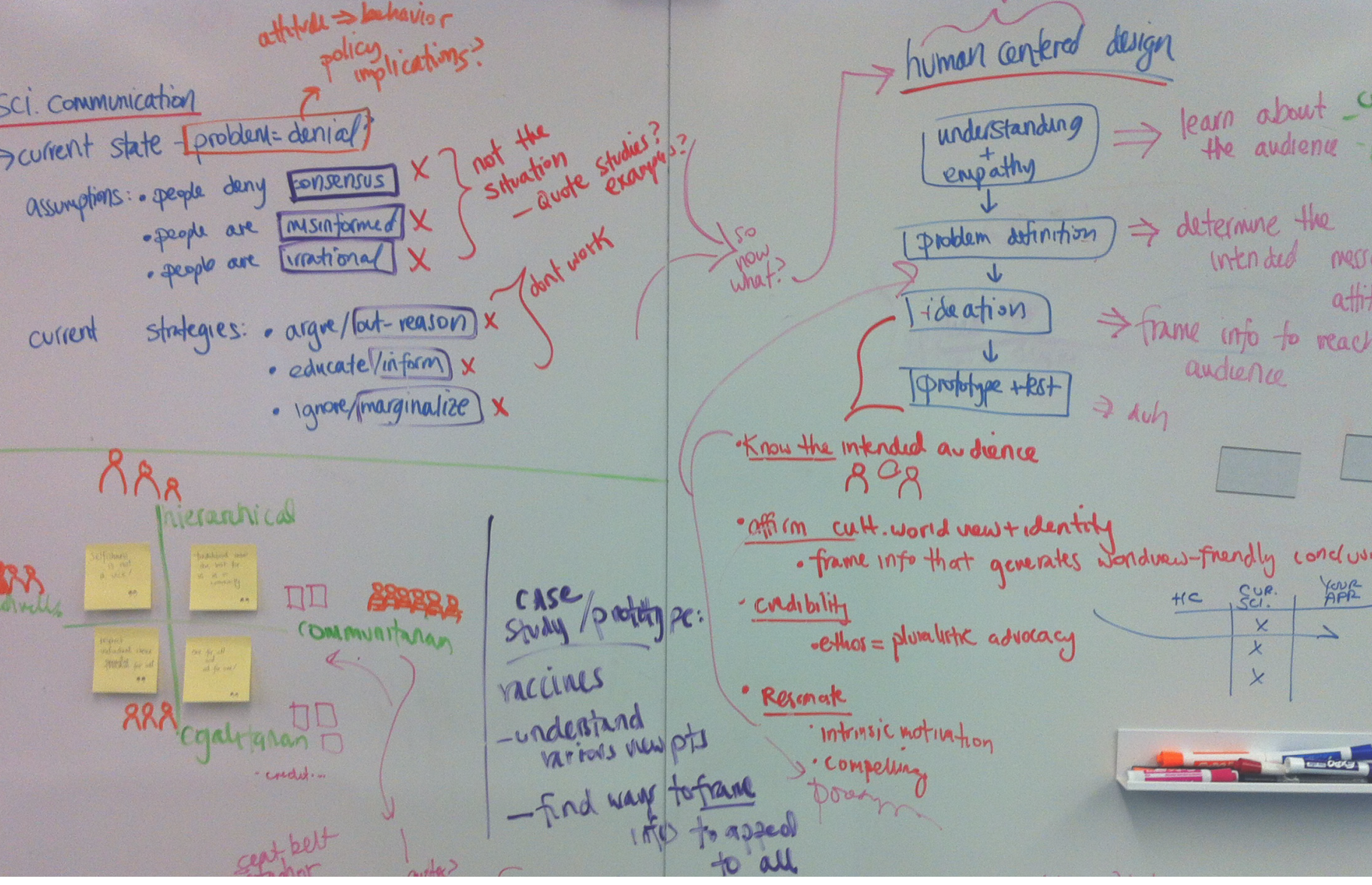

Demanufacturing Doubt: A Design Strategy for Science Communication

Jennifer Briselli

Demanufacturing Doubt:
A Design Strategy for Science Communication

A thesis submitted to the School of Design, Carnegie Mellon University
for the degree of Master of Design
in Communication Planning and Information Design

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IRB Study HS12-221: The Design of Communication Strategies to Enhance Understanding of Scientific Discoveries and Encourage Acceptance for the Validity of Scientific Consensus

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ABSTRACT

Communicating scientific concepts to non-scientific audiences can be difficult. Often, scientists rely solely on the strength of empirical evidence as an appeal to reason in public scientific discourse. Unfortunately, in a world where 'truthiness' has become an accepted part of media messaging, public understanding and attitudes do not develop solely in response to objective reasoning. From climate change to evolution, vaccines to nuclear power, the science community finds itself on the defensive as shifting perceptions of authority and the narratives that frame scientific communication undermine public understanding of science. This thesis project draws on social science, rhetoric, and communication design to develop and evaluate communication strategies that both compete with science denial narratives and stand on scientific evidence to make the truth more compelling than its alternative. These strategies are in turn made actionable and prototyped as a set of guidelines and exercises for scientists and those who communicate on their behalf.

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INTRODUCTION

GOALS

This thesis project aimed to identify the challenges facing modern science communication, and to develop insights that inform design strategies that could be made actionable for those invested in the public understanding of science.

CONTEXT

Communicating scientific concepts to non-scientific audiences can be difficult. Often, scientists rely solely on the strength of empirical evidence as an appeal to reason (logos) in public scientific discourse. Unfortunately, in a world where 'truthiness' has become an accepted part of media messaging, public understanding and attitudes do not develop solely in response to objective reasoning. From climate change to evolution, vaccines to nuclear power, the science community finds itself on the defensive as shifting perceptions of authority and the narratives that frame scientific communication undermine public understanding of science.

Unfortunately, while science concerns itself with the pursuit of objective, empirical knowledge, the manner in which lay people construct meaning from those facts, and perhaps more importantly, the communicator's inherently persuasive role in facilitating that meaning-construction, draw as heavily on emotion, authority, narrative and experience as on pure reason. The message put forth by the scientific community is therefore at risk of being lost on those who might be swayed by an even stronger appeal to authority (ethos) or emotion (pathos), especially when those competing appeals are made by non-scientists.

Logos refers to the internal consistency of the message, the clarity of the claim, the logic of its reasons, and the effectiveness of its supporting evidence.

Ethos refers to the credibility of the writer. Ethos is often conveyed through tone and style.It can also be affected by the writer's reputation, his expertise, his previous record, his integrity.

Pathos is the use of narrative techniques that help an audience to identify with the author's point of view. The values of the writer are implicit in the message. Pathos refers to both the emotional and the imaginative impact of the message on an audience.

To complicate matters, there exists an increasing population of individuals whose self-proclaimed "skepticism" constitutes a phenomenon referred to occasionally as denialism, defined as an adherence to a myriad of rhetorical arguments that suggest controversy where there is none, and rejecting propositions for which scientific consensus does exist. Even within the general population, who have been found to overwhelmingly support science and scientists[1], there are staggeringly large numbers of people with misconceptions about the existence of consensus and polarized views about policy implications that arise from that consensus. Most responses to the science communication "problem" as it is commonly perceived have taken one of three forms: debate, educate, or ignore.

Many in the scientific community act on the belief that if people were provided better information, they would always accept the evidence for a given theory and concede to the 'truth.' Unfortunately, this is rarely the case. Some researchers have demonstrated the ineffectiveness of empirical evidence in reversing an irrational denial of scientific fact. While improved education and scientific literacy is itself a worthy aim, it alone cannot bring about a less polarized public on topics of scientific controversy; it has actually been shown that certain populations become more polarized in their disbelief of scientific consensus when educated on a given subject.

Others encourage scientists to engage with "denier" or "skeptic" audiences only so far as necessary to reveal their faulty rhetorical strategies. This strategy might cast a damning light on the behavior of certain leaders within a "denier" movement, but does not address the attitudes of the average individual, who himself does not engage in rhetorical discourse but remains receptive to the strategies employed by those who design and mediate communication. Most people are not 'deniers.'

Still others insist there is no use in engaging with "denialists" for this very reason; they don't play "fair" in the arena of scientific discourse and therefore ought to be disqualified and marginalized as an entire population.

1. A 2009 Pew Poll found that 84% of the public say that science has had a positive effect on society and that science has made life easier for most people.

Pew Center for People and the Press: http://www.people-press.org/2009/07/09/public-praises-science-scientists-fault-public-media/

hypothesis	implication	outcome	*why* this approach fails
people are:	*so we need:*	*better understanding?*	*people are:*
in denial	more data more logic	no	people ***do*** trust science, but their values determine ***who*** they trust
misinformed	simplified information	no	cultural worldview influences ***how*** people process information
irrational	marginalization	no	people are willing to consider new info when it affirms their ***values***

The science communication "problem"

It would seem there is yet a fourth option, which is the focus of my work: to frame science communication as a rhetorical situation. We cannot ignore increasing polarization over scientific topics as a passing trend. The percentage of the population that dismisses some segment of scientific evidence grows larger every year, and studies suggest that many who would deny empirically supported discourse are in fact well-educated, reasonably intelligent and scientifically literate people. Unfortunately, we cannot "debate" with denier propaganda; it simply does not work. Diethelm and McKee, among others, have even highlighted the most common rhetorical strategies employed by denialists in scientific discourse; their work makes it clear that true dialectic is not feasible. We might consider the challenges for modern science communication not simply as a need for stronger evidence or better education, but a need for new communication strategies. We must begin by examining this rhetorical situation in context, considering the exigency as rhetorical situation. Though Bitzer suggests "the scientist can produce a discourse expressive or generative of knowledge without engaging another mind," it is not the "scientific audience," (who he describes as "capable of receiving knowledge"), that we are after;

A **rhetorical situation** is defined as the "context of persons, events, objects, relations and an exigency which strongly invites utterance."

from Bitzer, L. (1968). The Rhetorical Situation. *Philosophy and Rhetoric, 1.*

Rhetoric "is rooted in an essential function of language itself, a function that is wholly realistic and continually born anew: the use of language as a symbolic means of inducing cooperation in beings that by nature respond to symbols. Wherever there is persuasion, there is rhetoric, and wherever there is rhetoric, there is meaning."

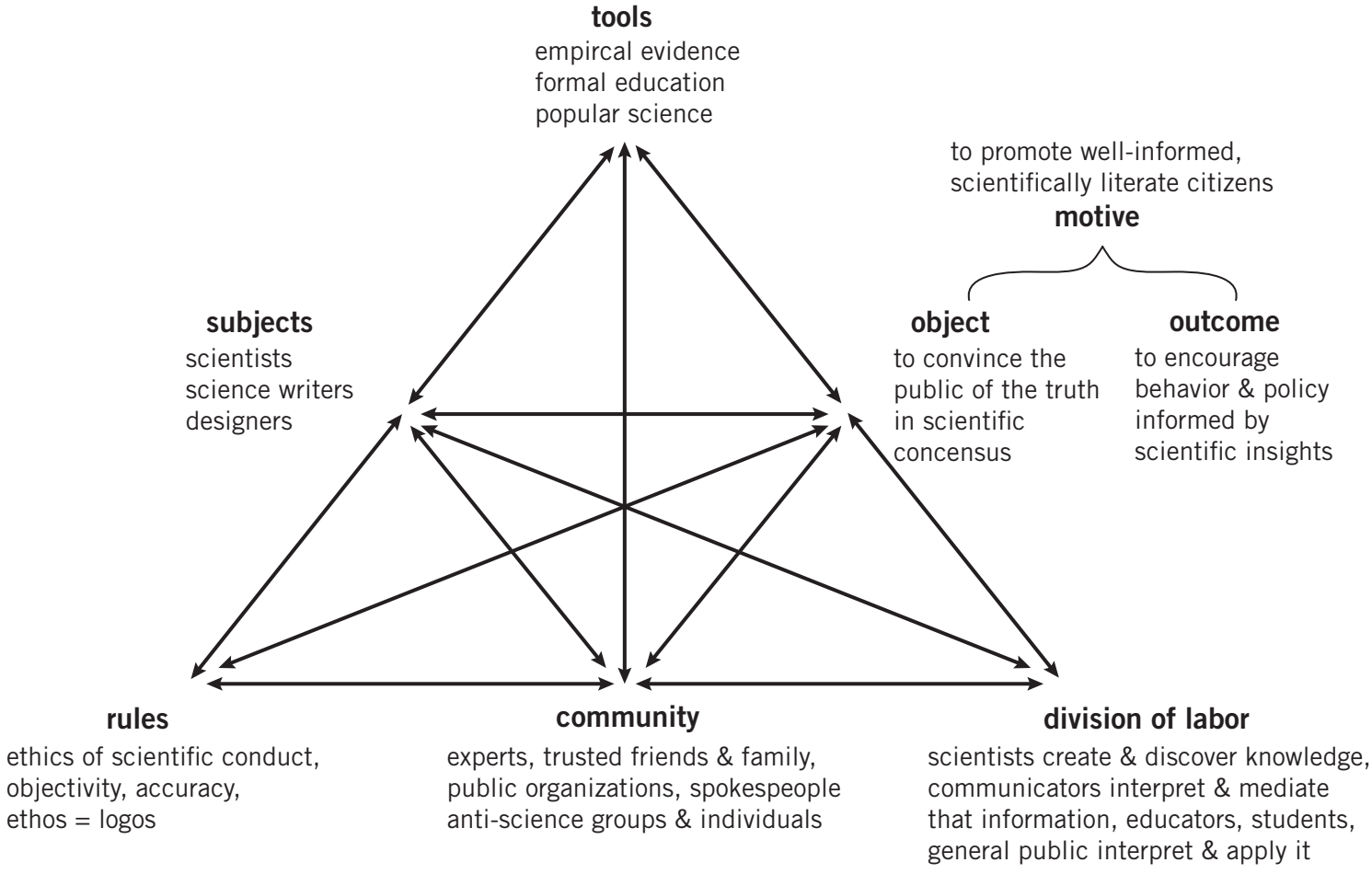
from Burke, K. (1950). *A Rhetoric of Motives*, New York: Prentice Hall,.

rather, it is the "rhetorical audience" who is, by definition, "capable of serving as mediator of the change which the discourse functions to produce."[2] As unpleasant as it may be for the scientist, if he is to convert extreme skepticism into acceptance, he (or those communicating on his behalf), must embrace the role of rhetor and would benefit greatly from a little Aristotelian advice, that is: to consider all the available means of persuasion.

In order for the scientific community to maintain agency in a socio-historical context that imposes ever changing constraints on a limited number of mediating tools, communication designers and scientists will need to work together. Ideally, scientists, science communicators, and designers will collaborate to innovate new strategies for both education on scientific topics and persuasion toward an increased adherence to scientific consensus that work within the ethos of the scientific community to reach an audience beyond it. Unfortunately, the rhetorical challenge as it exists today is often hefted by scientists onto the shoulders of science communicators, who, without the support of a sound design strategy, are in turn routinely criticized by those very scientists for failing to reach audiences in meaningful ways.

Communication designers, armed with a sound understanding of social psychology, rhetoric, and cognitive science, have access to a number of powerful communication strategies that are presently underutilized or outright ignored by science communicators. It would seem there is a greatly unrealized potential not only for an assessment of design strategies in science communication, but in the delivery of this assessment to the very scientists and designers invested in bringing science concepts to the public. It is also crucial that recommendations about communication strategy be constructed in a manner most likely to encourage collaboration between these communities in a confluence of interests and skills.

2. Bitzer, L. (1968). The rhetorical situation. *Philosophy and Rhetoric, 1.*



Science communication as an activity system

RESEARCH

RESEARCH

To begin the project, I reviewed existing literature and explored the present academic discourse on science communication to guide my research. I also studied the work of other researchers, social scientists, rhetoricians, and designers interested in the problems faced by science communication, risk perception, persuasion, and communication design, each of which face challenges parallel to those in science communication.

DENIALISM: A RED HERRING?

To better understand the problem in a social and historical context, I began by reading Naomi Oreskes and Erik Conway's book, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, a landmark text in the study of science denial and manufactured controversy. Oreskes and Conway cover the history of science controversies in the last decades of the 20th century and draw parallels between modern day climate change denial and the controversies surrounding tobacco, acid rain, and the ozone layer in previous decades. They identify the major players, their likely motivations, and the strategies they employed to generate doubt and stir controversy where science had otherwise reached consensus. Most telling are the methods by which many of these efforts were so successful: they employed rhetorical strategies that are often eschewed by the scientific community. Less prescriptive than explanatory, Oreskes and Conway's work illustrates what science communicators are up against in their efforts to improve science communication strategies and encourage confidence in scientific consensus. Similarly, Diethelm and McKee offer a concise overview of denialism as a phenomenon especially relevant in scientific debates. They define denialism as "the employment of rhetorical arguments to give the appearance of legitimate debate where there is none, an approach that has the ultimate goal of rejecting

a proposition on which a scientific consensus exists."[3] This definition echoes the account given by Oreskes and Conway in *Merchants of Doubt*. While they certainly provide a sound framework for both understanding and deconstructing many of the denialist tropes in science communication, Diethelm and McKee leave something to be desired in their recommendations for "dealing with" denialism. This seemed to be a common theme running through a lot of the literature I encountered. While many have studied denialism and identified the strategies used by leaders in the denialist movement, relatively few have offered any significant recommendations to combat these strategies.

Another obvious entry on any reading list about science denial is Michael Specter's *Denialism*, which begins with the promise of an exploration of denialism that might shed light on how to combat it. He writes passionately about several examples, from anti-vaccination movements to homeopathic hoaxes. He explores many examples of denial itself and its consequences on public perception, decision making, policy and health. Unfortunately, he never delves too deeply into the roots of denial (psychological or otherwise) and offers little more than a passionately frustrated expansion of the sentiments expressed by Diethelm and McKee, and yet offers nothing as useful as the historical context that Oreskes and Conway provide.

