

# **What can the anti-vaccination movement teach us about improving the public's understanding of science?**

January 10 2017, by Mike Klymkowsky

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The ubiquitous impact of science-based information and technologies in everyday life suggests that misunderstanding how science works can have serious consequences. Yet people's decisions and strongly held beliefs are often uncoupled from, or at odds with, the conclusions and recommendations of empirical studies and scientific consensus.

In some cases, the implications of misunderstanding or rejecting science are more or less harmless – does it really matter if someone believes the Earth is the center of the Universe? In other cases, they can be critical. Perhaps nowhere is understanding science more important than in the anti-vaccination (anti-VAX) movement. While infant/child vaccination rates have increased for the major vaccine-preventable diseases (2000-2014), there are growing pockets of vaccine refusal in multiple locations across the United States. The real world and serious implication of vaccine refusal is the disruption of local herd immunity, resulting in vaccine-preventable disease outbreaks. For example, regions of California, including Marin, Napa, and Sonoma counties, have seen significant increases in the number of pertussis and measles cases in recent years, largely related to increased intentional vaccine refusal among parents. Similarly, we have seen a revival of measles and mumps cases in and around Brooklyn, NY.

According to survey data, vaccine refusal usually relates to concerns about vaccine safety and perceived efficacy. Specifically, parents either misunderstand or flat out reject the data-based debunking of a causal relationship between vaccination and autism, based on a seriously flawed, and now retracted study. Additionally, parents may not see the point of vaccination since many vaccine-preventable diseases, and their serious health implications, have become much less common in the

developed world. We now live in a world free of smallpox and almost free of polio, making it difficult for people to connect to the painful consequences of their reappearance.

Parents who choose to [forgo or hesitate in vaccinating their children](#) tend to be white, well-educated, and living in households making \$75,000 or more annually. Presumably, such parents have ready access to relevant information, spend a lot of time researching the topic of vaccines, and, according to Seth Mnookin in [The Panic Virus](#) "take pride in being intellectually curious, thoughtful, and rational." These are individuals and communities that are generally assumed to support science and are scientifically literate by various measures (for example, they know that the Earth is not flat and that it travels around the Sun, they might even know that antibiotics do not "kill" viruses, although they may not know exactly why this is the case). But, for some reason, these parents become fully invested in exploring the "[debate](#)" relating to vaccine safety and efficacy, and are not able to differentiate scientifically supported conclusions from those that are not.

Maybe this mindset is influenced by the "healthcare consumerism" movement, which encourages patients to be more involved in their healthcare decisions, marking a shift away from the authoritarian, doctor-knows-best default. Furthermore, given the growing tax on the already faulty infrastructure of our healthcare system, this "look it up dear" trend has become an accepted norm. The ability to conduct "research" on an aspect of healthcare, and to have an appreciation on what "research" truly entails, is a direct application of science literacy. Assuming "research" is done correctly, the internet can be an excellent source of information for patients, with the potential of filling in any healthcare knowledge gaps.

One immediate driver of the anti-VAX movement, however, appears to be that internet search results on vaccines yield a very mixed bag,

potentially compromising the attempts at "research." For instance, when I plugged "are vaccines safe" into Google (December 2016), sites like CDC's [Vaccine Safety](#) and the US Health and Human Service's [Vaccine Safety](#) appeared in the feed. These sites, however, were outnumbered by anti-VAX (aka fake science) sites that can have the look and feel of a legitimate resource. In fact, [the internet is the main platform for anti-VAX messaging](#); parents who exempt children from vaccination are likely to have made their decision based on information they read online. Interestingly, anti-VAX information is often couched in non-science messages demonizing "lying big pharma," while simultaneously promoting the value of alternative (that is, [non-science-based](#)) medicine – as of 2015, an unregulated (and not completely honest) [\\$30B per year industry](#). One might suspect that anti-VAX sentiments are reinforced by alternative medicine and nutraceutical lobbying, further demonstrating an inability to correctly identify conflicts of interest and a [misunderstanding or flat out rejection](#) of evidence-based medicine.

While I value the opportunity for access to scientific and medical information, and believe that patients owe it to themselves to research areas specifically related to their health/illnesses, such information is often presented in a context that assumes a general understanding of underlying processes that are fundamental to the given explanation. For instance, when delivering information about vaccine science, is it to be assumed that readers are familiar with how the immune system works? Are parents aware of the impact of withholding vaccination on their, and [their neighbor's child's well being](#), or the potential immediate and long term effects of contracting the disease that the vaccine protects against? Do readers have a handle on autism spectrum disorder, and what we know – and don't know – about related genetic and environmental influences? When explaining a "why," such as why someone should vaccinate their child, "you have to be in some framework that you allow something to be true, otherwise you are perpetually asking why" ([Feynman on BBC, 1983](#)). In presenting materials on vaccines, have we

clearly established what needs to be understood and accepted? Does our audience have the foundational knowledge to understand the arguments for and mechanisms behind vaccination? These are questions that extend beyond vaccination, and generally go well beyond what is meant by scientific literacy.

