, UK and many other western countries.

Climate change scepticism

Climate change scepticism and associated myths are discussed in depth in other talks of this seminar.

Flat earth

The flat earth society believes that the earth being spherical is a large scale conspiracy propagated by "the establishment". Through the accessibility and ease of information spread on the internet this phenomenon has seen increasing traction over the last decades with "flat earth conventions" occurring yearly on every continent.

Chemtrails

A myth popular enough to be in the dictionary, chemtrails refer to another conspiracy theory. Theorists believe that "the establishment" spreads mind controlling substances using trails left in the sky by jet-planes.

2 When debunking fails

2.1 How not to debunk a myth

To investigate the naive approach to debunking, R. Masaryk and M. Hatokova[2] conducted a short study in which they attempted to confront false beliefs "head-on". They wished to qualitatively analyse the responses of anti-vaccination mothers and young women towards debunking stimuli. The participants were split into four

groups each of which was subjected to one of the following approaches: citing studies that correct the vaccination-autism connection, explaining the risk of MMR diseases, telling an anecdotal story of a young measles survivor and showing disease images.

The responses of the participants were negative towards all approaches and the mechanisms for providing the corrective information. Each group was presented the debunking methods in a small group, in which they were then allowed to discuss their opinions and responses. The responses included a feeling of bias towards vaccination, the participants felt they should have been presented with papers that explained dangers of the vaccinations. Other responses were similarly concerned with a bias towards vaccination and a feeling that the attempt to change their minds was a sign of this. Both the measles story and the disease images were said to be emotional blackmail and were said to be unreliable as anecdotal evidence.

It is clear that there were issues with effectively debunking the anti-vaccination myth with these techniques as there are clear flaws with these methods. Interestingly the response from people frustrated with myth believers is often to assume, that these people are not able to critically think or are not intelligent enough to discern the facts from fiction. However it is clear from some of the responses (only a small selection of which shown here) that this is not true. A single story *is* anecdotal and is not evidence. Anecdotal evidence is often a cause of misinformation and the participants showed the ability to understand the unreliability of it. The message that was missed, however, is that the consequences of the MMR diseases are severe. The goal of these methods was to make the stories generalisable to the situation of the participants and their own children, to induce a discussion of a risk assessment between the perceived risks of the vaccines vs the diseases. Instead, the focus of the discussions became the participants' feelings of being manipulated/blackmailed. Clearly, the message that was intended by these methods did not come across to participants, in fact the questionnaires filled in before and after indicated that participants had a stronger belief in their anti-vaccination attitude after the debunking.

2.2 Why does debunking fail

It is not difficult to predict that the "brute-force" approach to debunking myths; simply explaining to someone they are wrong, doesn't succeed. However to understand the background to the issue, it is important to analyse why people respond in this way to de-biasing and corrective information. To do this we must examine how people learn information and how acceptance of the new is dependant on the existent.

Essentially, when new information is relayed, the listener must quickly asses the

validity and truth of the statement. In fact so many factors come into play that the default position is to accept new information as true. This isn't entirely unexpected, a person with the default position of flat scepticism and/or disbelief would struggle to interact effectively in society. The fact that a person is relaying information to you sets the precedent that there is a reason for it and that they have sufficient knowledge of the subject matter to do so. This "guarantee of relevance"[3] that comes with receiving new information is very resilient. Unless contrary knowledge exists, why should it be assumed the speaker is not being honest. It has been shown to require a high level of concentration to be sceptical of new information. At the very least it is difficult to avoid accepting new information as true, if there is not immediate reason to doubt the honesty of the speaker, or counter-information doesn't already exist.

The same barrier however exists, to countering misinformation. The actual facts must counter existent erroneous knowledge in order to bypass the "guarantee of relevance" barrier. Only when the listener has prior information that casts doubt on that, which is newly being provided, can the listener counteract the default position. It is therefore not enough to simply present the truth impartially and hope it erases the "incorrect facts", as was shown in the Masaryk and Hatakova study.