While the concept of science denial looms large as an obvious challenge to the science community, it turns out to be a distraction from the source of most difficulties faced by science communicators. In fact, most people trust scientists and the work they do, and don't "deny science" at all.[4] The real question, it turns out, is why some people interpret scientific findings differently than others, and which factors influence people's acceptance of facts as facts.

3. Diethelm, P., & McKee, M. (2009). Denialism: What is it and how should scientists respond? *European Journal of Public Health, 19*(1), 2.

4. "Most people believe that government investments in science pay off in the long run... Scientists are very highly rated compared with members of other professions.."

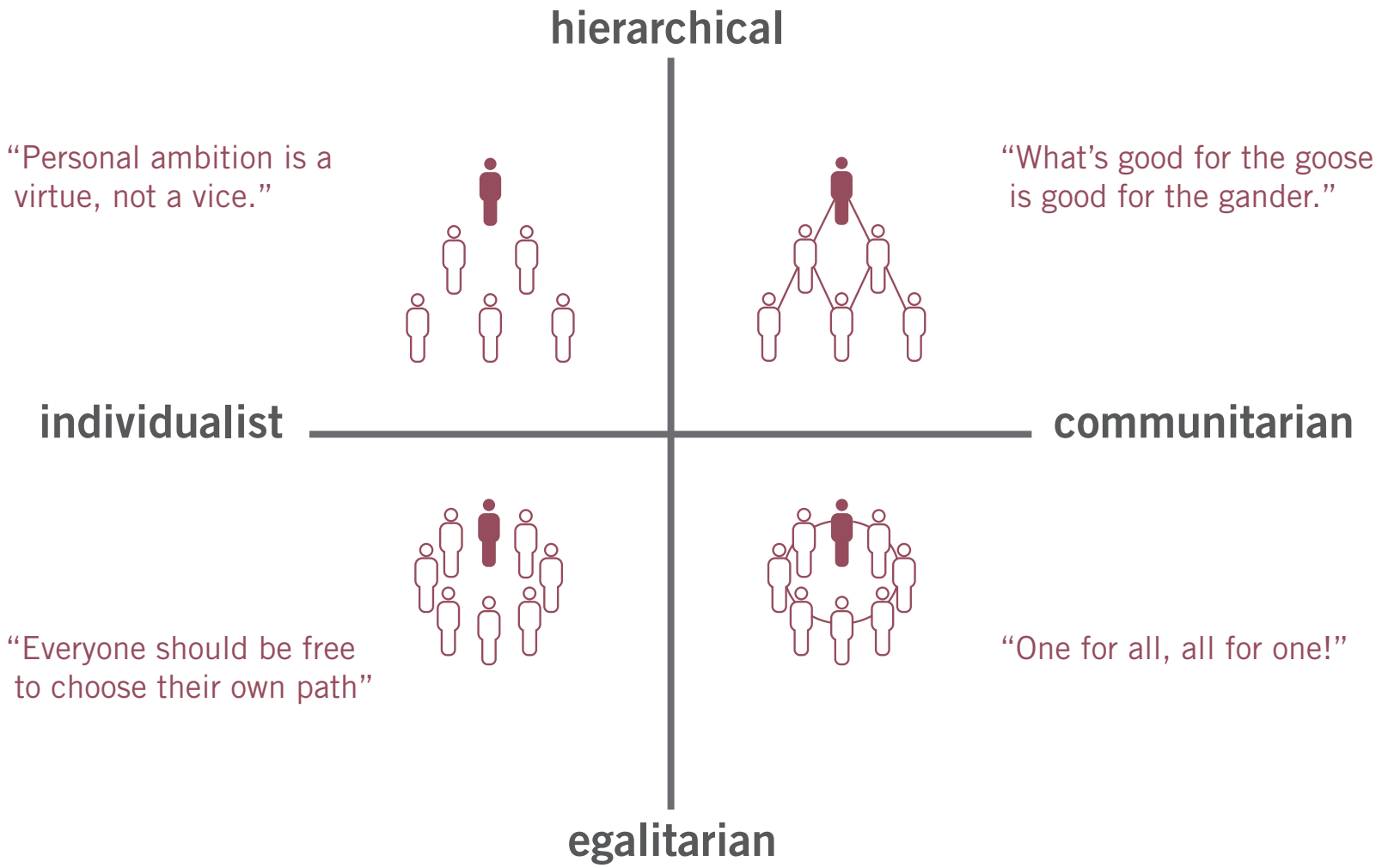
Pew Center for People & Press: http://www.people-press.org/2009/07/09/public-praises-science-scientists-fault-public-media/

A VALUE PROPOSITION

It is clear from Oreskes and Conway's historical tracing that many science denial narratives rely on appeals to individual values, which are strongly associated with cultural in-groups, upbringing, and personality. Social scientists and psychologists have studied what they call *identity-protective cognition* in depth, so I turned to the work of these experts for an anthropological and psychological understanding of how values influence the effects of science communication.

Dan Kahan's work at Yale University, as part of the Cultural Cognition Project, serves as a major underpinning of my exploratory research. Two of Kahan's papers, *Cultural Cognition of Scientific Consensus*, and *Fixing the Communications Failure*, serve as the cornerstone of Cultural Cognition research as it applies to science communication. Kahan and his colleagues seek to understand motivated reasoning, which is generally defined as the unconscious tendency of people to process new information into conclusions that suit a particular end or goal.

Kahan's work describes motivated reasoning, and many of the mechanisms by which it occurs, as an identity-protective phenomenon (as opposed to being economically motivated, for example). That is, people tend to interpret information in a manner that matches their previously held values and affirms their cultural worldview, and people tend to trust the expertise of those they perceive to hold similar values. Kahan's work builds on the research of anthropologists Mary Douglas and Aaron Wildavsky, and the Cultural Theory of Risk developed in the 1970s and 1980s, updating and improving their work to suggest a "group-grid" matrix that defines an individual's cultural worldview along two spectrums: hierarchical-egalitarian and individualist-communitarian.



Cultural worldview & values: Depending on where an individual falls along each spectrum, his or her interpretation of scientific or risk related information can be reasonably predicted based on whether its implications affirm or threaten his or her worldview and values.

Because science communication has not been the subject of much design research, I initially planned to follow a human-centered design process by conducting ethnographic research to understand potential audiences and develop a conception of potential users as individuals with particular backgrounds and needs that would drive the design process. However, the studies performed by the Cultural Cognition Project, as well as previous work by Douglas, Wildavsky and others, have provided a richer and more thorough ethnographic study of my potential audience than I would be able to develop working alone over a nine-month period. Instead, I began with the cultural cognition matrix as a foundation that I built upon as I developed a design strategy with different values in mind.

I also saw a significant design opportunity in the application of this anthropological framework to the design of science communication strategies. As Kahan writes on his blog, "the science of science communication has generated critical insights about valid psychological mechanisms. Such work remains necessary and valuable. But in order for the value associated with it to be realized, social scientists must become experts on how to translate these lab models into real, useable, successful communication strategies fitted to the particulars of real-world problems."[5] Ideally, my hope is that this project has contributed, even in some small way, to this effort.

5. Cultural Cognition Project *http://www.culturalcognition.net/blog/2012/9/19/the-local-adaptation-science-communication-environment-the-p.html*

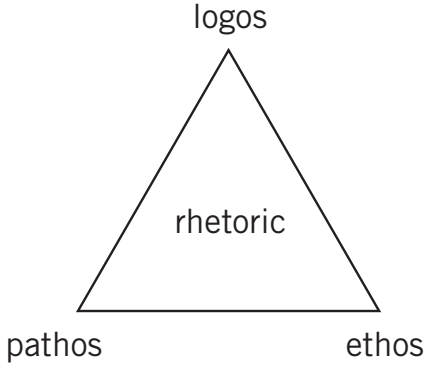
Another book I read early in the process was Chris Mooney's *The Republican Brain: The Science of Why They Deny Science— and Reality*. In it, Mooney explores the brain science that might reveal genuine differences between liberal and conservative thinking and how people fall into different ideologies. Throughout the book, Mooney uses a term I find interesting: politicized wrongness. It's a great way to differentiate between the genuinely pathological deniers out there (beyond reach, or at least the scope of my project goals) and the rest of the population. Just as I've based my thesis goals on the premise that science communication will need to evolve from a simple 'more information,' 'better education,' and 'ignore the naysayers,' approach, Mooney expresses an

identical sentiment: "Scientific and fact-based arguments often don't work to persuade us; education often doesn't protect us from lies and misinformation; more information and knowledge sometimes just give us more opportunities to twist and distort- and worst of all, the two groups we'll broadly call 'liberals' and 'conservatives' have an array of divergent traits that sometimes make them unable to perceive or agree upon the same reality."[6]

Mooney's work provided two main takeaways for my research. First, it suggested I should determine the cultural worldview of participants in my research and consider what communication framing would be most appropriate for people in different points along the cultural worldview spectrum. Second, I needed to explore the narratives and metaphors that are used successfully outside the scientific community, even those used to attack or deny science and ask, "Why are they successful? What aspects of human nature do these metaphors touch, and in what types of audiences, where current practices in science communication fall short?"

6. Mooney, C. (2012). *The republican brain: The science of why they deny science, and reality.* Hoboken, NJ: John Wiley & Sons, Inc., 24.

ANSWERING A RHETORICAL QUESTION



A study of the different metaphors, narrative styles, and other argument strategies implied a need to explore the rhetoric of science. As a practice, rhetoric stands on the pillars of logic (logos), emotion (pathos), and character (ethos) to communicate persuasively. As surely as it can be used to fabricate false arguments, exploit emotions, and claim undue authority, it also offers a window into the more noble application of its art to understanding the audience on a deep level (human-centered design) and determine how their needs for logical argument, emotional resonance, and trust inform communication strategies.

To explore the rhetoric of science as both a critical analysis and search for design implications, I began with Wayne Booth's *How Many Rhetorics?*, in which

he writes, "rhetoric makes realities, however temporary."[7] This philosophy guides both the book's theme and its implications for my thesis work. Over the course of the book, he covers the history of rhetoric, in both practice and study, including its ever-changing reputation over history as both the noble art of persuasive communication and the deceptive art of lying. He continues to explore the myriads of rival definitions and celebrates several of the writers and thinkers who have embraced (or re-embraced) rhetoric in the modern era, ultimately suggesting that "rhetorical training (is) essential in learning not only how to protect against deception but also how to conduct argument that achieves trustworthy agreement and thus avoids the disasters of violence."[8]

7. Booth, W. (2004). *The rhetoric of rhetoric: The quest for effective communication*. Malden, MA: Blackwell Publishing, 50.

8. ibid.

Booth makes a distinction between the conventional, persuasive rhetoric, and what he calls "Listening-Rhetoric," which includes a broader range of communication strategies aimed at understanding multiple viewpoints. He writes, "when Listening-Rhetoric is pushed to its fullest possibilities, opponents in any controversy listen to each other not only to persuade better but to find the common ground behind the conflict."[9] This concept of Listening-Rhetoric proved especially relevant for my project; while many in the science community have tried simply to argue climate chance deniers down with logic, for example, they have been frustrated by the failure of those efforts to persuade audiences who have been taken in by stronger appeals to emotion or authority. Listening to the audience, or in another sense, understanding how they perceive and react to information, can go a long way toward making a rhetorical approach to science communication, especially when "listening" draws on an understanding of cultural cognition and motivated reasoning.

9. Booth, W. (2004). *The rhetoric of rhetoric: The quest for effective communication*. Malden, MA: Blackwell Publishing, 10.

To expand on the role of rhetoric in science communication in particular, I read Leah Ceccarelli's *Manufactured Scientific Controversy: Science, Rhetoric, and Public Debate* which examines three cases of "manufactured" scientific controversy, and offers a comparative study of argumentative dynamics to reveal what she deems "rhetorical traps" set by those who seek to delay policy decisions by questioning scientific consensus. Unlike many others writing about the

rhetoric of science, Ceccarelli makes a clear and concrete recommendation: to shift the rhetoric of science from one of scientific discourse among researchers to one of a public facing rhetorical approach to science communication.

Meanwhile, through a similar case study of the nuclear era and associated controversies over the last several decades, Carolyn Miller explores the role of ethos in risk analysis, arguing that we can understand the scientific community's discomfort with expert opinion as an expression of its long-standing preference for logos over ethos. A scientist or engineer is expected to support a claim with factual observations and sound reasoning (logos), abjuring appeals to emotion (pathos) or personal character (ethos). Thus, "what might in other situations be central to an ethical appeal—affiliation, prior success, masterful expertise—in science and technology must be treated as logos, as factual evidence, attributes of the technical situation rather than of an advocate in a rhetorical situation."[10]

10. Miller, C. (2003). The presumptions of expertise: The role of ethos in risk analysis. *Configurations, 11,* 184.

Miller's arguments shed light on the challenges faced by the science community (some by their own creation, of course), in constructing and maintaining credible ethos without subverting it to logos. In designing communication strategies that can appeal to the public and counter misinformation, it becomes especially important to avoid the pitfall of over-reliance on any one of the three Aristotelian appeals. "Risk analysis and other expert discourses have had great rhetorical success, in part due to the presumptions that expertise has been able to gain. But their success is limited by the loss of trust—that is, precisely by the poverty of their ethos."[11] We can perhaps see the legacy of this "poverty of ethos" playing out today, as the scientific community no longer enjoys the luxury of authority in claiming scientific consensus on certain topics, such as climate change or vaccination safety. It will be an important design challenge to rebuild and incorporate genuine ethos, in the classical sense.

11. Miller, C. (2003). The presumptions of expertise: The role of ethos in risk analysis. *Configurations, 11,* 202.

Similarly, Craig Waddell points out that scientists possess an important responsibility in this process by two functions: lobbying and informing. He suggests that scientists can use their authority to lobby for appropriate

application of their work, and they can use their knowledge to inform the public about potential risks and benefits from their work. Unfortunately, while Aristotle describes rhetoric as "appealing to the whole person through a complex interplay of ethos, logos, and pathos, the privileged position of logos in Western culture has often led to the denial of any appropriate role for pathos in science-policy formation."[12]

It has become increasingly clear to me that there is little reason for logos to remain the strongest appeal in the rhetoric of science communication, and Waddell outlines a case study that demonstrates that a balanced approach that incorporates authentic appeals to emotion as much as authority and reason have potential to be more convincing. This philosophy guided my project as I endeavored to develop rhetorical strategies that balance and blend all three appeals. As Waddell points out, science is inherently uncertain and performed in terms of degrees of certainty, not absolute truths. Therefore, "if we accept that there is no Truth, no objective foundation upon which to base belief, then we must simultaneously accept responsibility for constructing a foundation, for constructing truths."[13]

If science communicators are to construct meaning for their audiences, they will need to do so deliberately. While information itself may be objective, the language choices made by those communicating that information can frame it in such a way that an audience interpretation becomes quite subjective, and framing can significantly affect the way individuals process that information. George Lakoff has written a lot about framing, especially within a political context. He acknowledges that framing can be deceptive, obscuring or influencing people in dishonest ways, but also serves a purpose to help people focus on the important and discard the extraneous. Lakoff also suggests two main frames tend to dominate modern messages: one derives from what he calls the "strict father" family narrative, the other from what he calls the "nurturing parent" family narrative. These hold stronger implications for politics than science communication, but the overarching ideas are relevant, especially if taken in conjunction with Kahan's the cultural cognition research.

12. Waddell, C. (1990). The role of pathos in the decision making process: A study in the rhetoric of science policy. *Quarterly Speech Journal, 76*(4), 381.

13. Waddell, C. (1990). The role of pathos in the decision making process: A study in the rhetoric of science policy. *Quarterly Speech Journal, 76*(4), 393.

How might the science community achieve a more rhetorical approach to science communication? Even if we accept that we must make a more balanced appeal to pathos and ethos alongside logos, many in the science community (especially those who study risk communication and decision science) model people as rational actors; that is, people in an ideal world should, and can, make decisions based on facts and logic alone. Walter Fisher describes this worldview as the "Rational World Paradigm," and offers what he calls the "Narrative Paradigm" as an alternative conception of human communication. The Narrative Paradigm "can be considered a dialectical synthesis of two traditional strands in the history of rhetoric: the argumentative, persuasive theme, and the literary, aesthetic theme."[14] In other words, he proposes that all meaningful communication is a form of storytelling and that people experience events and information as a continuous narrative with individual conflicts and characters. Perhaps most importantly, these narratives are most compelling and personally meaningful when they are cohesive.

14. Fisher, W. (1984). Narration as a human communication paradigm: The case of public moral argument. *Communication Monographs, 51.*

Approaching communication through the lens of this narrative paradigm offers some important implications for more compelling science communication. Throughout history, science communication has almost certainly been practiced within a "Rational World Paradigm," which operates on the assumptions that humans are rational, that decision making and communication are based on clear-cut argument and logic, that logic is dictated by context (legal, scientific, etc.), that rationality is determined by subject matter knowledge, and that the world is a series of logic puzzles that can be solved accordingly. I became quite interested in what a science communication approach would look like if designed within a Narrative Paradigm. There has certainly been some pushback against similar ideas in the past, but as Fisher writes, "the narrative paradigm does not deny reason and rationality, it reconstitutes them, making them amenable to all forms of human communication."[15] Fisher suggests that logical

15. ibid.

reasoning need not be bound to argumentative prose or rational inferential structures, but that it might instead play out in all sorts of symbolic action, including the non-discursive.

While considering the implications of this Narrative Paradigm for designing more persuasive science communication, (and what ends that persuasion might serve), I reviewed the work of B.J. Fogg, and Richard Thaler and Cass Sunstein, all of whom are cited often on topics pertaining to persuasion and behavior change. These concepts are often misconstrued to be closely related, if not the same, and they require some untangling.