Confounding the difficulties associated with being a critical consumer of healthcare information is the tendency for humans to connect with stories – particularly [stories with negative outcomes](#) – regardless of factual content. According to a [McKinsey research summary](#) on healthcare consumerism, "there is often a disconnect between what consumers believe matters most and what influences their opinions most strongly." This can also relate to the concept of [biased assimilation](#), where people unknowingly engage in cherry picking to find the arguments that best support the values held by those in their community. In the context of the vaccine discussion, [parents can be influenced](#) by the (abundant) stories linking vaccines to the onset of a spectrum of health issues, even if they doubt the validity of the story, even more so if they are a part of a community that supports anti-VAX sentiments. This natural human behavior is reinforced by celebrity-backed, widely-publicized campaigns that falsely link vaccines to autism—despite [retraction of the original study](#) AND numerous subsequent [studies disproving these claims](#) – likely sustains anti-VAX momentum. Given the incoming presidential administration's [suggested openness to anti-VAX arguments](#), this momentum could be amplified.

Vaccine hesitancy and rejection is not restricted to the United States. In fact, nearly every country experiences pockets of vaccine-preventable disease outbreaks, resulting from vaccine hesitancy or refusal, as described in a recent [WHO working group report](#) on the topic. Similar to trends seen in the United States, the choice to align with anti-VAX sentiments has complex underpinnings, often relating, in part, to personal/community belief systems and distrust of healthcare providers

and institutions. As an extreme example, the Taliban [\[link\]](#) are vehemently opposed to vaccinations as they view vaccination programs as antithetical to their traditional beliefs and culture; such programs can be seen as a nefarious plots to "inject" Western culture into traditional societies. One result has been [terrorist attacks targeting polio workers in Pakistan](#), killing 60 since 2012.

At the risk of oversimplifying the issues related to [vaccine hesitancy](#) and rejection, people's decision's for themselves and their children might have less to do with the message, and more about how—and in what context—the message is delivered. In fact, a [meta-analysis](#) on persuasive techniques common to anti-VAX websites suggest that these sites go far beyond simply providing (inaccurate) information on [vaccine safety](#). These sites are making genuine connections to parents' values (i.e. freedom of choice) and lifestyles (i.e. healthy eating), adeptly contextualizing anti-VAX sentiments as being a part of holistic well-being. Such sites skillfully cultivate feelings of trust and credibility by aiming their message to hit the more human side of things. These sites get human behavior, while pro-objective evidence sites often do not. When looking at the anti-VAX movement, we see the power of personal stories and of presenting anti-VAX "science" alongside related messages that promote the values and ideals of the target population.

So how do we apply these lessons to improving the public's understanding of particular science-based decisions? While it may feel counterintuitive, perhaps we should stop trying to win arguments using the traditional academic approach, with data, error bars, and p-values, as [these risk strengthening the emotional appeal of anti-evidence, anti-scientific viewpoints](#). Instead, we can present data-based conclusions in compelling and effective ways, keeping in mind the connections and disconnections between human emotion and rationality. As the world's population continues to soar, the importance of humanizing our messages, arguments, and conclusions is paramount.



There is no universal equation governing scientifically literate decision-making, it is unlikely that one will ever be identified simply because [human behavior](#) is difficult to predict. From a practical perspective, this may mean that "scientific literacy" as an over-arching concept is less useful than fostering a deeper understanding of relevant issues in science and medicine. In recognizing the need to provide people with specific knowledge to make informed, data-based decisions, it is implied that facts (empirical observations) are clearly differentiated from non-facts. However, this idea is much more complicated, and the interpretation of "facts" is impacted by the context of individual experiences (the [Saigon, 1965 episode](#) of the Revisionist History podcast provides an excellent example of such an analysis). The inability to predict how someone will interpret empirical evidence is the giant wrench stuck in the gears of the science literacy machine. With regard to the anti-VAX movement, we are dealing with an emotionally-charged phenomenon that is deeply intertwined with human nature (the need to protect ourselves and our children), and the process goes beyond answering general true-false questions. While difficult, the effort to better understand and meaningfully correct points of failure in communicating any controversial [science](#) issue is likely to be beneficial, particularly when we consider the consequences of [scientific illiteracy](#).

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