A resistance to debunking clearly exists, it is now well established that it is easier to impart new information than to counter existing information that has been accepted as knowledge. Once new information has been vetted and accepted as true it is quickly incorporated into a persons mental model and becomes hard to dislodge. To debunk a myth that has become knowledge, it is important to understand the process of learning, to ensure the debunking information can be accepted by the subjects.

2.3 Lewandowski's four questions

To analyse the process of evaluating the truth of information, Lewandowski, Ecker et al. [4] studied a vast variety of papers that documented different processes and approaches. The result was that they proposed four fundamental questions that were felt to be the default steps which a person goes through to analyse the validity of new information:

1. Is this information compatible with other things I believe to be true?
2. Is this information internally coherent?—do the pieces form a plausible story?
3. Does it come from a credible source?

4. Do other people believe it?

1. Is this information compatible with other things I believe to be true?

Information that has once been learned and accepted as knowledge, fuses together with similar and related knowledge to contribute to a mental model that defines our understanding of the world; a "worldview". As new knowledge is gained, it is built up on existing concepts and accepted facts which ensures that through this layering effect, particularly fundamental knowledge is bound to many other facts. When information is now presented that challenges this mental model, the listener is resilient to accepting that a part of their knowledge; a part of their worldview, could be false[6]. It is difficult to only extract single "myth" pieces, as such knowledge is not isolated and so removing it leads to a cascade of other facts needing to be questioned and potentially also removed. Naturally there is a resilience to this on a cognitive and emotional level and this becomes increasingly difficult the more fundamental the idea being challenged is. Therefore, if new knowledge is compatible with the existing mental model, it is vastly easier to accept into the model than that which is challenging.

2. Is this information internally coherent?—do the pieces form a plausible story?

Accepting information is also tied to it being memorable and repeatable. Isolated information is contextless and therefore is harder to link with other pre-existing knowledge. Introducing new information in a story-like setting enhances retention as it organises the information in a coherent way that ideally also addresses any misconceptions and gaps. It is important that the narrative of the information is simple and factual. Any gaps leave either doubts in the validity of the information, or worse, can be filled with falsehoods or misunderstandings. Once the story is understood it is difficult to unlearn as it creates many links to pre-existing knowledge.

3. Does it come from a credible source?

The ideal of healthy scepticism would be that when deciding on the credibility of a source, people are impartial and judge based on factors of past credibility and knowledge of the subject matter. Unfortunately, people judge the validity of information based on instinct and the perceived trustworthiness of the researcher or the presenter of it. It was shown that climate change denying studies "funded from donations from people like you" or "funded by Exxon Energy" were seen as equally acceptable by study participants[7]. From this and similar studies it becomes clear that people are a lot less rational than they might consider themselves to be when

analysing the credibility of a source.

4. Do other people believe it?

In society there are social norms that must be adhered to and accepted for a person to function in it. As social beings it is nigh impossible for ones opinions and beliefs not to be shaped by the society one lives in and interacts with. After assessing the validity of information based on questions $1-3$, a "second reality test"[5], as to whether it should be accepted is the views of those around you. It has been shown that in rumour transmission, the strongest indicator of whether the rumour was believed by a person was the number of times the rumour had been repeated to this person. On the whole this shouldn't be seen as wholly undesirable as this piece of information has been passed through multiple peoples' "questions 1-3", before being accepted. This should be an effective filter for misinformation. However the potency of this fourth part of the truth evaluation becomes clear in the existence of myths that do continue to exist and be propagated in society.

The effect of a belief being shared with a subjects core social group can lead to an "echo chamber" effect of vastly increasing the repetition of the myth by others. This perpetuation of the myth increases the conviction, that it is believed by a wider audience than it actually is. In turn, this effectively makes the person feel a part of a greater proportion of society as a whole. A polarisation of the media content consumed(famously the individual tuning of the Facebook news feed is an example), has the same effect of making people feel secure and included in their society and their beliefs. In this "bubble", people feel affirmed and validated in their beliefs which are echoed back to them and reinforced by the people they trust. Again, this is a phenomenon that also has its reasons and benefits, people are able to collaborate on a large, socially complex scale due to social norms, beliefs and values[9].