Writing about human computer interaction, Fogg has developed foundational principles in persuasive technology, walking a line half way between the persuasive methods of rhetoric and the choice architecture that Thaler and Sunstein describe as a "nudge" toward behavior change. Fogg defines persuasive technology as that which makes "an attempt to change attitudes or behaviors or both (without using coercion or deception),"[16] though almost every example he describes is written in the context of changing human behavior. Certainly, changes in attitude lead to changes in behavior, and that behavior change may indeed be the end goal most significant for those studying how technology can indeed be persuasive. But, Fogg does warn designers to begin addressing behavior change by focusing on triggers and gaps that make behavior change easier, not by changing underlying attitudes.

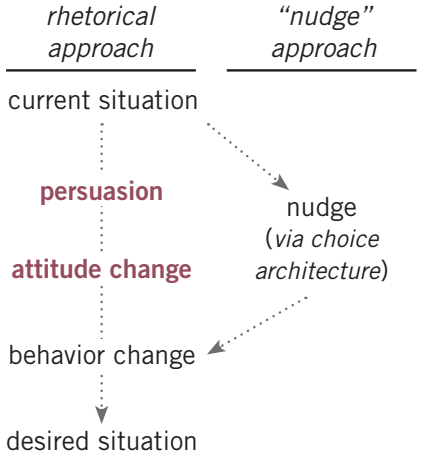
16. Fogg, B. J. (2002). *Persuasive technology: Using computers to change what we think and do*. Morgan Kaufmann Publishers, 15.

For my project, however, technology can only serve as a component of the effort, not the entire ecosystem in which science communication takes place; a design strategy is most impactful when it is relevant across a range of media and contexts. There is much that persuasive technology may have to offer in assisting the process of persuasion, but if the goal of the science community is not as much to effect certain individual behaviors, (and it is not), but rather to achieve confidence in consensus and encourage adoption of theories and policies that affect populations, the role of technology as Fogg emphasizes is less relevant.

Fogg's ideas about triggers, for example, and the ways that technology can encourage a person to do something, are cutting edge; however, when the goal is not to trigger a behavior but to get people looking in the same direction as one another, persuasive technology may only be a single tool in the larger toolbox for attitude change.

Meanwhile, Thaler and Sunstein's *Nudge: Improving Decisions About Health, Wealth, and Happiness* is a book about behavior change, not persuasion. They explore the pitfalls of a rational-actor model (like Fisher's Rational World Paradigm) for policy and economics and draw on psychology and behavioral economics to encourage what they call libertarian paternalism and the deliberate engineering of choice architecture.[17] They explore the "Reflective System" and "Active System" of thought, similar to Don Norman's theory of experiential and reflective cognition, and they describe several commonly understood cognitive biases that thwart people's intentions to operate rationally in the world of decision making.

17. Thaler, R., & Sunstein, C. (2008). *Nudge: Improving decisions about health, wealth, and happiness.* New Haven, CT: Yale University Press.



In essence, Thaler and Sunstein explain how designers can essentially nudge people into desired actions as an end-run around the whole rhetorical challenge that I am interested in. For some types of issues, this is ideal: when the desired behavior is achievable even without a significant attitude change, or when inaction is more a symptom of the status quo than disagreement. For example, increasing recycling rates, encouraging organ donation, and assisting health care decisions can all be achieved via carefully planned choice architecture that includes little persuasive messaging. However, when the goal is not only to effect a behavior change or aid decision making for a wide population of people, but to empower those people with the ability to make good decisions in unrelated circumstances or to inoculate people from future misinformation, a nudge is not enough. This book offers a good look at what a nudge can do, but also illustrates what a nudge cannot do, and that's where persuasion is still the key.

INFORMING INFORMATION DESIGN

As I turned my exploration from social science and rhetoric as a critical analysis toward the practical implications for communication design, I looked to two seminal works on information design. Edward Tufte has shaped the field of information design through his many writings on the subject, especially in his recommendations for the design of data-rich visualizations. In *Envisioning Information*, he focuses on the process by which a designer can render complex and often 3-D information in 2-D space, "escaping flatland," as he calls it. Tufte offers several examples of effective information design through maps, diagrams, charts and tables, and demonstrates how color can add depth of meaning.

Though Tufte's work serves as a cornerstone of information design, my thesis work drew less from his specific guidelines and more from the several overarching principles he presents in his discussion of information design. He encourages thoughtful consideration of each design variable and explores the strategies by which a designer might convey complex information without dumbing it down or diluting its significance in attempt to reduce noise and increase signal. Tufte writes that designs should be "so good that they are invisible,"[18] but not that data should be oversimplified in the process. In my attempts to develop communication strategies for science, this was an important challenge to remember; too many people solve the problem of scientific complexity by dumbing it down to tell a good story and sacrifice accuracy or authority in the process. Tufte's suggestions help designers walk the line between too much data and not enough, and were relevant throughout the project.

18. Tufte, E. (2006). E*nvisioning information.* Cheshire, CT: Graphics Press, 33.

Meanwhile, Jean-Luc Doumont's *Trees, Maps and Theorems: Effective Communication for Rational Minds* provides guidelines and practical tips for communicating in written documents, presentations, and visual displays. Doumont offers three rules for effective communication: understand and adapt to the audience, design for understanding, and use effective redundancy.

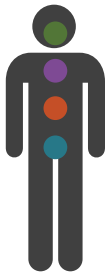
He offers many examples and illustrations and the book itself stands up as an example of all three strategies in action. I have found this book to be an excellent resource for information design. It is not a book about rhetoric, but Doumont's three recommendations, (to know your audience, especially), are quite in line with a rhetorical approach to information design.

RESONANCE FREQUENCY

While information design informs the logos in construction of a message, and social psychology and ethnographic research provide a richer understanding of audience to uphold its ethos, there remains the challenge of making science communication resonate with the public. In his book, *Don't Be Such a Scientist: Talking Substance in an Age of Style,* Randy Olson writes about how to make science compelling and the often overlooked (or outright ignored) value of good storytelling. As a Harvard-scientist-turned-filmmaker, Olson writes, "the powerful and effective communication of science has to be much higher priority than ever or the science community will lose its voice, drowned out by either the new anti-science movement or just the cacophony of society's noise."[19]

19. Olson, R. (2009). *Don't be such a scientist: Talking substance in an age of style*. Washington, DC: Island Press, 8.

In the book, he gets rather quickly to the core of the problem: the scientific community does a pretty poor job of communicating important ideas to the public because they don't make people care. He offers a primer on the nature of mass audience appeal, suggesting it all boils down to making connections with four body parts, each with increasing power to captivate and engage:



head: intellectual engagement
heart: emotional resonance
gut: visceral experiences
crotch: sex appeal

His recommendations to the science community, that I whole heartedly embrace, are:

1. Don't be so **cerebral**.
2. Don't be so **literal-minded**.
3. Don't be such a **poor storyteller**.
4. Don't be so **unlikeable**.

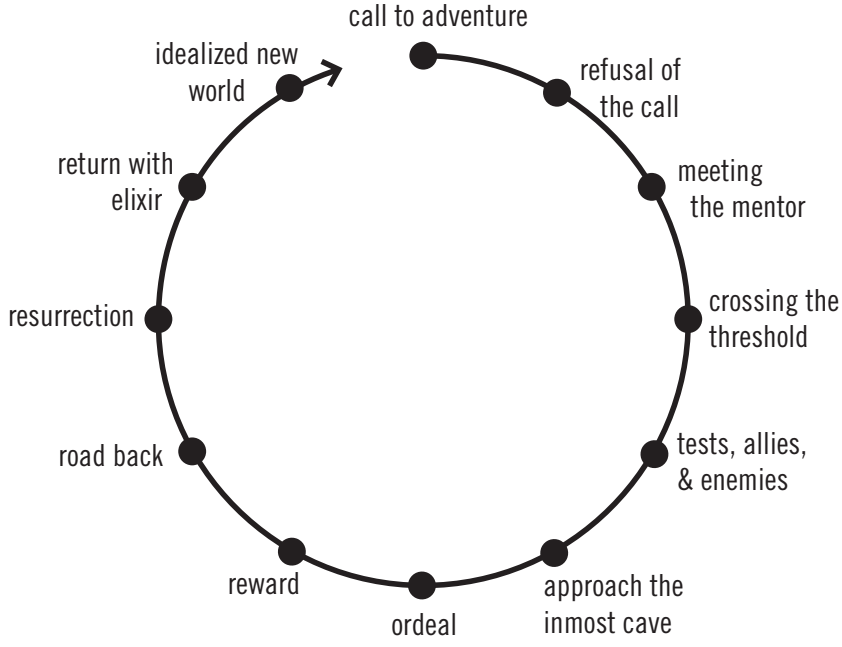
In other words, worry less about the logos (1 and 2), and improve your pathos (3) and ethos (4). He writes, "scientists fall victim to the belief that information alone is enough to effect change. They think, 'if I can just put these facts together into this specific argument, when people see it all assembled they will change their their outlook."[20] This philosophy sums up the conclusions reached by so many of the authors and researchers who have studied and written about science denial and manufactured controversy. Rhetoricians like Carolyn Miller, who have examined the rhetoric of science and demonstrated how science has systematically subverted appeals to authority and emotion into an all-encompassing appeal to reason that leaves much to be desired for the audience, would support Olsen's recommendations wholeheartedly; he is basically encouraging scientists (or those communicating about science) take up the ancient art of rhetoric and simultaneously infuse a good dose of storytelling into their work. Olsen's book provided a nice set of principles that guided the storytelling and appeals to emotion (pathos) as I explored them in this project.

20. Olson, R. (2009). *Don't be such a scientist: Talking substance in an age of style*. Washington, DC: Island Press, 59.

Olson's writing meshes well with the presentation and storytelling strategies espoused by Nancy Duarte and Jonah Sachs, as well. In her book *Resonate*, Duarte writes about the power of storytelling and demonstrates how crafting a powerful, interesting narrative can lead to the most compelling (and persuasive) presentation of information. She illustrates success stories and provides guidelines for good presentation.

See Duarte, N. (2010). *Resonate: Present visual stories that transform audiences.* Hoboken, NJ: John Wiley & Sons, Inc., 35.

One of the most valuable parts of Duarte's book is her discussion of the James Campbell monomyth, often called the Hero's Journey. This narrative pattern illustrates the underlying structure for many of the world's oldest and most compelling movies, films, and books. Duarte provides a number of very clear illustrations and examples that bring the Hero's Journey to a concrete level that can be applied to communication with an audience. In this manner, the audience becomes the "hero," and the communicator takes on the role of mentor as he guides the audience through the journey of the message. The Hero's Journey is easily applicable to the presentation of scientific information, and at present, does not seem to be embraced by many in science communication. Duarte's book proved an excellent resource for the design of compelling narratives within science topics and an ideal companion to the work of Tufte and Doumont.



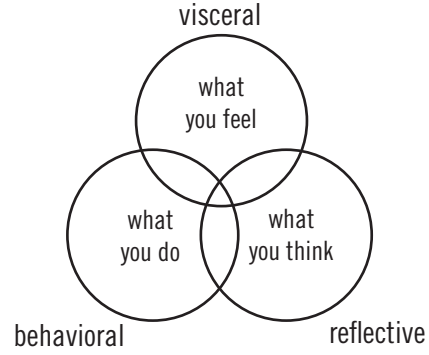
The Hero's Journey: Duarte models the experience of the audience as hero on adventure.

Jonah Sachs' book, *Winning the Story Wars*, is a recent release that echoes many of the sentiments expressed by Randy Olson and the strategies described by Nancy Duarte. Also drawing heavily on Joseph Campbell's monomyth of the Hero's Journey, Sachs outlines some of the most important strategies for compelling, persuasive, communication. Though his book is written for advertisers, I can see that his guiding principles are very applicable to science communication. He also argues that marketing does not necessarily imply deception or disingenuous communication; to the contrary, he argues, (and explores through numerous examples and case studies), that good storytelling can make information compelling for the right reasons, an argument I believe many scientists would find reassuring.

I also reviewed two books by Don Norman. In *Emotional Design: Why We Love (or Hate) Everyday Things*, he supports the need for communication that creates emotional resonance with audiences. Norman suggests that the human brain processes information in three layers: hardwired automation, conscious everyday behavior, and deeper contemplation. Each level of processing implies its own design approach, depending on what a designer may be focused on and how he defines the end goal for the user. In this book, however, Norman focuses on the emotional response to designed objects, because emotions "change the way the human mind solves problems."[21] He describes how an emotional response can be visceral, behavioral, reflective, or a combination of the three.

21. Norman, D. (2004) *Emotional design: Why we love (or hate) everyday things*. New York, NY: Basic Books, 18.

I found these categories reminiscent of the four areas that Randy Olsen suggests as resonant for great storytelling: visceral gut reactions, reflective intellectual engagement, behavioral impacts from emotion, and so on. It's no surprise to me that Norman's and Olson's writing overlap, despite working in different fields and coming from different backgrounds. They both seem to have hit on an important, if intuitive, understanding of human nature: we are emotional creatures and pathos plays a critical role in persuasion. When designing an object, communication artifact, or educational campaign, it becomes even more important to consider not only the logical construction of that object or



information, but to consider how it will resonate emotionally, on all three levels (visceral, behavioral, reflective) with the audience. Many science communicators focus less on emotional response and more on logic because there is a fear that emotions will cloud the science, but Norman makes a another strong argument for the role of emotion in design as a positive factor to be considered and, more importantly, consciously designed for.

ALL TOGETHER NOW

As I began to ask how all these facets of good communication might come together in a unified, and yet still useful, framework, I looked to the work of other educators and designers who have written on the topic. Grant Wiggins and Jay McTighe describe a process that can be used for instructional design and curriculum development that focuses on backward design. *Understanding by Design* emphasizes the importance of establishing desired outcomes and learning goals, and encourages educators and other instructional designers to build backwards to develop curriculum and assessment materials that move learners through instruction toward those goals. The concepts of *backward design* and *teaching for understanding* are not completely novel in the realms of experience design or psychology, but Wiggins and McTighe present them as a novel design approach to classroom learning that I myself had embraced as a former teacher.

Though my thesis work is not specifically related to classroom education, nor am I focusing solely on information design or educational design, even the best rhetorical strategies cannot be successfully applied to communication of information that itself is not well understood by the audience. *Understanding by Design* offers a solid example of how we might apply a "design approach" to fields outside design, with clear and measurable results. Of course, one might argue (as I would) that teachers are themselves designers, and that curriculum planning is itself a design art. Beyond the process described by Wiggins and McTighe as a

prescriptive measure for teachers (less relevant for this project), *Understanding by Design* also represents a an attempt to apply a student-learning centered (as opposed to teacher-instruction centered) approach to curriculum development, and as a whole piece it serves as an example of what this project attempts to do for science communication. By applying a rhetorical design approach to science communication, I have aimed to create a similar set of recommendations and framework that may be shared with practitioners, in this case science communicators instead of teachers.

Similarly, Don Norman's work informs this type of design process by encouraging designers to think about people and how they process information *as they design products and systems to support that process. In Things That Make Us Smart: Defending Human Attributes in the Age of the Machine,* Norman differentiates between two types of cognition: experiential and reflective. Experiential cognition is a "state in which we perceive and react to the events around us, efficiently and effortlessly," while reflective cognition is "that of comparison and contrast, of thought, of decision-making."[22] Experiential cognition is more automatic, and might be compared to the Type 1 thinking described in current popular writing about neuroscience. It is quick and reflexive. Meanwhile, reflective thinking might sound more similar to Type 2 thinking, that kicks in a moment or two later and allows the logical brain to override potentially rash decisions that would otherwise be made by the Type 1 thought process. Norman makes a point to explain, however, that experiential cognition is not simply rash and in-the-moment; rather, it represents the sum of many hours, days, and years of experience, and the mental schema that is constructed around that experience.

22. Norman, D. (1994). *Things that make us smart: Defending human attributes in the age of the machine.* New York, NY: Basic Books, 16.

Norman stresses the implications of designing for both types of cognition. It would seem at present that science communication leaves something to be desired in this regard. Even though psychology has provided a sound understanding of cognitive biases and heuristics that may short-circuit the reflective process, there is not much work representing efforts to move around

those biases. For example, confirmation bias is the process by which people tend to emphasize and pay closer attention to information that confirms previously held beliefs (reinforcing the schema) and thereby makes it harder to promote truly reflective cognition that allows for restructuring and learning. Motivated reasoning and identity-protective cognition take this type of short-circuit one step further, suggesting that people tend to completely misinterpret information (rather than merely emphasize or ignore it) in a manner that protects cultural identify and cultural values. And yet, this project is the first to my knowledge aiming to suggest how communication strategies might be designed specifically to combat the negative consequences of identity-protective cognition.

In this project, the challenge was to develop communication strategies that promote reflection. As Norman writes, "the trick in teaching is to entice and motivate the students into excitement and interest in the topic, and then to give them the proper tools to reflect."[23] However, in the case of science communication and debunking misinformation, it may not be as simple as engaging with experiential cognition and following up with reflective cognition; it will be an ever-important challenge to make sure the reflection is genuine and not simply identity-protective.

23. Norman, D. (1994). *Things that make us smart: Defending human attributes in the age of the machine.* New York, NY: Basic Books, 30.

In considering that challenge, I discovered a recent paper by Stephan Lewandowsky to be particularly useful. *Misinformation and Its Correction: Continued Influence and Successful Debiasing* represents the most recent developments in the study of misinformation and science controversy. Published just as I began to synthesize the learning from this research phase, Lewandowsky's exploration of the mechanisms by which misinformation is disseminated in society builds on the foundation built by Oreskes and Conway. It also examines misinformation at the level of the individual, reviewing the cognitive psychology of denial and suggesting that understanding cultural cognition may play a large role in challenging misinformation, and concludes with concrete recommendations for debunking misinformation.

These recommendations include the design, structure, and application of information in an order that should theoretically maximize impact, and ideally help practitioners, (who Lewandoskwy identifies as journalists, health professionals, educators, and science communicators), design effective misinformation retractions, educational tools, and campaigns. Though it represents the current edge of research on misinformation and myth debunking and, more importantly, one of the only sources of evidence-based recommendations I have found, it does not offer case studies or examples of said strategies.

When I began this project, I thought perhaps my contribution to the field would be in generating similar types of communication design strategy recommendations, but a thorough examination of the existing literature and relevant work both within and beyond science communication has revealed that what has not yet been accomplished is an execution of these strategies with significant reflection on how well they work with different audiences, and certainly little effort to make these recommendations more actionable by the standards of instructional designers like Wiggins and McTighe.

INITIAL OBSERVATIONS

In addition to an extensive literature review, I distributed a brief online survey that asked respondents to watch a handful of short videos on Youtube.com and rank their preference for each, as well as explain why they liked or disliked each video. The four videos each presented a different message: one pro-vaccination, one anti-vaccination, one encouraging action to curb climate change, and one suggesting climate change is not a problem. They also reprensented a range of styles, from serious and dramatic to humorous and silly. I also included a handful of cultural cognition identification questions, (see Appendix) to determine if differences would be observable in a small sample size.

Immunize: The Vaccine Anthem

Source: Two singing doctors: Dr. Harry & ZDoggMD, (www.*ZDoggMD.com*)
Message: Immunization is good; the risks are small & the benefits are many.
Tone: Humorous parody of a Bruno Mars song; fun & silly.

One More Girl

Source: Two brothers, "motivated to make this documentary when (their) sister experienced serious side-effects after her first injection of the Gardasil vaccine." (*www.onemoregirl.com)*
Message: Gardasil (HPV vaccination) is dangerous and the FDA is not trusthworthy.
Tone: Dramatic, frightening.

Symphony of Science

Source: "melodysheep," (*www.symphonyofscience.com)*
Message: Global climate change is real and the world must take this challenge on together.
Tone: Hopeful, playful music with auto-tuned speeches by Bill Nye and other scientists.

Not Evil Just Wrong

Source: Phelim McAleer & Ann McElhinney, (*www.noteviljustwrong.com)*
Message: The only threat to America is the "flawed science and sky-is-falling rhetoric of Al Gore and his allies in environmental extremism."
Tone: Dramatic, skeptical, critical.

Exploratory survey artifacts

As an exploratory survey, it was intended not to confirm a particular hypothesis, but merely to determine which outcomes predicted by my early insights would be observable. The results from 33 respondents lead to more insights: the survey made it clear that differences in cultural worldview are observable even on a small scale. However, there was not a general majority preference for one particular video, message or tone. However, most of the respondents who liked the serious videos said they found the silly videos trivializing and those who liked the humorous videos said the serious videos were too dramatic.

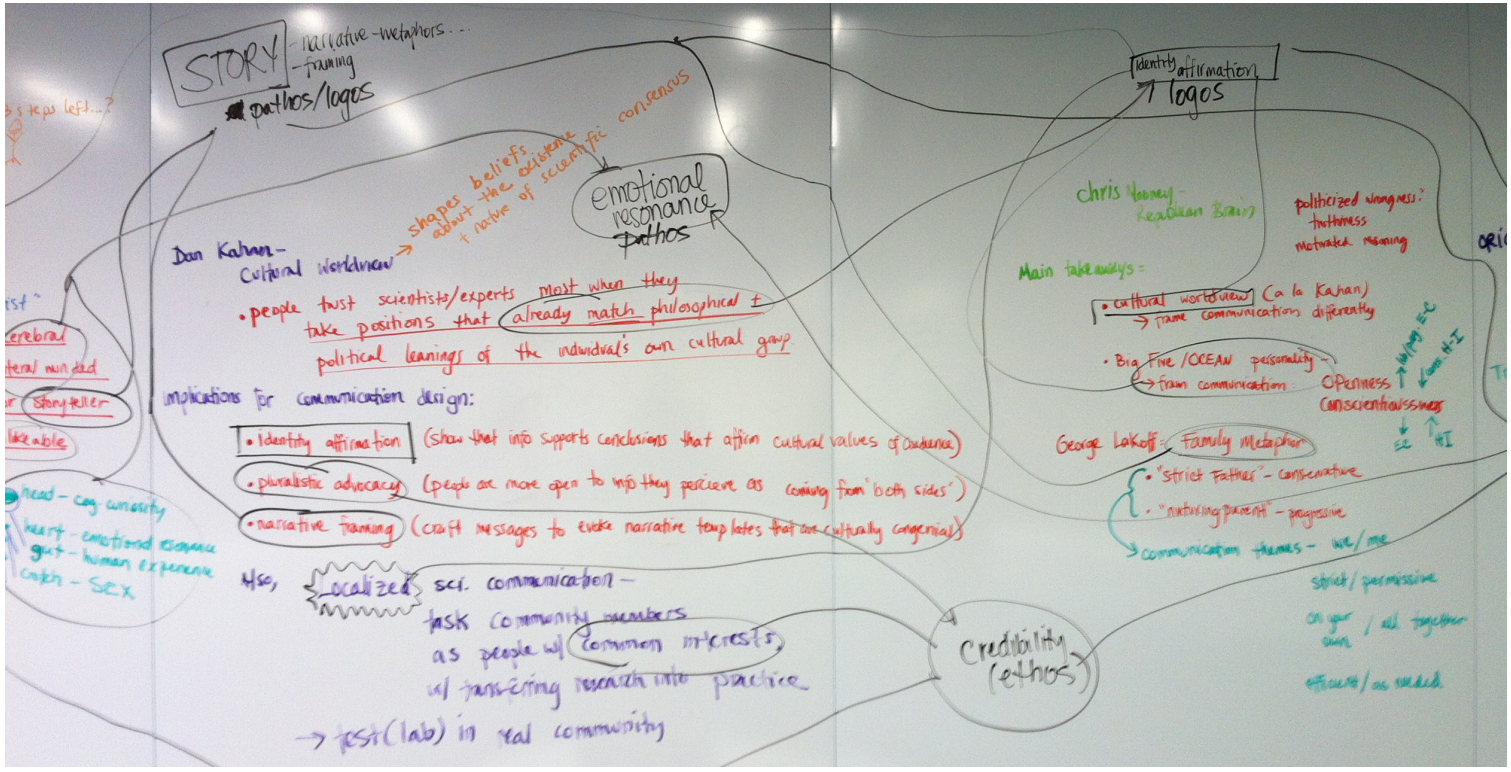
Perhaps most interestingly, I found that the majority of people, when asked *why they **trusted*** the video they selected as most trustworthy, said they trusted a video most **when its message agreed with their own opinions** or feelings on the matter at hand. Relatively few mentioned objectivity, or statistics, or expert, unbiased authority (unless said authorities were again confirming their own previous viewpoint). Respondents were very honest about this reaction, even when they were being asked outright what made something "trustworthy."

My next steps were to distill this research into concrete design implications and synthesize them into a single strategic framework for science communication that could then be applied and evaluated for a particular science topic.

SYNTHESIS

INITIAL FRAMEWORK

As I distilled my research into main ideas, themes began to emerge. I pulled out some of the common threads to find design implications, which clustered around four main ideas: understanding values and identity-protective cognition, affirming those values, telling an emotionally resonant story, and maintaining credibility.



Synthesizing the research

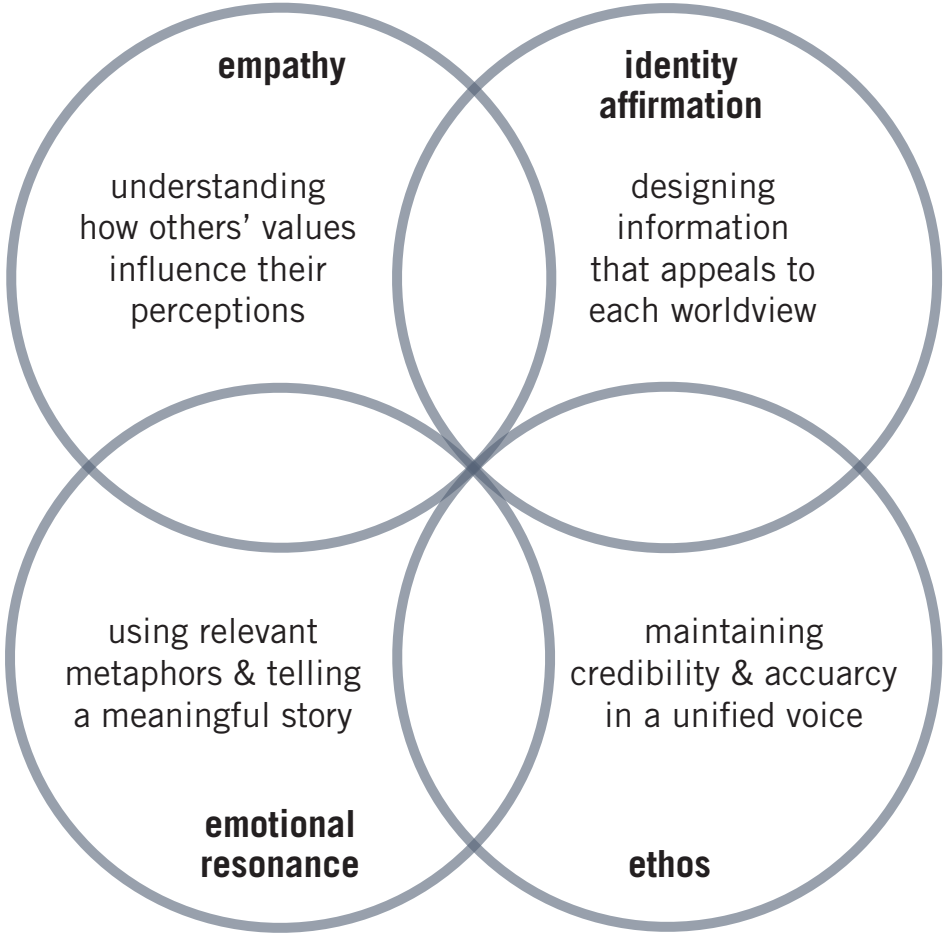
***know* the intended audience, including:**
cultural worldview and values
current beliefs, understanding, and education level
preferences for and familiarity with certain frames and metaphors

***affirm* their values & identity**
highlight infomation that reaches value-affirming conclusions
frame information with appropriate narratives and metaphors

establish *credibility*
sources that are perceived to share one's values are more trusted
sharing more than one perspective to avoid perceptions of bias

make it *resonate*
be compelling: appeal to the head, heart, gut, and crotch
narrative structures (Hero's Journey) are important

These strategies may not be novel in the traditions of classical Aristotelian rhetoric or human centered design, but because these insights emerged from a number of places (philosophically and academically) and are specific to science communication, they are more relevant than simply reading a book about rhetoric or design thinking. They are more meaningful and more practical.



Initial framework: a design strategy for science communication

A DESIGN SOLUTION

SELECTING A TOPIC

In order to apply these insights as a communication design process, I elected to make a case study of one particular science topic. Choosing a single topic for the prototype was difficul, though not for lack of options. In fact, it was hard for the very opposite reason: the list of potential topics for a study on denial, rhetoric, and communication design strategy is disappointingly long.

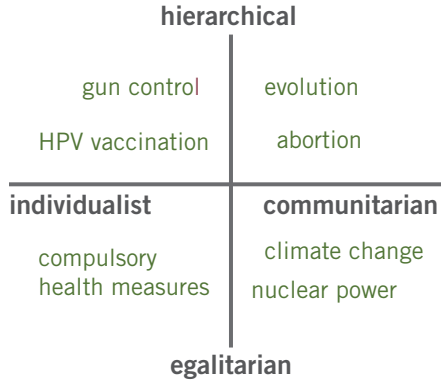
The choice was complicated by findings that suggest different groups of people, (liberals vs. conservatives, hierarchical individualists vs. egalitarian communitarians, etc.), are more likely to trust scientists on some topics, and deny scientific consensus on others, rather than being pro- or anti-science across the board. Science is itself an objectively neutral undertaking, but people tend to trust different scientific perspectives more or less than others based on their own cultural worldviews and personality biases. No matter which topic I selected, I would automatically be looking at a predetermined group of people who were more likely to disagree or deny consensus on that topic, and choosing that particular audience was difficult.

I also considered the implications for each topic in its significance for daily life decisions. For example, many people must take up the question of vaccination at some point in their lives, whether to be vaccinated for certain diseases as adults or to vaccinate their children; fewer people have a personally relevant reason to know the details about evolution, for example. Climate change is obviously a prime choice but it would have required drilling down to a very concrete and narrow slice of the issue that might render its relevance less useful for my research. I therefore selected vaccination for the application of the initial framework.

Topics I considered:

climate change, evolution, vaccination, big bang theory, GMO foods, nuclear power, fracking, nanotechnology

Topics that are commonly perceived to be risks by each worldview:



APPLYING THE FRAMEWORK

I began exploring existing articles, brochures, websites and videos about vaccination, examining the arguments made for and against vaccination by various sources. As a way to understand what already works and what falls short of compelling messaging, I considered 'fact based' pro-vaccine messages like the *Hug Me! I'm Vaccinated* campaign, and Parenting.com's article, "10 Vaccine Myths: Busted," along with alternative messages like *One More Girl,* the anti-vaccine documentary Kickstarter project dedicated to questioning the HPV vaccine, Gardasil. The latter example is certainly quite compelling on an emotional level because it arouses fear. I wondered how one might counter anti-vaccine fears with a similarly compelling, but more accurate, message that maintains its scientific integrity?

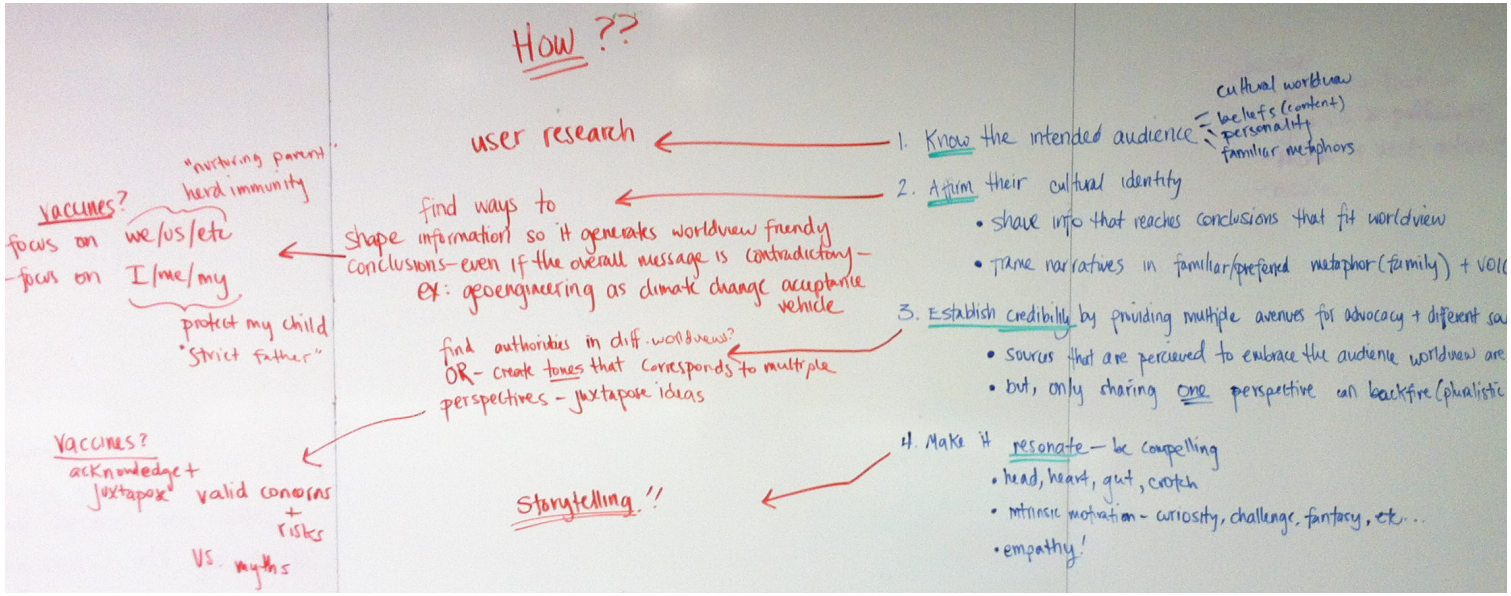
http://hugmeimvaccinated.org

http://www.parenting.com/article/10-vaccine-myths---busted/

http://www.kickstarter.com/projects/1995527181/one-more-girl-documentary

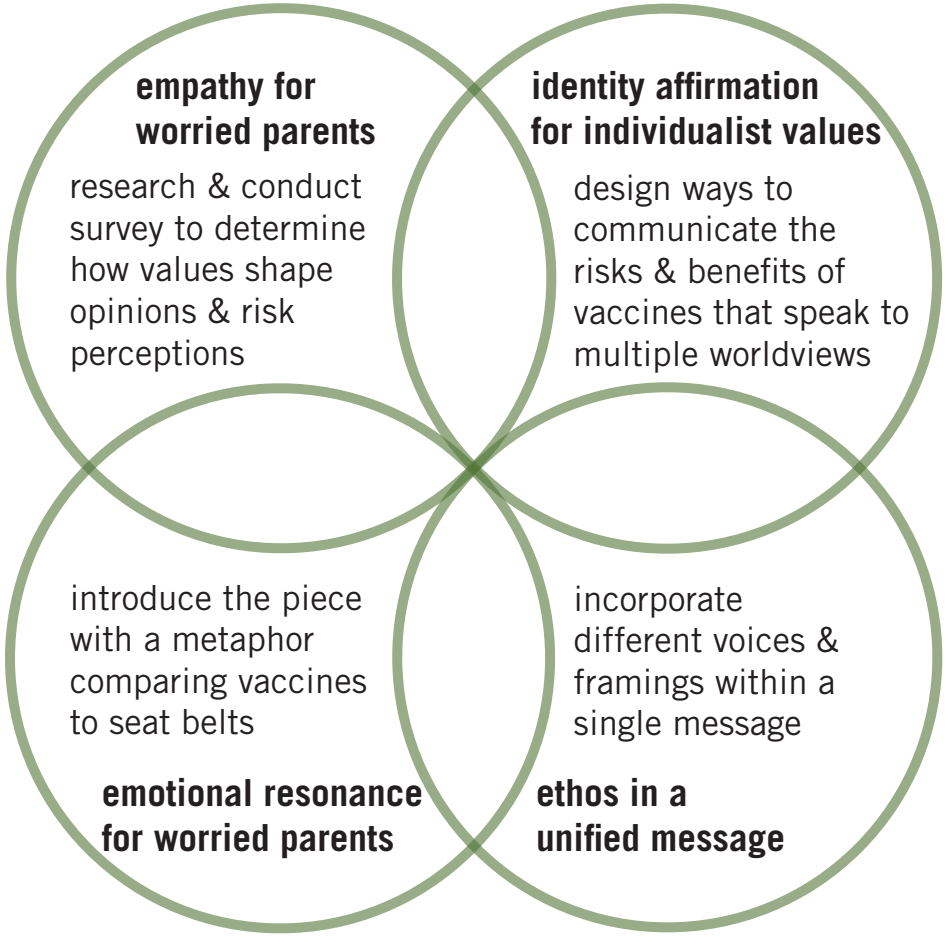
I also explored the history of vaccinations and anti-vaccination movements, the science of immunity, and the modern causes for both praise and concern, warranted and absurd, that vaccination represents. I decided to create an informational piece about the risks and benefits of childhood vaccination and share that artifact with an audience to determine whether it had any effect on attitudes toward vaccination or trust in scientific consensus.