2.4 Backfire effects

Backfire effects were investigated and coined by Lewandowsky, Ecker et al. [4] to describe the experimentally determinable change in perception of Myth believers when confronted 'aggressively' with the facts.

- The continued influence effect: In summary, the effect describes the phenomenon that a retraction of the misinformation rarely, if ever actually eradicate its effects. Studies have shown that retractions effect the misinformation on a spectrum, though it is not clear which variables determine their success. The mechanism of retraction and time after the misinformation is received have a varying influence. The final impact being, either a continued but re-

duced reliance on the false information or an outright backfire, that is to say an increase in belief.

- The familiarity backfire effect: When an idea is accepted in a persons mental model, it is established as factual and often built into linked knowledge. Therefore a removal and replacement with the alternative true information is made difficult by the familiarity of the false narrative. After a debunking process, the experience of being debunked will be associated with the corrective information as a "metacognative" experience. The misinformation that existed was well established and familiar, therefore a fluently relayed corrective narrative will have the advantage and any lack of fluency of the message will taint the debunking. For example, if the incorrect information is *that* an event occurred, providing the corrective information that it *didn't*, can backfire. Here the negation can just be lost in favour of the familiar information of the event, only strengthening the misbelief.
- The overkill backfire effect: For many of the reasons already discussed, it is clear a simple and concise narrative is preferred of a complex one. Providing the correct information may be inherently more complex than the original misconception, therefore it is important to be sensitive to the volume of corrections. Too many varied and complex explanations and counter-arguments can overload the listener and again reinforce their belief in the simpler explanations.
- The worldview backfire effect: As discussed before, ideas that harmonise well with peoples beliefs/mental model will be easier to accept. This will therefore be difficult as, when debunking, there is always pre-existing information built into this model that sits in the place the facts should inhabit. As a persons mental model contributes to their ideology and beliefs, attacking misinformation that is present there can feel like a personal attack. Any personal attack that threatens a persons worldview leads to defensive behaviour which is not conducive to changing opinions.

3 A template for debunking myths

3.1 The template

It now remains to bring together the features of myth debunking that have been deemed most important and valuable to success, into a coherent template for debunking.

- **Pre-exposure warning:** Priming people to understand the information they

are about to receive is false when discussing contentious information, prevents reinforcement of any false beliefs as well as any initial belief in misinformation. This is clearly also a possible preventative measure to prevent an initial belief in misinformation.

- **Source credibility:** As discussed previously of the intuitive factors that go into a sources credibility; expertise and trustworthiness, the latter is the most impactful of the two. The perceived trustworthiness of the source, whether that is the public image of the institution, or even a picture of the research leader must be established.
- **Self-affirmation:** To combat the worldview damaging effects of correcting misinformation it is important to affirm other worldview values and essentially assist the subject in understanding that their worldview as a whole is not incompatible with the correction. This obviously becomes increasingly difficult the more fundamental the belief held. By affirming the core values of the subject they become less defensive and threatened by the "worldview-inconsistent" information.
- **Social norming:** This refers primarily to the type of language used to ensure the subjects feel included, rather than attacked and ostracised. It is important to use either an injunctive or descriptive norm to support the corrective message. Due to the polarising effect of believing in particularly large scale myths, it is important to accept the social significance of the belief for the subject. For example, vaccination-hesitant parents are more likely to socialise with other similarly inclined parent´s as parenting style is a sensitive and emotionally charged topic. Therefore when debunking the anti-vaccination myth it is crucial to ensure the subject is aware that they will continue to be socially accepted, despite potentially losing ties to their original social circles.
- **Graphical representation:** Essentially the debunking attempt should strive to be memorable and draw attention to the core message. It has been shown that graphical representation increases the retention of information and aids understanding.
- **Alternative information:** Debunking will create a gap in a persons mental model, it is important to fill this gap with correct factual accounts to prevent the danger of misinformation creeping back in like sand into an unfilled hole. Regular retractions and replacements of the myth with facts reduce the continued influence of the misinformation however it must be carefully done as there is a risk of backfire from continued reference to the myth.
- **Salience of core corrective message:** A message that can be delivered flu-

ently increases the receptivity of the subject, therefore enhancing its impact. As the "truth-evaluation effort"[8] for information reduces, that is to say the information is conveyed in a manner that enables it to be fluently processed, acceptance of it increases. Analogous to people nodding along to a well conveyed presentation. It has been shown that making the true information as easy to process as possible is much more effective than focussing on the fallacies of the original myth.