I experimented with different combinations and structures for said information, trying out linear, interactive, and choose-your-own-adventure style paradigms for a viewer's path through the information to determine what an audience would find most appealing and still make sense, logically.



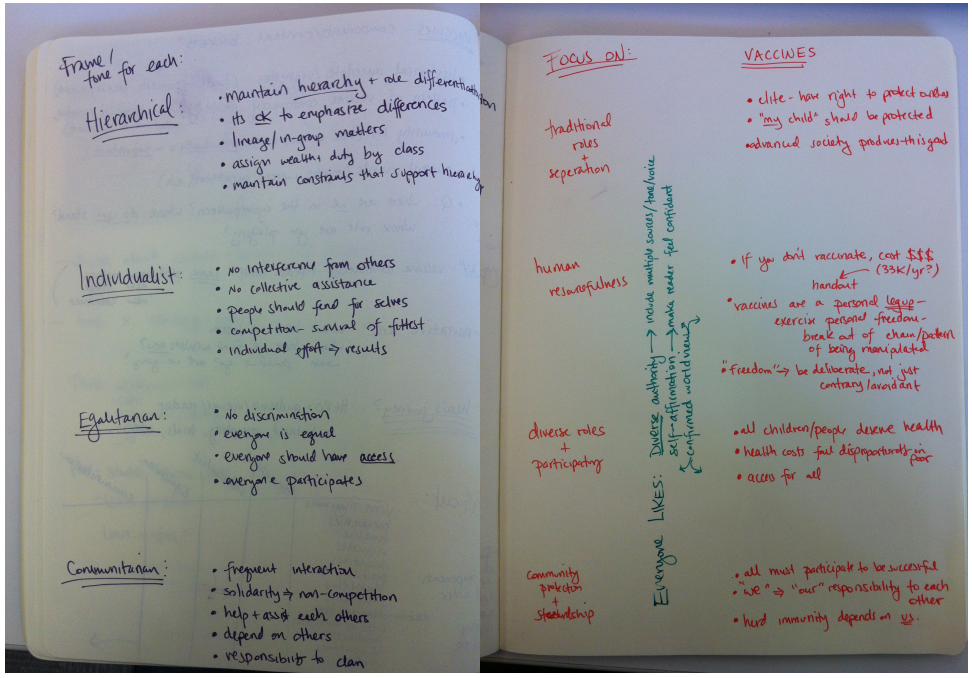
As I worked toward a final structure that supported both the educational and persuasive goals for the piece, I also experimented with different framing strategies that appealed to audiences with different cultural worldviews, to determine whether this affirmation of cultural identity would be a central strategy in my science communication framework.

Applying the initial framework, a communication artifact began to take shape:



The initial framework, applied to vaccination communication

As this process evolved, I imagined all the ways a science communicator could frame the facts about vaccination in order to resonate specifically with different cultural worldviews and speak to different types of concerns. A lot of the messaging we currently see about vaccination focuses on social responsibility and herd immunity, (itself a loaded term if for no other reason than the poorly chosen word *herd*), which may strike a discordant note with hierarchical-individualists who resent the idea of group dependence, while it may galvanize egalitarian-communitarians who resonate with a "we're in this together" message. So how might we craft a message about vaccines that makes vaccination seem like the ultimate expression of patriotic, personal freedom? For example, I characterized some of the arguments for vaccination in terms of personal defense, armor if you will, in a battle to stay healthy.



Framing vaccination information for each worldview

Mapping ways to frame information for different values

I also encountered the question: **should I include all the possible metaphors and framing contexts in one artifact, or create multiple versions that somehow self-select depending on the audience?** The latter makes more sense for testing out audience effects, but the former is a far more realistic implication for future science communication strategies. Two considerations drove my decision:

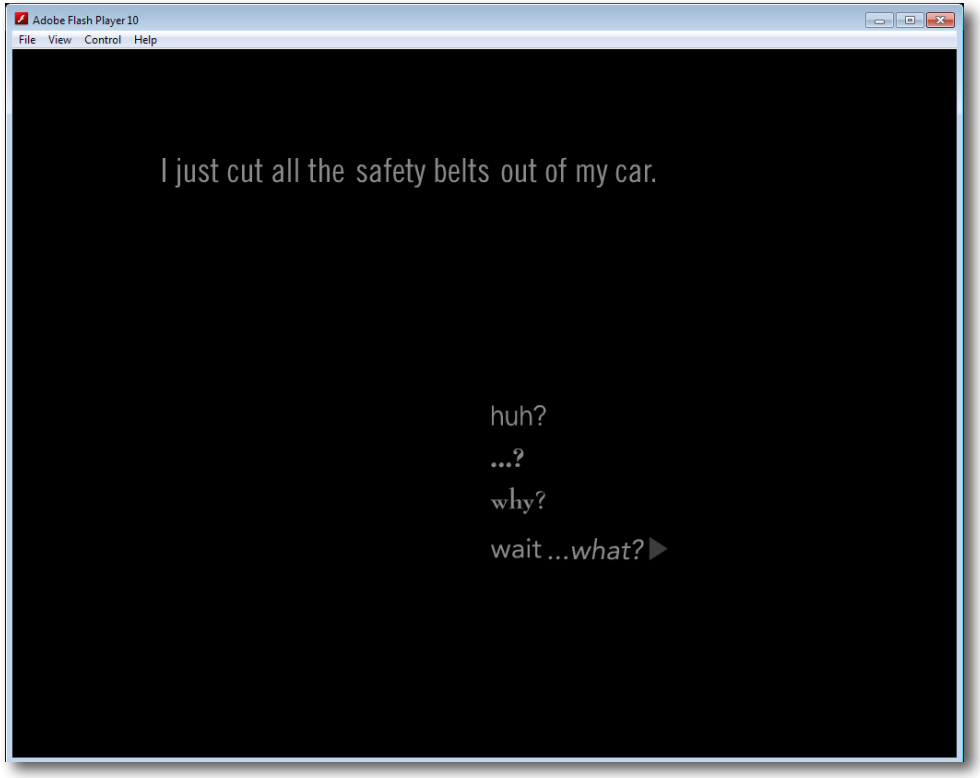
1. A single unified piece is more feasible if I'm going to suggest these strategies for others to use. Most individuals and even organizations won't have the resources to conduct targeted demographic marketing.

2. Even if said organizations did have the ability to create and target multiple communication pieces, that kind of strategy would be duplicitous and certainly prove problematic for reputation and credibility. The scientific community's job is to tell the truth about what they have learned, not to sell specific ideas. It is therefore important to draw a very stark contrast between spinning or marketing or advertising, which I would avoid at all costs, and simply framing the same information (with all necessary scientific integrity and accuracy) by using different metaphors and weaving various narratives around it.

Obviously, it's a challenge to frame information differently for varied audiences within a single piece, but I did it in this case by presenting information through distinct 'voices' (implied by different typefaces) in a conversation dialogue, and then providing a diverse range of arguments for vaccination through subtle language cues.

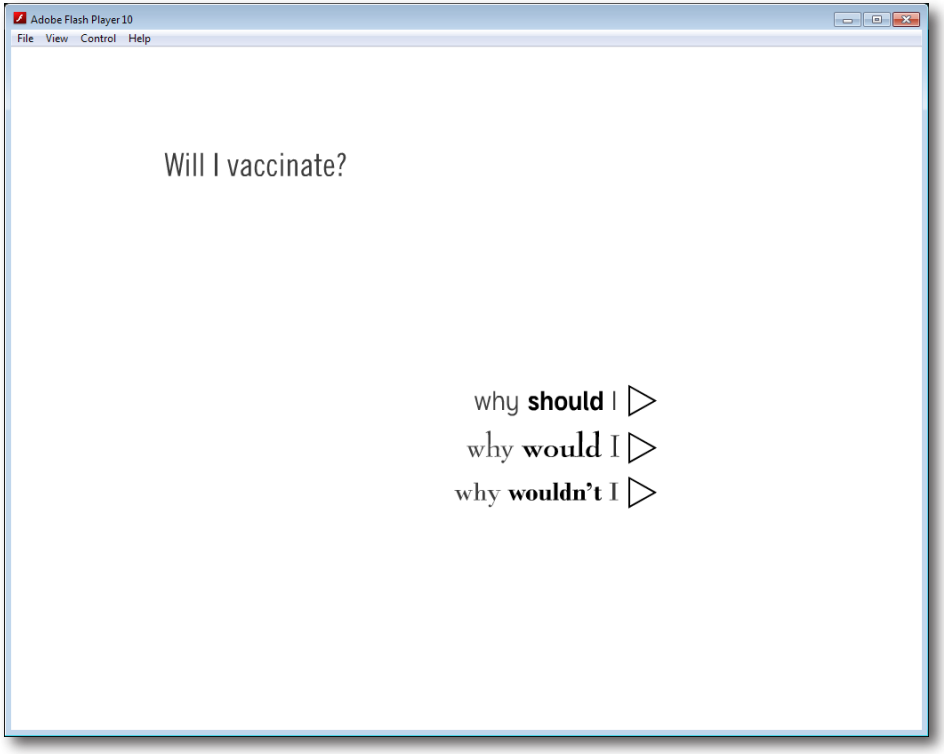
THE PROTOTYPE

I decided to unify the different types of vaccination information framing into one piece, through a single metaphor: seat belts. This comparison provided an opportunity to highlight both the benefits and risks of vaccination just as seat belts offer similar benefits and risks to wearers. The prototype, an interactive informational piece about the benefits and risks of vaccination, opens with a conversation taking place between several voices (represented by different type on screen) about the choice to use seat belts.



See Appendix A

Transitioning to an identical conversation about whether to vaccinate a child, the piece then offers some historical context for anti-vaccination movements and their influence on public health, and concludes with a segment where viewers can see several different arguments for vaccination framed differently for different values and concerns.



See Appendix A

The **"why should I"** arguments included information framed in a way that I thought would be most compelling for those with communitarian (and to an extent, egalitarian) values. They focused on community responsibility and interdependence, highlighting herd immunity and protection for the vulnerable.

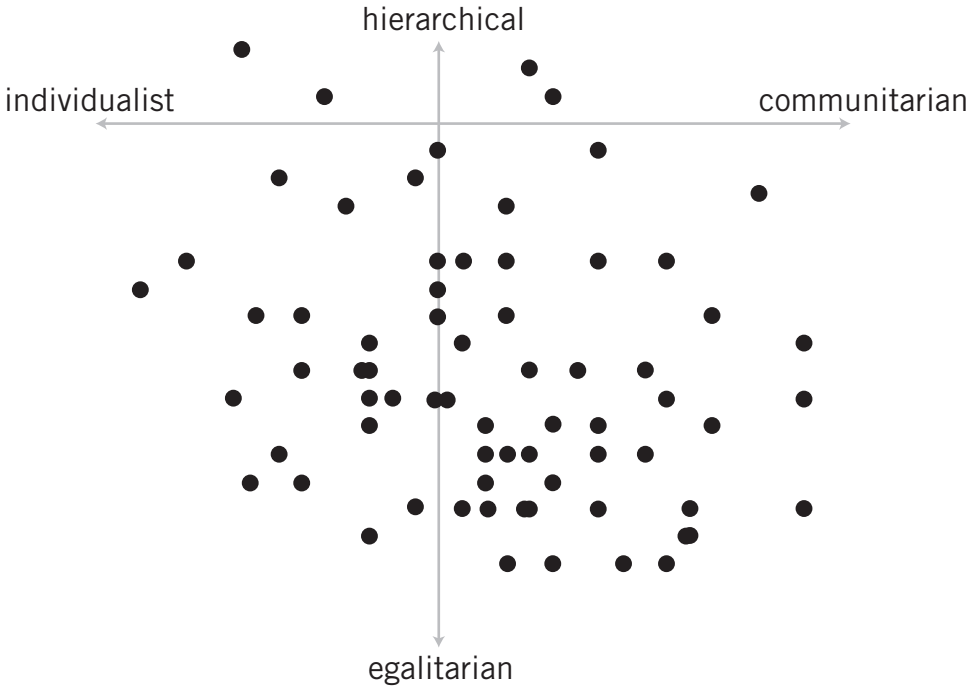
The **"why would I"** arguments included information framed in a way that I thought would be most compelling for those with individualist values. They focused on the benefits to the individual and followed a "me against the world" theme through comparisons to training and protection. They highlighted self-protection.

The **"why wouldn't I"** arguments included information that I didn't frame for a particular worldview; instead I hypothesized that this information would be fairly neutral in its attempts to debunk some commonly held myths about vaccination. I used plain, straightforward language, statistics, and a neutral tone.

The piece concluded with an assertion that vaccination is ultimately a **choice**, and this point was meant to appeal to those with an individualist worldview. People with these values are most concerned with personal freedom from mandates and least often addressed by public health messages.

EVALUATION

In order to assess whether different styles of argument and information framing would appeal to certain cultural worldviews more than others, I shared this prototype with a wide sample of adults. The accompanying survey garnered 70 complete responses and assessed respondents' demographic information as well as their cultural worldview (see Appendix B). Respondents indicated the extent of their "disagreement" or "agreement" for a number of attitude statemtents in order to place each respondent on a map at the intersection of two scales.



Respondents' cultural worldviews plotted along the cultural cognition scales

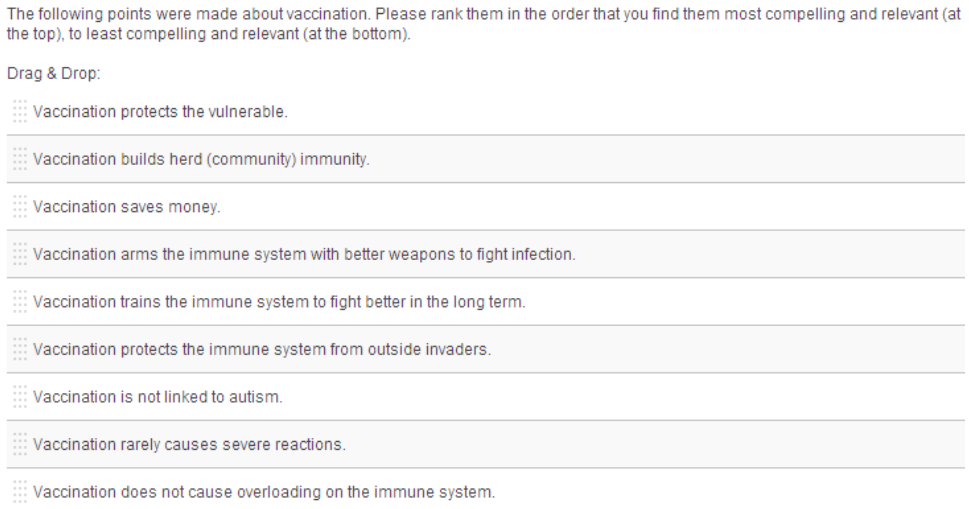
Each respondent then answered a handful of questions to assess factual knowledge about vaccination as well as personal attitudes toward vaccination. After viewing the informational piece that I created according to the initial communication framework, the respondents were asked the same questions about attitudes (to determine if the piece had any effect on their opinions) as well as prompted to share what they found most and least appealing about the informational piece as a whole. Respondents were also asked to identify which arguments for vaccination were most appealing or resonant to them.

In assessing attitudes, I asked the same six questions before and after respondents viewed the vaccination piece to assess its effect, if any, on viewers.

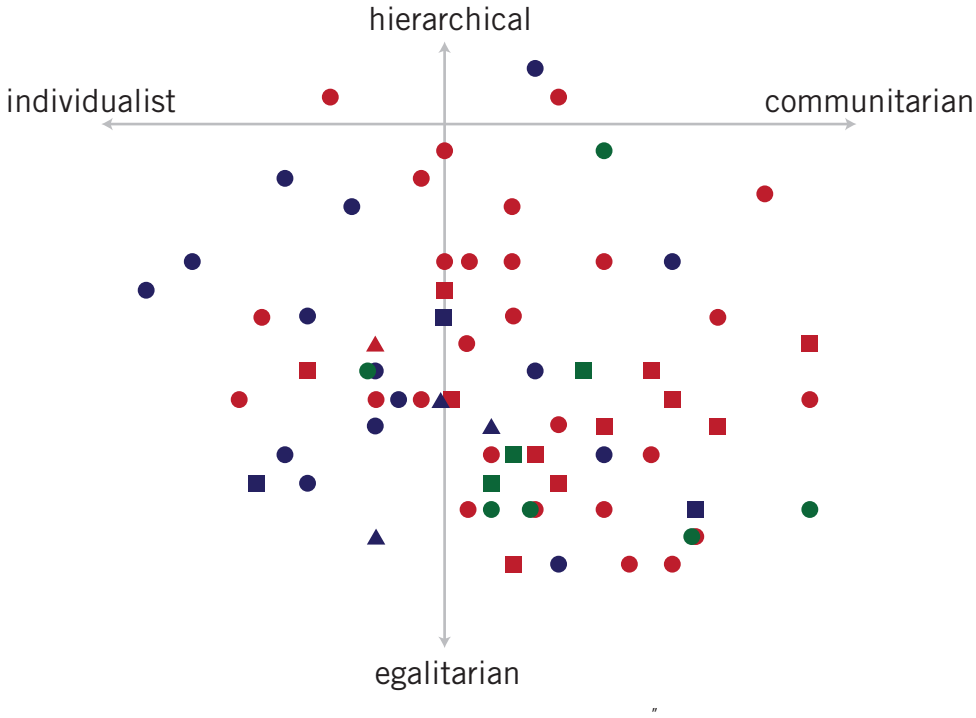
Before viewing the piece, the average attitude toward vaccines was overall slightly positive. Respondents with more individualist values tended to feel less positive toward vaccines, while those with communitarian values were a little more positive; however, all fell within a range that wasn't statistically significant. There was not a statistically significant correlation between the change in responses and cultural worldview either. That is, people were predisposed to feel a certain way about vaccines, and while that attitude may have changed slightly after viewing the piece, the extent of that change itself was not tied to any worldview: individualists and communitarians alike tended to adjust their attitudes by roughly the same amount. Scored as a sum of the six questions, the average score before viewing the piece was +6.9 and after viewing was +7.4.

Generally, with a change this small, I would not assume the informational piece had any effect on vaccine attitudes; however, the overall positive trend (however small) does suggest that the piece wasn not detrimental or polarizing, which is a good thing.

As for the preference for individual arguments, results were more conclusive. The vaccination piece included a handful of arguments for vaccination that were framed for different worldviews. At the end the survey, respondents were asked to identify which of the arguments they found most appealing or resonant.



My aim was to determine if the arguments framed around individual protection would appeal more to individualist respondents, and if the community responsibility arguments would appeal to the communitarian respondents, as an assessment of the strategies in my initial communication framework.



Which argument for vaccination appeals most to you?

Why Should I? (communitarian)
- protect the vulnerable
- herd/community immunity
- saves money

Why Would I? (individualist)
- arming the immune system
- training the immune system
- protection from invaders

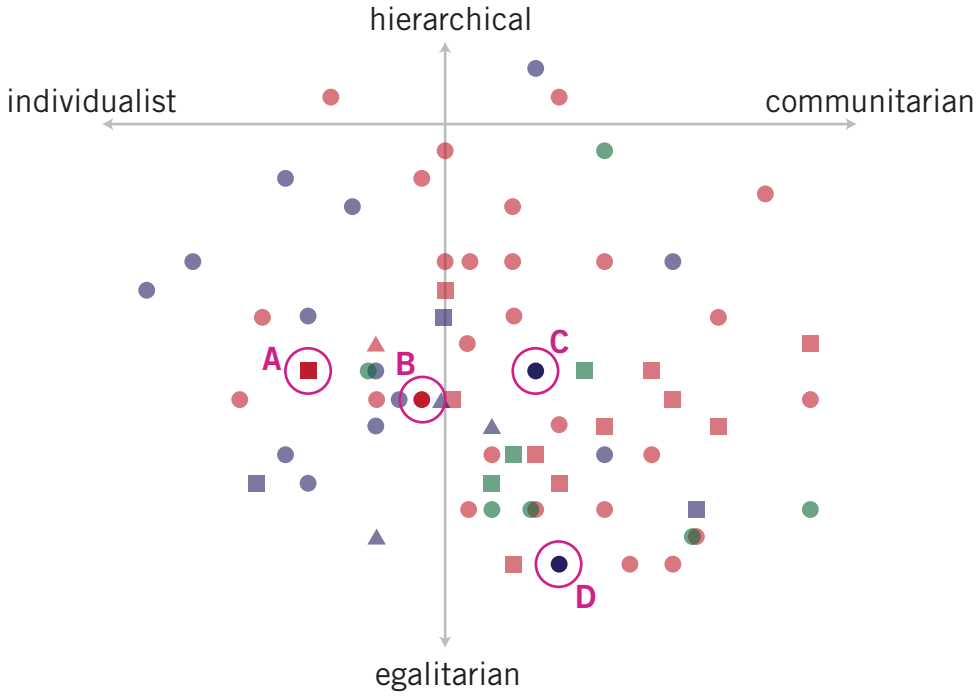
Why Wouldn't I? (neutral)
- no autism link
- severe reactions are rare

Respondents' preferred arguments: The "Why Should I?" arguments were generally more popular with communitarian worldviews and "Why Would I?" arguments with individualist wordlviews.

In the diagram, each point represents a response, plotted in the grid according the respondent's worldview. If the arguments that I designed to appeal to individualists had in fact appealed to individualists (and vice versa), I might have expected to see very distinct preferences, with those choices separated along the spectrum. However, that was not the case; there was certainly a good amount of variability in the preference for different arguments. In hindsight, if the results really had skewed predictably so the individualist arguments were favored only by individualists and communitarian arguments by communitarians, it would have been a bit disconcerting; people are certainly not that one dimensional.

What's more, these results were a little more interesting (and I believe, encouraging) because they suggested the potential for people with different cultural worldviews to find the same sort of messages compelling (even if for different reasons, which I explored next). The results did illustrate a little bit of a trend, however. The individualist arguments were slightly more popular toward the individualist end of the scale, and vice versa.

I was most curious about all the people who scored as individualists but claimed to prefer a communitarian argument, as well as the communitarians who preferred what I thought were individualist arguments.



Outliers I chose to explore in depth: A, B, C, D

What's going on there? Did it suggest that I, as a designer trying my hand at a new communication strategy, simply did a bad job of framing information specifically for what I thought were communitarian and individualist arguments? Or was some of the underlying theory, based on so much social science, flawed in its application to this kind of communication design?

Or, perhaps these outlier respondents preferred arguments I didn't expect them to choose, but for reasons I **would** expect. To determine if this hypothesis was realistic, I asked respondents to identify which parts of the vaccination piece appealed or resonated most with them, and why, as well as the reverse, (which parts appealed to them least). Consider the following responses:

Respondent A, who scored on the individualist end of the spectrum, claimed the arguments about herd immunity and community responsibility were most appealing, but in the open ended response, also stated:

"The issues here seem to be about overall societal importance; I see this as an individual choice but it also made me think about the overall effect on society."

Perhaps this respondent is saying, as an individualist, the individualist arguments may resonate more but the communitarian arguments actually achieved some level of convincing beyond his or her current views. The *I never thought about it that way before* sentiment is echoed throughout the text responses at a significant level, and it may explain some of the 'unexpected' points on the graph.

Take respondent B, who also scored as an individualist. This person also identified a communitarian argument as the most resonant, and in the open ended section described the most appealing part of the whole piece as being prompted to:

"reflect on my views on society's good vs. individual freedom"

And to explain why, explained:

"It forced me to take the greatest time to consider my answers. I spend quite a deal of time trying to develop and revise my own personal, internally-consistent political philosophy."

Similarly, respondent C, a communitarian who chose an individualist argument, said this:

"vaccination is a safe procedure and the outcome benefits us all, as individuals and as members of society"

and

"Clearly, to get vaccinated is an individual responsibility, but not in every case- sometimes you pay a high price, or things make them unavailable to a great portion of the society, government should be responsible for making the vaccination process available to all the population."

This type of response suggests that this person does, indeed, share communitarian values and sees vaccination as a community responsibility, but perhaps found the argument about arming one's immune system with weapons to fight disease as a good case to make to a government whose job it is to defend its citizens.

Respondent D, also a communitarian who chose the argument about arming one's immune system, wrote:

"Good points that I liked: societal obligation vs. individual choice, allocation of risk and which to minimize i.e. getting vaccinated creates a tiny risk for my child but significantly reduces societal risk whereas without vaccines I PERCEIVE to have all risk eliminated for my child but society may take on greater risk..."

These examples illustrate what I've learned: individualists do seem to prefer the arguments I expected to be compelling for individualists, and communitarians do seem to prefer the arguments I expected to be compelling for communitarians, but that effect is not dramatic. Perhaps more importantly, there is evidence to suggest that two people with different values may find the same message appealing, but for different reasons- and those reasons are consistent with their values. Individualists like respondents A and B may have found the information framed for communitarian values appealing, but both expressed their reasoning through language consistent with individualist values, and the same is true for C and D for communitarian values.

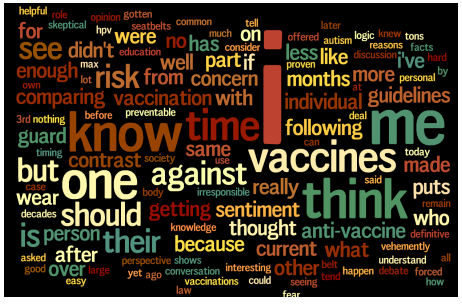
Of course, this may not be the case for every single respondent (and likely isn't), but my analysis of the open text responses supports this general interpretation. What's more, it's encouraging to see that a science communicator can look for ways to frame information with a few carefully crafted metaphors and creativity in voice and narrative, and expect to reach audiences with different values who may find overlapping arguments resonant, even if they do so for different reasons. At this point, the major take away was that it's more important to avoid alienating a particular audience than it is to meticulously engineer a message for a specific cultural worldview, which may be where this particular piece about vaccines was most successful. As I continued to consider how I could put this knowledge in the hands of science communicators, it was reassuring to think that a solid understanding of cultural cognition and a willingness to include all four ends of the value scales may be all it takes to get some ideas through the psychological door of otherwise resistant audiences.

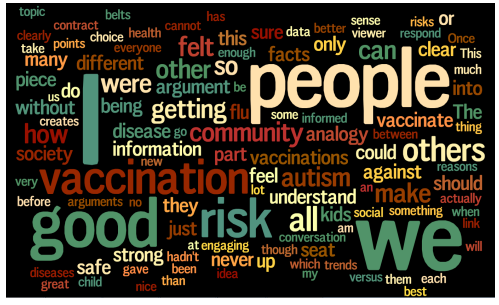
Finally, I explored the open text responses for common themes. I analyzed the text for the most common examples cited as "most appealing" and "least appealing." Most respondents elaborated on what they found most compelling and resonant, but several did not answer the same question about "least appealing," or did so with little elaboration, so there are fewer responses for the negative aspects of the vaccination piece.

The most common items cited as "most appealing" were:

providing multiple viewpoints (25 mentions)
the seat-belt metaphor (12 mentions)
the timeline depicting anti-vaccination movements (7 mentions)
the old anti-vaccination propaganda and painting (6 mentions)
presenting facts and statistics (6 mentions)
the conversational tone (5 mentions)
the interactivity (5 mentions)

Visualized, the open text responses also suggest some subtle differences in interpretation between individualist and communitarian worldviews.





Individualist respondents *Communitarian respondents*

Size represents the frequency of use; color is decorative only. Notice ***me*** *vs.* ***we.***

Even as individualist and communitarian values lead to entirely different concerns about the same subject matter, the most compelling implication from the open text responses was by far the expression of potential for making someone see a subject in new light. The positive responses to including multiple viewpoints and the willingless of outliers like Respondents A, B, C, and D to consider alternative interpretations speak to the power of presenting information in multiple forms or from multiple perspectives: ultimately helping someone experience that *I never thought of it that way before* moment.

Consider the following quotes. Each of the following comes from different respondents who scored as **communitarian:**

On the concept of vaccination as a right,
I had never thought about them that way

On the concept of vaccinating children as an individual choice to avoid risk,
I have never really thought about it in that light

On the myth of an autism-vaccine link,
I hadn't paid much attention to the autism debate, it was satisfying to have a clear answer

On the risk that comes from others who may chose not to vaccinate,
I hadn't considered that aspect before as much as the others

On the seat-belt metaphor,
it made me stop and think about tradeoffs between different types of risk on a problem I didn't already have a sensitivity on

And, each of these from different respondents who scored as **individualist:**

On the seat belt metaphor,
it made me think more about what the government's role in vaccination could/ should be

On the timeline depicting past anti-vaccination sentiment
it was the one part of the entire presentation I never thought about before
I never thought people had the same fears decades ago

On the concept of vaccination as a responsibility
it made me stop and think about it in a new way

All in all, the results from this particular case study were encouraging. While I initially expected to see a more drastic split in the types of arguments that resonated at each end of the cultural worldview spectrum, hindsight suggests that would have been a disappointing result and would have implied the need to carefully integrate distinct narratives and metaphors any time we might wish to communicate with large and varied audiences.

Thankfully, the evaluation of this communication piece suggested that it may not be necessary, or even ideal, to frame information uniquely for each cultural worldview, but instead just to prioritize the inclusion of multiple perspectives and avoidance of polarizing language. This implication aligns perfectly with the significance of pluralistic advocacy in my design strategy. Providing multiple perspectives that affirm the values of each cultural worldview provides opportunities for individuals to align with the messages that resonate most, regardless of whether it is due to those messages' affirmation of cultural identity, or because they provide an opportunity for welcome reflection and adjustment of views on a subject they had previously only considered in a different light.

At the same time I was applying the initial framework to the vaccination piece, I was also sharing my progress and research insights with other designers, social scientists, researchers and writers through my blog, as well as at design conferences and even in the audition process for Carnegie Mellon's TEDxCMU event. Through many informal conversations about my findings, I received a lot of valuable feedback and began to observe patterns in people's reactions to learning about motivated reasoning and identity-protective cognition, especially in the context of science communication. One of the most common sentiments I encountered was a sense of wonder, often about one's own values and how they have in the past influenced interpretation and communication style. It became apparent that simply teaching science communicators about identity-protective cognition and rhetorical strategies, and encouraging them to reflect on their own worldview, constitutes a critical first step toward improving science communication.

A DESIGN STRATEGY

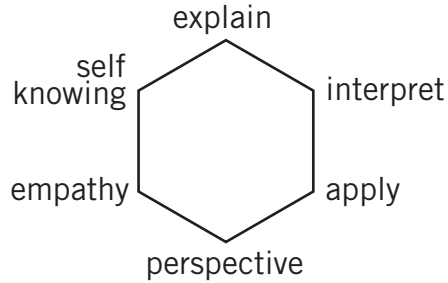
REFINING THE FRAMEWORK

Informed by these observations and the results of the vaccination case study, I updated the initial framework to include the critical self-reflection component as well as more refined concepts of ethos and identify affirmation.

The framework offers a set of strategies that together provide the foundation for more compelling communication. Only after I arrived at this more refined version did I begin to see stronger parallels with the writing of Wiggins and McTighe; they describe six facets of understanding that educators should look for as evidence of learning and achievement of desirable outcomes. These six facets include the ability to **explain, interpret, apply, gain perspective, empathize,** and **possess self-knowledge** about a given topic.

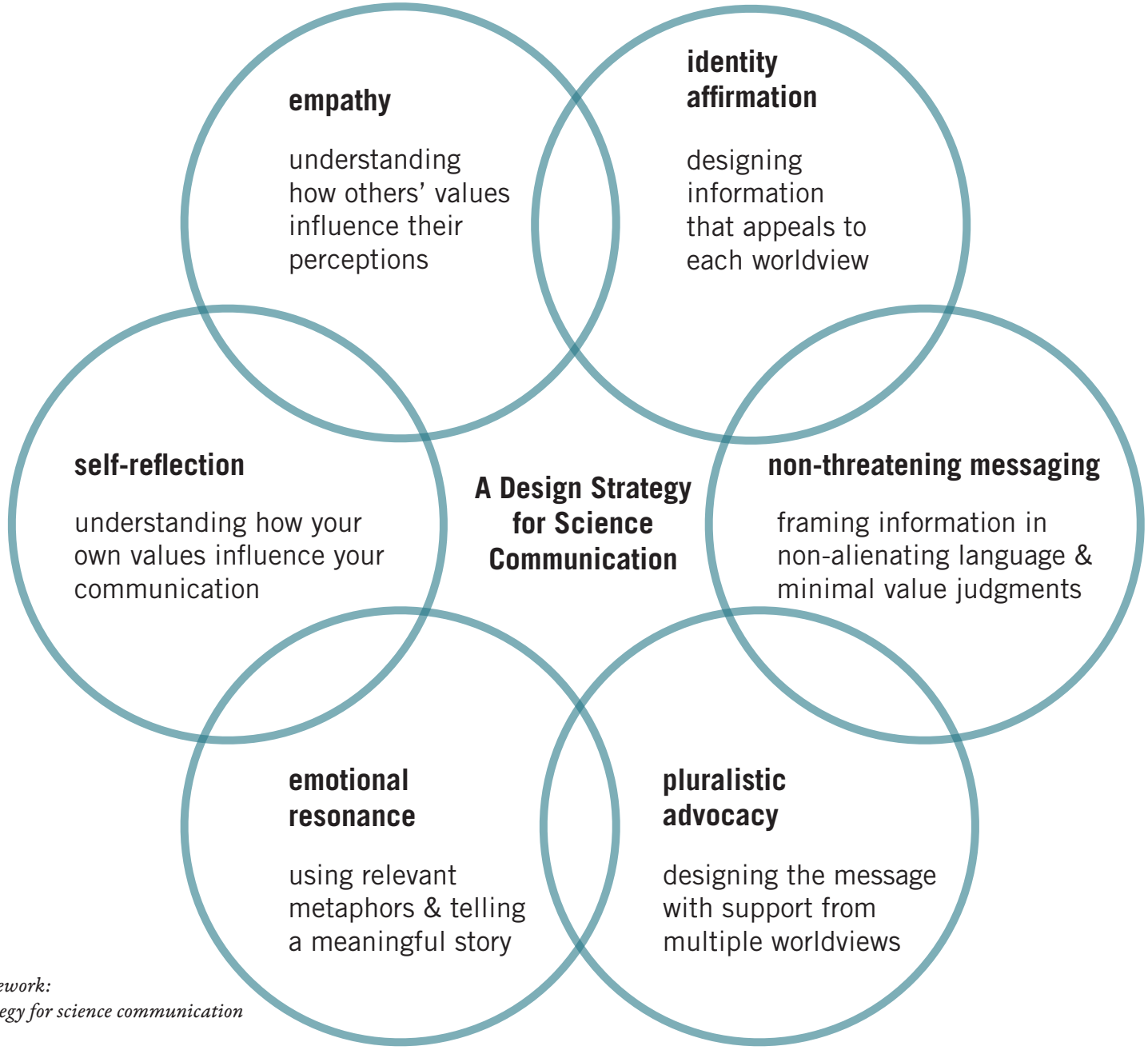
See Wiggins, G., & McTighe, J. (2006). *Understanding by design.* Upper Saddle Ridge, NJ: Pearson Merrill Prentice Hall.