- **Regular follow-up:** The familiarity backfire effect's potency increases with the frequency of repetition of the myth. Therefore it is important to note the origin of the original myth, if the subject is regularly re-exposed to the misinformation there is a danger of weakening the effect of the debunking. The only countermeasure short of removing all sources of misinformation from the subjects environment, is to re-debunk as frequently as practically and ethically possible.

3.2 Testing the template

To test this template, it interesting to investigate a recent study by Paynter et al. (2019)[10] that attempted to debunk the use of non-empirically supported treatments to help children with autism. In this study 86 medical professionals in the field of paediatric autism were divided into test and control groups. During the training session, three empirically supported treatments (ESTs) and three non-ESTs were presented with accompanying evidence for and against. Scientific research both supported the ESTs and showed a lack of support for the non-ESTs which were supported only by anecdotal evidence. The control group received training materials that were in common circulation while the test group received a specifically misinformation countering designed training session.

- Throughout the session the researchers endeavoured to apply the descriptive norm to create a consensus that the best patient care is based on ESTs. They later also described ESTs as the only responsible way to treat patients.
- Before introducing any non-ESTs, participants were informed that the following information was a myth as well as explicitly labelling it.
- The researchers established source credibility by reiterating to the professionals that the reason for the study was to assist them in their work and helping patients. They also explained their impartiality and lack of vested interest as well as even including a picture of a researcher that had scored high in a

"trustworthiness" pilot test.

- Next they had a "self-affirmation" session which affirmed the participants commitment to patient care, by demonstrating through their participation, a willingness to learn and improve.
- When presenting research statistics, researchers endeavoured to make the contrast between supported and not supported treatments clear by demonstrating graphically the number of studies that supported and/or did not support the treatments. Photographs displaying ESTs were also used to increase familiarity with the correct treatments. It was also made clear that the ESTs were all legitimate replacements for the functionality the non-ESTs claimed to achieve.
- The core messages were that: non-ESTs are ineffective, the evidence that showed this and the alternative EST with its accompanying evidence. The retention of these messages was increased by presenting these core statements in styles and/or textboxes that were distinguishable and that stood out.

The results showed a marked decrease in support for non-ESTs after the session both for the control and the treatment groups. The debunking-templated study showed significantly better debunking effects as seen in figure 1 when compared to the control. Clearly this debunking method was effective, at least in the short-term. It is likely that in the long-term, reinforcement sessions would have been necessary to maintain such support patterns.

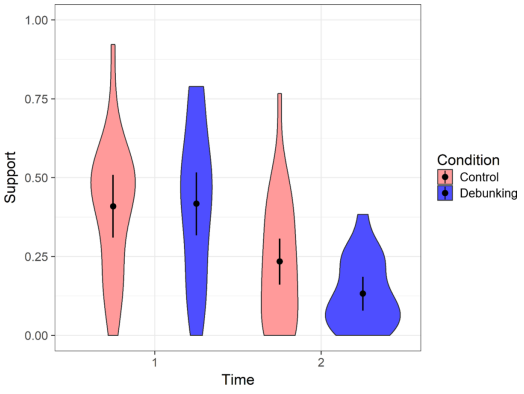

Figure 1: *Fig 1. Violin plot, showing mean support for non-ESTs across control and debunking conditions at time points 1(pre-intervention) and 2(post-intervention).*