Six Facets of Understanding



While these concepts don't align perfectly with the framework I've developed, there is certainly a significant overlap when viewed through the lens of educational theory. Similarly, through a rhetorical lens, the six components of this framework can be resolved into the familiar appeals: **pathos**, **logos**, and **ethos**, in a modern context.

Of course, one major consideration in developing this framework has been to consider its intended audience; working with and understanding the needs of science communicators has brought me to the realization that scientists will find the language of other scientists most compelling and most resonant, far more than an identical treatment with the vocabulary of educational theory or a lesson on rhetorical concepts like common tropes and stasis theory. Designing this framework specifically for its audience and deliberately using social science as a foundation for its application was an important part of my thesis project direction.



Refined framework:
a design strategy for science communication

The next step was to bring this perspective forward into the development of design tools that would be useful for science communicators who could put these strategies to work in the world.

DESIGNING A DESIGN TOOL

Mid-way through this project, I met the founders of *Public Communication for Researchers*, a campus group of graduate students, professors, journalists and science communicators at Carnegie Mellon University who want to enhance the conversation between the science community and the general public by training future scientists to be better communicators. They became very interested in my thesis work, and I became very interested in working with scientists who find themselves in a position to make use of the very strategies I hadbeen designing.

I turned my focus to the question of how best to make my findings useful for science communicators themselves: *Should I produce a booklet of tips and techniques? A style guide? A workshop, a curriculum, a webinar, a presentation?* After sharing a presentation on my thesis work with PCR, I realized they would be a valuable group to work with as I developed a communication tool based on my framework, because they are themselves interested in not only better communication strategies, but teaching these strategies to others.

I began thinking about the strategies in my science communication framework, and my experience applying them to the vaccination piece, and I asked myself what others would need to know if they were to apply the same process I did. I explored different methods I might use to share design principles with designers and non-designers alike, and before long, I found myself designing a tool kit that could help people apply the understanding I gained over nine months to their own communication design practice.

As I explored similar design tools, including the IDEO *Method Cards*, Frog's *Collective Action Toolkit*, the *Design with Intent Toolkit*, I compared their strengths, weaknesses, and intentions. In addition to these, I also thought considered Brian Eno's *Oblique Strategies*, LUMA Institute's *Innovating for People Planning Cards*, a set of psychology tidbits for UX designers called *Mental Notes*, *The Decision Book*, and the *Activity Deck* that accompanies Jonah Sachs' book, *Winning the Story Wars*.

Some of these tools are essentially a deck full of **somethings**. The LUMA and IDEO cards are a collection of techniques and methods that people can try in the practice of human-centered design. Similarly, the *Mental Notes* and *Oblique Strategies* cards are a collection of things to think about. *Mental Notes* is a set of psychology principles, and the user is prompted to reflect on a randomly drawn card might inspire their work. The *Oblique Strategies* set is a little more esoteric; it wasn't created specifically for designers and I think that makes it a little more interesting, if a little less practical in its usefulness as a collection of non-sequiturs. Meanwhile, *The Decision Book* is a collection of models, mostly visualized through diagrams and illustrations, for strategic decision making. Even though it's not a card set, it functions similarly.

The *Story Wars Activity Deck* is a little different. Because it accompanies a book, it is less a stand-alone tool than the others, but also more prescriptive. It consists of three activities and the accompanying Values and Archetypes cards help users brainstorm and apply the ideas Sachs discusses in the book. This card set caught my attention because it functions not as a collection of **somethings**, but instead as a proxy for a teacher or mentor. It's a set of **exercises**.

I wondered how I might combine the strengths of these different styles of toolkit to produce something useful, usable, and desirable for science communicators. A structure like the exercises in the *Story Wars* deck would be very useful, but without the luxury of an accompanying book, I'd need to find a way to include the content itself within the set. The other decks that function more as

a collection of individual concepts offer the ability to be drawn at random, to provide inspiration or prompt reflection, where the *Story Wars* cards cannot. How might I combine these and tweak them a bit to fit the goals for my design process? I decided to incorporate five types of information:

The actual content. The information about cultural cognition, values, and other principles a person would need to understand in order to use the toolkit.

The strategies. The key ideas that I have crystallized into a design process for science communicators.

Exercises. The techniques people can try, using this tool, to develop skills that make use of the information they now have.

Context. The background info, a few key studies, anything that helps to flesh out the communication design process.

Supplementals. To make exercises possible, I needed to include extra materials that would be used with those exercises.

Essentially, these categories boil down to:

***What** do I need to know?*
***Why** do I need to know this information?*
***How** do I use this information?*
***When** & **where** should I use use it?*

Design Tools explored:

IDEO Method Cards
http://www.ideo.com/by-ideo/method-cards

Frog Collective Action Toolkit
http://www.frogdesign.com/collective-action-toolkit

Design With Intent Toolkit
http://www.danlockton.com/dwi/Main_Page

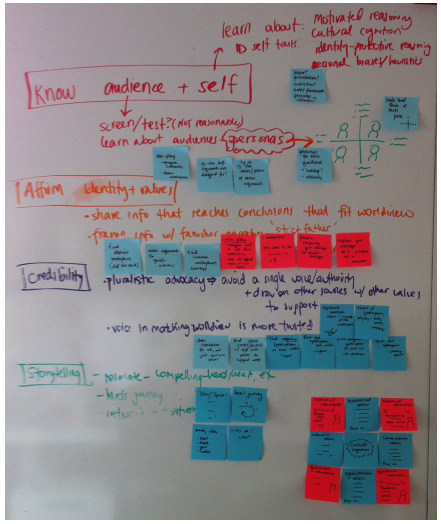
Oblique Strategies
http://www.rtqe.net/ObliqueStrategies/

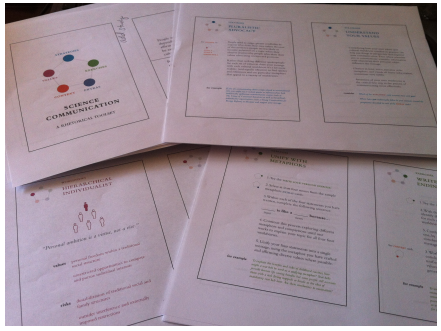
LUMA Institute Planning Cards
http://www.luma-institute.com/innovatingforpeople

Mental Notes
http://getmentalnotes.com/

The Decision Book:
50 Models for Strategic Thinking
by Mikael Krogerus & Roman Tschäppeler

Story Wars Activity Cards
http://freerange.com/store





Designing the toolkit

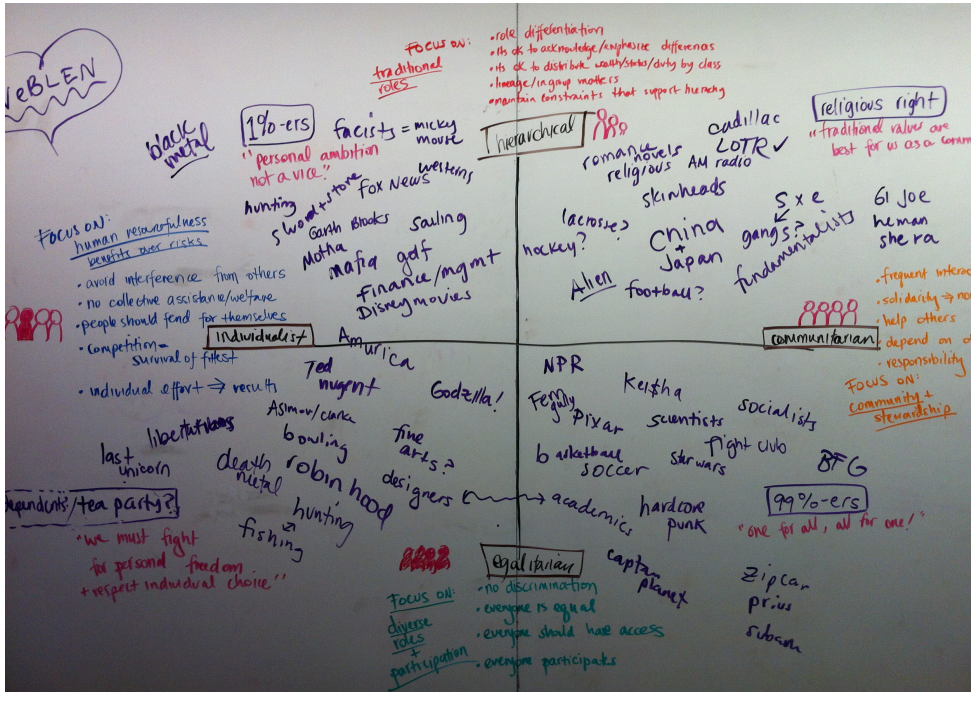
So I designed just such a tool, and was offered the opportunity to prototype the card set as part of a workshop that I conducted with PCR. This gave me the opportunity to produce paper prototypes and solicit feedback from participants to evaluate the initial design and its potential usefulness.

One of the more difficult parts of the card design process was developing a personified conception of the cultural cognition grid. It was easy enough to describe values and attitudes, but to develop personas for each of the four quadrants would be far more useful to scientists by helping them concretely imagine their audience. I contacted Dan Kahan and others involved with the Cultural Cognition Project at Yale and found that, across the board, the social scientists who study identity-protective cognition were hesitant to provide stereotypical qualities, and for very good reason. Cultural cognition is not a typology, it's a mechanism. People don't fall neatly into the four 'quadrants' like four neatly defined personality types; they hold values and develop worldviews that shape how people interpret information and make decisions.

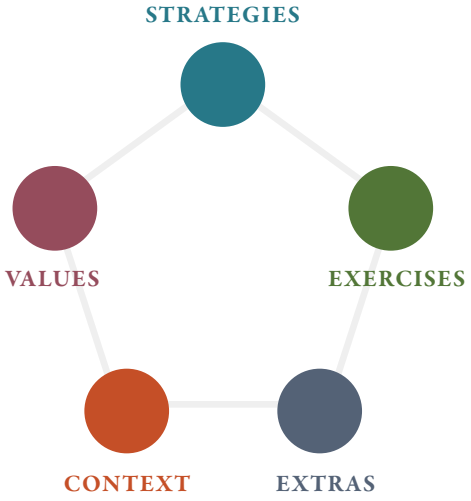
That said, I decided to push forward, even where it meant venturing into the overly simplified, unrealistic, or absurd, as part of a deliberate design practice. To contrast with the social scientists' hesitations, I also asked a handful of designers who have become, (through my own educational efforts), familiar with cultural cognition and motivated reasoning, to personify the four ends of the cultural cognition value scales. Perhaps predictably, they pushed archetypes into stereotypes, and then pushed those stereotypes as far as they could go, into the land of the almost uselessly absurd, (all the while acknowledging that none of these stereotypes are realistic in their simplicity).

During these design exercises, I prompted people to consider what kind of car a hierarchical-individualist would drive, or who their favorite Disney princess would be. Sometimes creating a very, very low resolution picture of an abstract concept like cultural cognition is the only way to develop a mental picture at all; designers can always fill in the fine grain details moving forward. This process also helps people who are trying to understand something for the first time see distinct boundaries, even if those boundaries are not truly distinct (or even real) on closer inspection.

I used the personas generated in these exercises to develop a concrete set of values cards that would constitute the content of the design tool, and then continued the design process to create five categories for the card set, with examples, quotes, and cross references.



Personifying the four quadrants of the cultural cognition scales

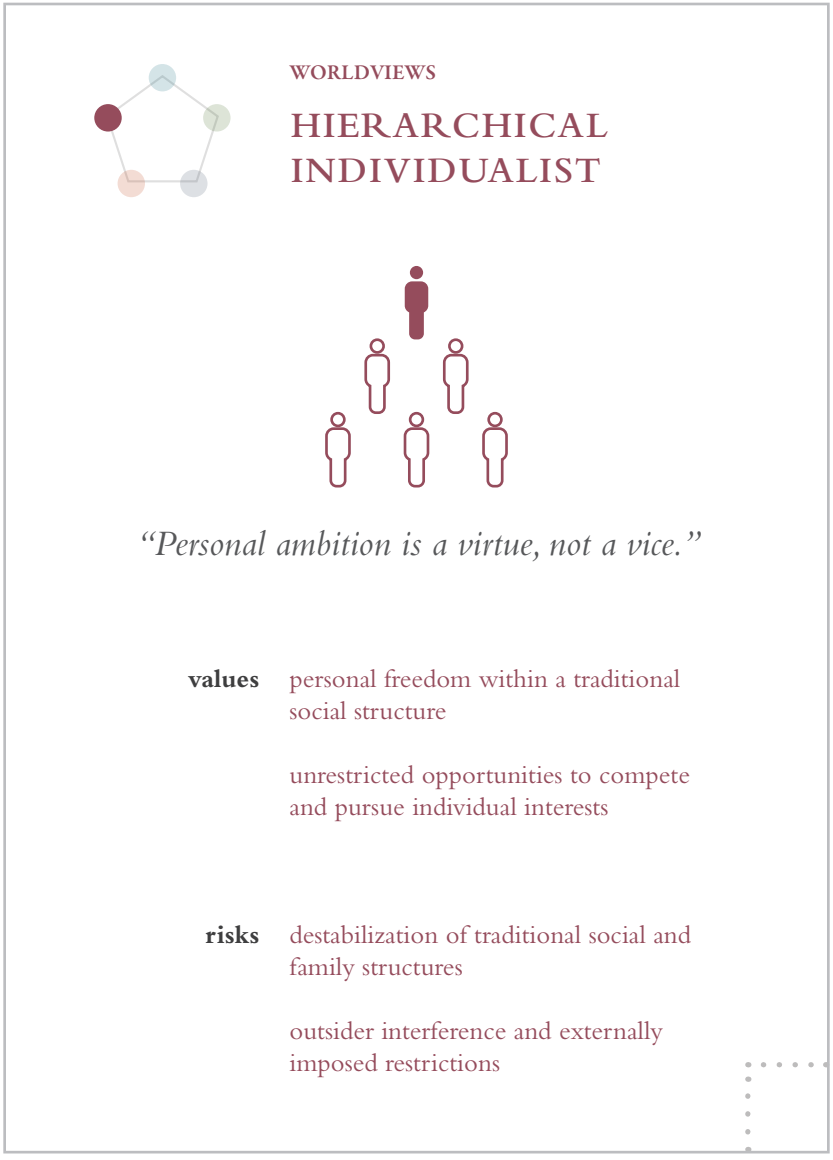


DESIGNING SCIENCE COMMUNICATION

A RHETORICAL TOOLSET

See Appendix C for full card set

Contents: Values, Strategies, Exercises, Context, Supplemental Materials



Worldviews cards

The Worldview cards include information about each of the four cultural worldviews and the associated attitudes for each quadrant of the cultural cognition grid. These cards help the user develop a sense for both his or her own values as well as the values of others that can influence how they interpret scientific information differently.

Understanding how certain types of information can be framed to threaten or affirm an audience's values begins by knowing how those values manifest as attitudes and personality traits in people.

The Strategy cards include all six of the strategies identified in the communication framework I have developed. Each strategy is explained with a rationale for its importance and context or examples for the user to explore in Context cards or apply with Exercise cards.

These cards are cross referenced by other cards, but can also be used as a stand alone set that serves as a reference for the design strategy as a whole, when a user simply wants to explore the strategies themselves.

STRATEGIES

IDENTITY AFFIRMATION

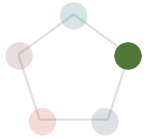
When communicating about scientific topics, look for ways to share information that does not lead to a single, one-sided judgment. Instead, consider a multiplicity of interpretations that may still point to the same general conclusion.

Design your message to allow for slightly different interpretations so that people with different worldviews may reach conclusions that affirm their values.

Consider the following appeals to each of the different values:

hierarchical	*stability, authority, expertise*
egalitarian	*equality, access, participation*
individualist	*resourcefulness, independence, privacy*
communitarian	*collaboration, community, stewardship*

Strategies cards



EXERCISES

WRITE FOUR VERSIONS

1. **Select** a topic from the SAMPLE TOPICS EXTRAS card.

See WORLDVIEW *cards.*

2. **Write** a brief explanatory statement (several sentences) about that topic. Repeat this process for a total of *four versions*; each version of the statement should appeal directly to one of the four worldviews.

3. **Choose** a noun from the SAMPLE METAPHORS EXTRAS cards, (or choose your own), and incorporate that metaphor into each of the four versions.

4. (optional) Continue to the UNIFY WITH METAPHORS EXERCISE.

for example *How might you explain the fundamentals of evolution to each worldview, separately?*

Exercises cards

The Exercise cards provide techniques and prompts to apply the strategies and become comfortable with the content in the Worldview cards. Many of them include cross references to Context cards and make use of Extras cards.