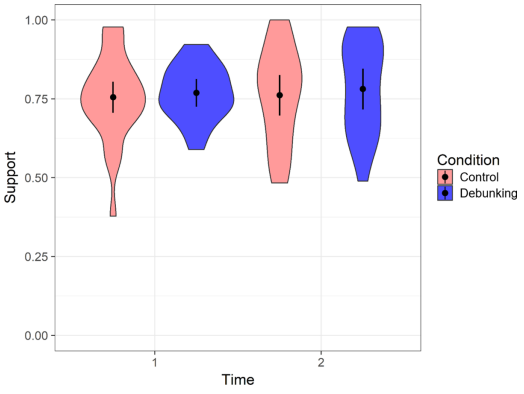

Figure 2: *Fig 2. Violin plot, showing mean support for ESTs across control and debunking conditions at time points 1(pre-intervention) and 2(post-intervention).*

4 Further insights

Throughout this report and the accompanying seminar presentation it has been possible to construct a template for debunking a myth. The model has had a quantifiable debunking impact shown in a study that was designed using many of the concepts. Unfortunately there are many interesting areas, which it has not been possible to explore fully.

4.1 Larger scale questions

A profound question is: *If these techniques allow for misinformation that is accepted to be corrected, could they also serve the purpose of implanting false information?*. Unfortunately it doesn't seems possible to satisfactorily answer no. Clearly if debunking techniques are capable of correcting misinformation, they are also capable of replacing correct information with false information as the two ideas are cognitively the same. The best response to this issue might be to support the effort of critical thinking on an educational basis. If people are more informed as to the techniques involved in learning, re-learning and "information manipulation"(which could both mean debunking or the opposite, the spread of misinformation) they can discern for themselves when they are being influenced.
An important step towards ensuring that misinformation is more easily recognised and countered is ensuring any conflicts of interests are declared. This is already widespread practice in scientific and legal situations. In general it is unfortunately not in a companies interest to inform a customer of their biases for their product. Politically it is difficult to ensure those players with conflicts of interest are held accountable for their actions which might encourage more transparency. An example is the Iraq War(2003) after which it was determined in the US and the UK to be an illegal war with the reasons for entering into it even today being unclear with heavy speculation on financial interests. Despite the conclusion that the war was illegal, both Bush(US) and Blair(UK) remain legally consequence free.
Another philosophical question is *Does one have the right to debunk a persons misbelief if those beliefs are not harming anyone else and they do not suffer themselves?* There is obviously copious amounts of literature pertaining to similar topics but this does also tie in here.

4.2 Concluding remarks

Without some semblance of success in debunking it would be possible to conclude that people are set in their ways and are reluctant to change. Cynically this could

lead to the judgement that humans are entirely irrational beings. This includes the idea that we are incapable looking past our own biases and emotional instincts as well as social conventions. Watching global events unfold on a daily basis, including the polarising rhetoric and political debates in which facts have little impact, but belief and stirring emotional responses show their impact, it would be easy to be affirmed in this cynical view. Delving into the concept of the worldview can go some way into explaining why worldview affirming emotions have such power. For example the feeling that somebody else is responsible for your relative suffering as is the case with nationalist political rhetoric, unites a population for a common cause.

The template for debunking approaches the debunking of information as a cerebral, logical process. However, as humans are not entirely logical and are in fact more responsive to emotion, social pressures and conventions as well as their instincts or biases the template cannot be universally effective. The social norming and affirmation steps attempt to address this, do so however again, from a cerebral outlook, that there is a logical progression that can induce particular mental states consistently.

To conclude, debunking myths is a complicated and nuanced process that in this model can only be applied to small groups or individuals. This is because limitations of this template imply that the people whose misinformation is being corrected have an interest in changing and are willing to partake in the social norming exercises. A second issue with debunking in larger groups is also that the more people are involved, the less similar their worldviews will be which mean they will require different types of affirmations to confirm them. Essentially on a large scale the best solution seems to be to teach the concepts of critically thinking to enable people to be critical of the reasons and evidence behind their own beliefs. A *healthy* scepticism allows people to debunk their own beliefs and ideally prevent themselves falling into these traps in the first place.

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