These cards are meant to be used as independent practice or in collaborative sessions when users want to improve their science communication skills or explain the communication design strategy to others.

The Context cards provide support for the strategies and exercises by providing key studies that informed the development of the communication framework, as well as concrete examples of cultural cognition in current science communication topics.

CONTEXT

PERSPECTIVE A: CLIMATE CHANGE

Environmental risk perception is an excellent illustration of the different worldviews. While an increasing number of climate scientists have reached consensus on various aspects of anthropocentric climate change, polls continue to show that different parts of the public discredit this consensus.

See WORLDVIEW *cards.*

HIERARCHICAL-INDIVIDUALISTS are likely to be very dismissive of climate change risk because crediting those risks would lead to restrictions on commerce and industry. Acknowledging this risk also implies an indictment of the authority of social elites.

Meanwhile, EGALITARIAN-COMMUNITARIANS perceive unregulated commerce and industry as sources of unjust social disparities and symbols of self-serving and community harming behavior. They find it more natural to credit claims of environmental risk, which affirm their own values and criticizes others.

consider *Groups like the conservative Enery & Enterprise Initiative frame their messaging about energy reform as an expression of traditional values and free trade rights. How does this type of framing affirm hierarchical-individualist values?*

Context cards

EXTRAS

SAMPLE METAPHORS

tablecloth	sock	horse	weapon
curtain	television	seat belt	armor
pizza	book	car	spoon
package	magazine	swing	elbow
cupcake	bag	sprinkler	watch
fridge	monkey	currency	eye
screen	adult	hammer	skin
mouse	train	light bulb	toe
leg	chocolate	highway	frown
stomach	pond	bumper cars	foot
dancer	river	insulation	lettuce
nurse	jam	tree	paper
nail	engine	ocean	floor
garden	bookcase	bear	tractor
bridge	continent	bottle	elephant
sand	planet	kidney	shoe
palm tree	rocket	street	shoulder
camel	star	bowl	tongue
room	wallet	boot	train
pajamas	children	pillow	lungs
socks	population	knee	toenail
dog	dress	shadow	child
dinosaur	lipstick	flowers	nose
subway	bus	soil	custard
sandwich	sandwich	daisy	slime
record	rectangle	fertilizer	beard
sun	waterfall	weed	caravan

Extras cards

The Extra cards provide supplemental materials such as a list of potential metaphors and quotes to be used in the accompanying exercises.

EVALUATING THE DESIGN TOOL

To evaluate the design of the cards and share my thesis findings with PCR and their community of scientists, I presented a workshop on my thesis research, insights, communication framework, and strategies. I provided each participant with a paper prototype of the communication design tool kit and we worked through two of the exercises included in the set. As such, the workshop served a dual purpose: to educate and evaluate the framework and card set.

The intention for the card set was for participants to take each set back to their colleagues and, ideally, use them in collaborative settings to reproduce the learning I shared at the workshop. Most researchers spend their time researching, not communicating, but my hope was that a tool like this one might help them feel more confident to apply some of the knowledge I have developed on the design of science communication. In my experience, tools like the IDEO or *Story Wars* cards are most useful not when I'm sitting alone at my desk, but when I use them to communicate about design principles and methodologies with others, especially non-designers. I'm hoping that, where a simple collection or a single activity may fall short, this science communication design tool will be able to function as both a collection of informational cards and a more structured set of activities, together, with the flexibility to be used differently depending on specific needs.

As I walked through the different values and cultural worldviews described by the cultural cognition theory of communication, and then described the facets of my own communication design strategy framework, participants reflected on their own values and how their worldviews influence their communication and interpretation. We discussed how these strategies differ from the current approach to science communication.

During the workshop, I solicited feedback from 19 participants. While there was inherent value in observing how people made use of the information I shared in the workshop itself, I was especially interested in how useful the participants believed this tool might be in the future. I asked them a handful of questions both pre- and post-workshop to evaluate the framework and cards. The card set was designed for scientists to use both collaboratively and independently, and I hoped that its use would be both instructive (via exercises) and inspirational (values and strategies as any-time references). The feedback was promising.

19 participants

#1. "Can you see yourself **using these strategies** in the future?"

YES

#2. "What do you find **challenging** about science communication?

connecting to the audience & making things meaningful

being compelling without advocating

dealing with uncertainty & complexity

#3. "What do you find most **useful or relevant** for your practice?"

using metaphors to create a unified message

reflecting on my own values and my audiences' values

everything!

6 people said these strategies directly address the **concerns cited in #1.**

14 people also said they look forward to **using the cards with colleagues.**

CONCLUSION

REFLECTION

Social psychology and decision science provide a deep knowledge of how people interpret information. The theory of cultural cognition suggests that, more than education, gender, age, or any other characteristic, people tend to assess risk and interpret scientific information based on how that information fits or threatens their cultural worldview and values. This phenomenon influences how people assess consensus and who they deem credible enough to trust.

When people deny scientific consensus or disbelieve a particular message, it's often because that information is framed in a way that threatens an individual's particular values. In order to design within this context, science communicators must first **understand their own values,** and **empathize with different worldviews.** What's more, communication is most compelling and persuasive when it **affirms cultural identities**, is **emotionally resonant** and **non-threatening**, and communicated by people who an audience perceives to share the same values as **credible authorities**.

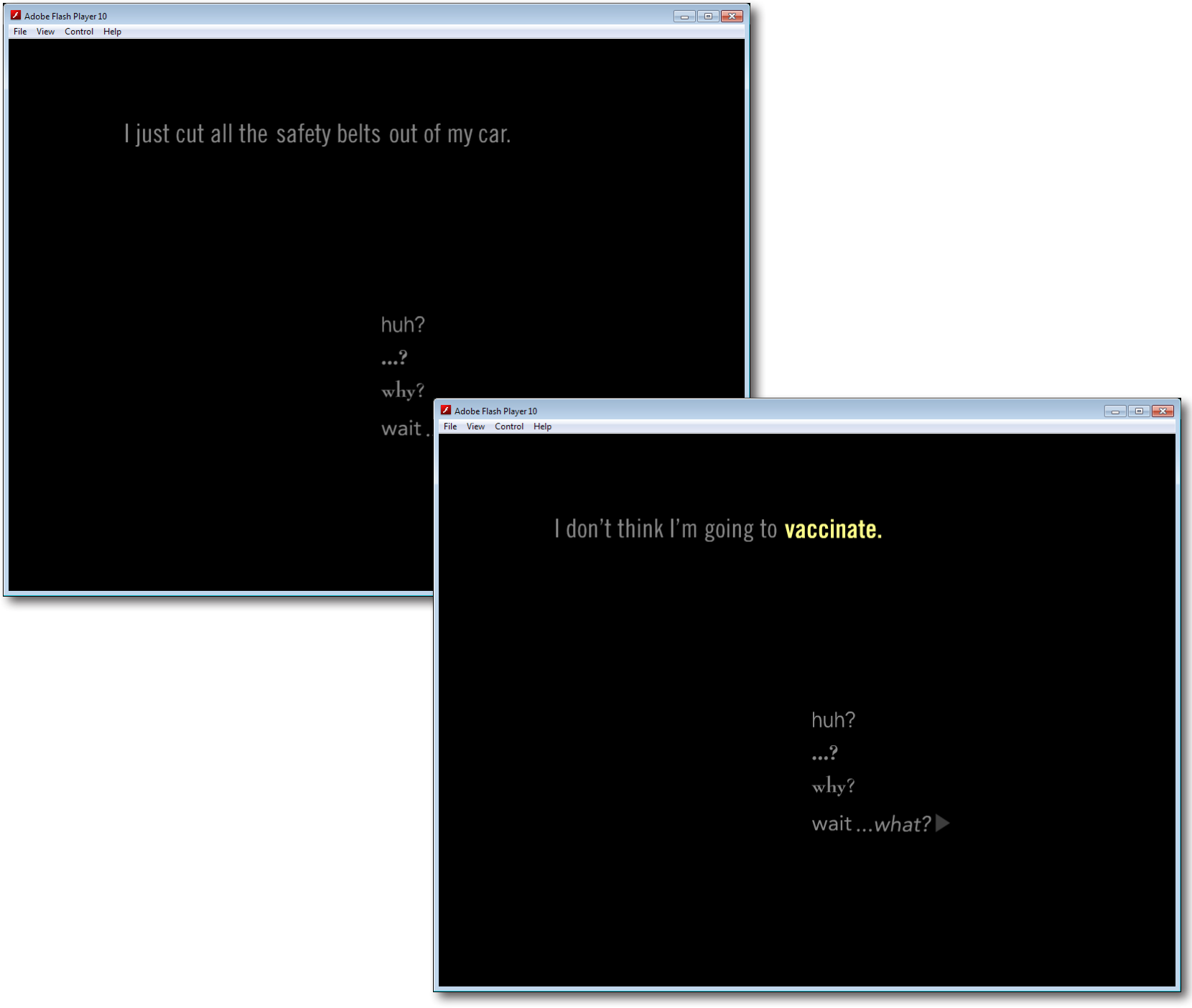
As I developed this strategic framework for science communication, applying and evaluating it through the a case study on vaccination, the greatest insight turned out to be that audiences with diverse values expressed a willingness to consider opposing views on the issue. The sheer volume of people expressing the sentiment that they "never thought about it that way before" became a key component to making these strategies actionable. While framing information differently for each worldview does successfully appeal to those particular worldviews, I found that including *several types of arguments within a single unified piece* produces the greatest positive effect by affirming audiences' values and providing non-threatening access to alternative views simultaneously.

NEXT STEPS

Beyond a continued refinement of the card set and further evaluative case studies, another potential application of this framework might be as a critical tool for evaluating science communication. That is, writers and designers who mediate and curate science communication might use this type of framework to evaluate existing work and share insights accordingly.

Additionally, though I chose to focus my efforts on designing for the science community and those who communicate on their behalf, this framework certainly has implications for far reaching fields beyond science and even risk communication; there would be value in exploring its potential role in policy and deliberative discourse as well as more alternative approaches to conventional science education and public understanding of science.

APPENDIX


Adobe Flash Player 10
File View Control Help
I just cut all the safety belts out of my car.
huh?
...?
why?
wait .
Adobe Flash Player 10
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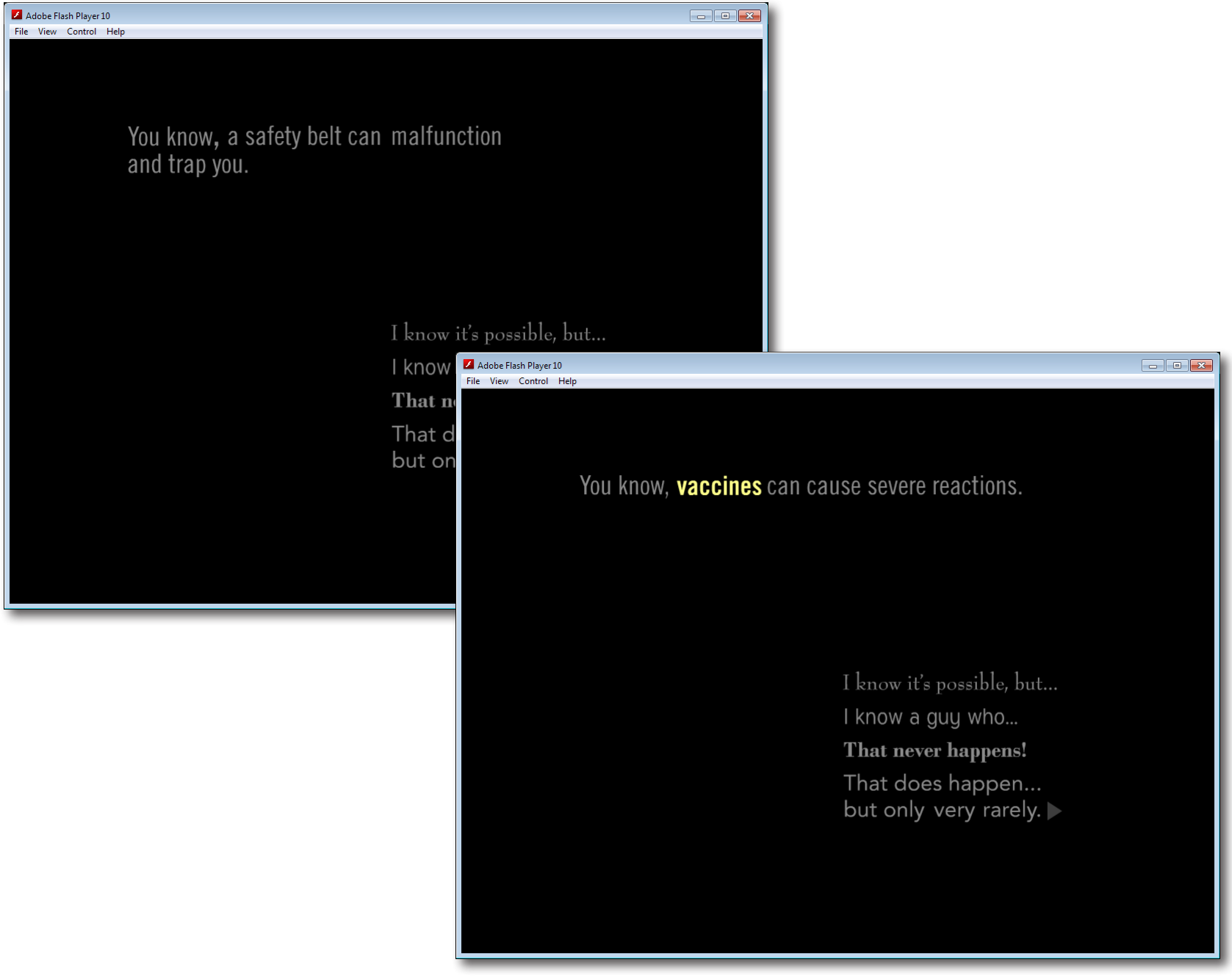
I don't think I'm going to vaccinate.
huh?
...?
why?
wait ...what?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You know, a safety belt can malfunction and trap you.
I know it's possible, but...
I know
That n
That d
but on
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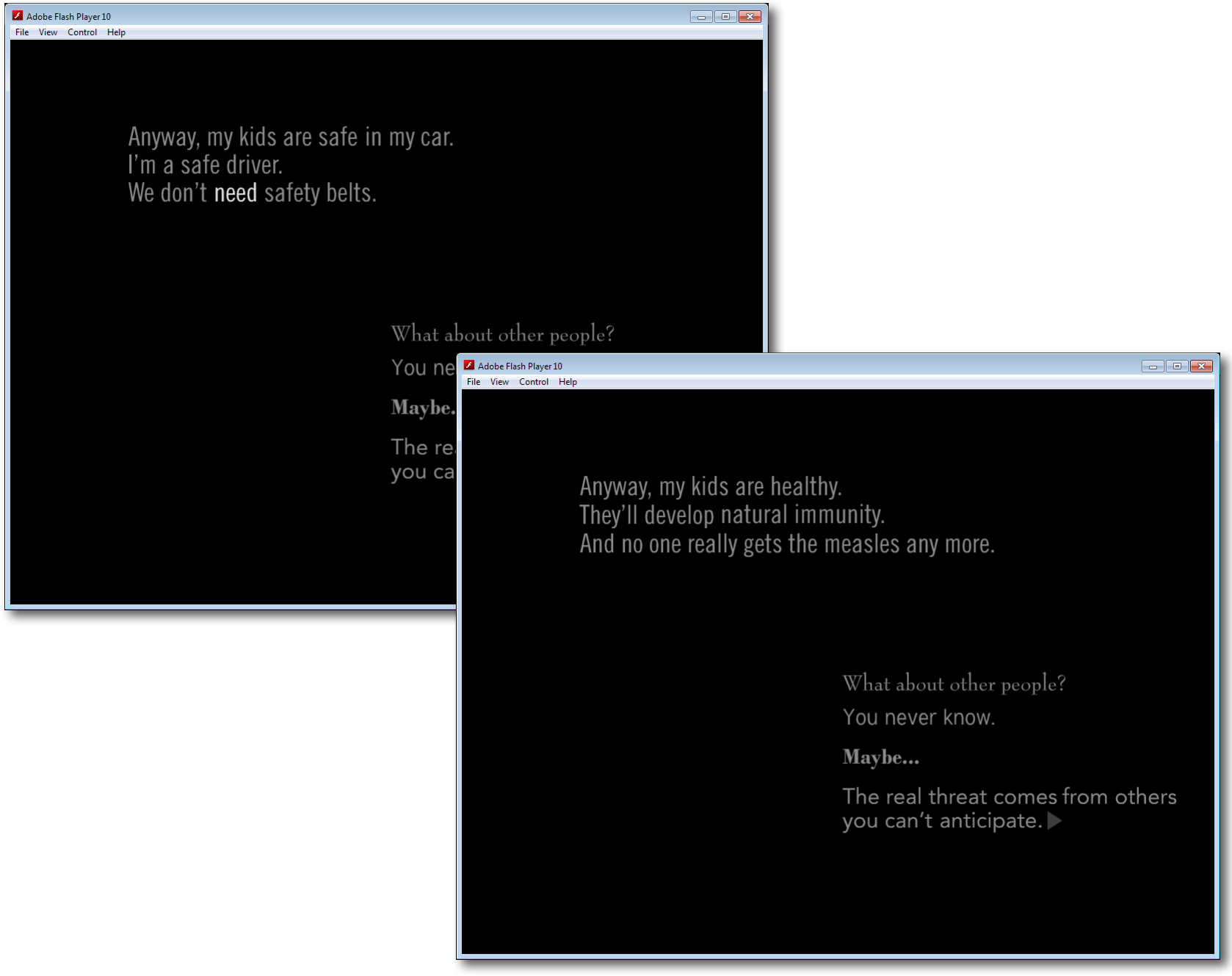
You know, vaccines can cause severe reactions.
I know it's possible, but...
I know a guy who...
That never happens!
That does happen...
but only very rarely.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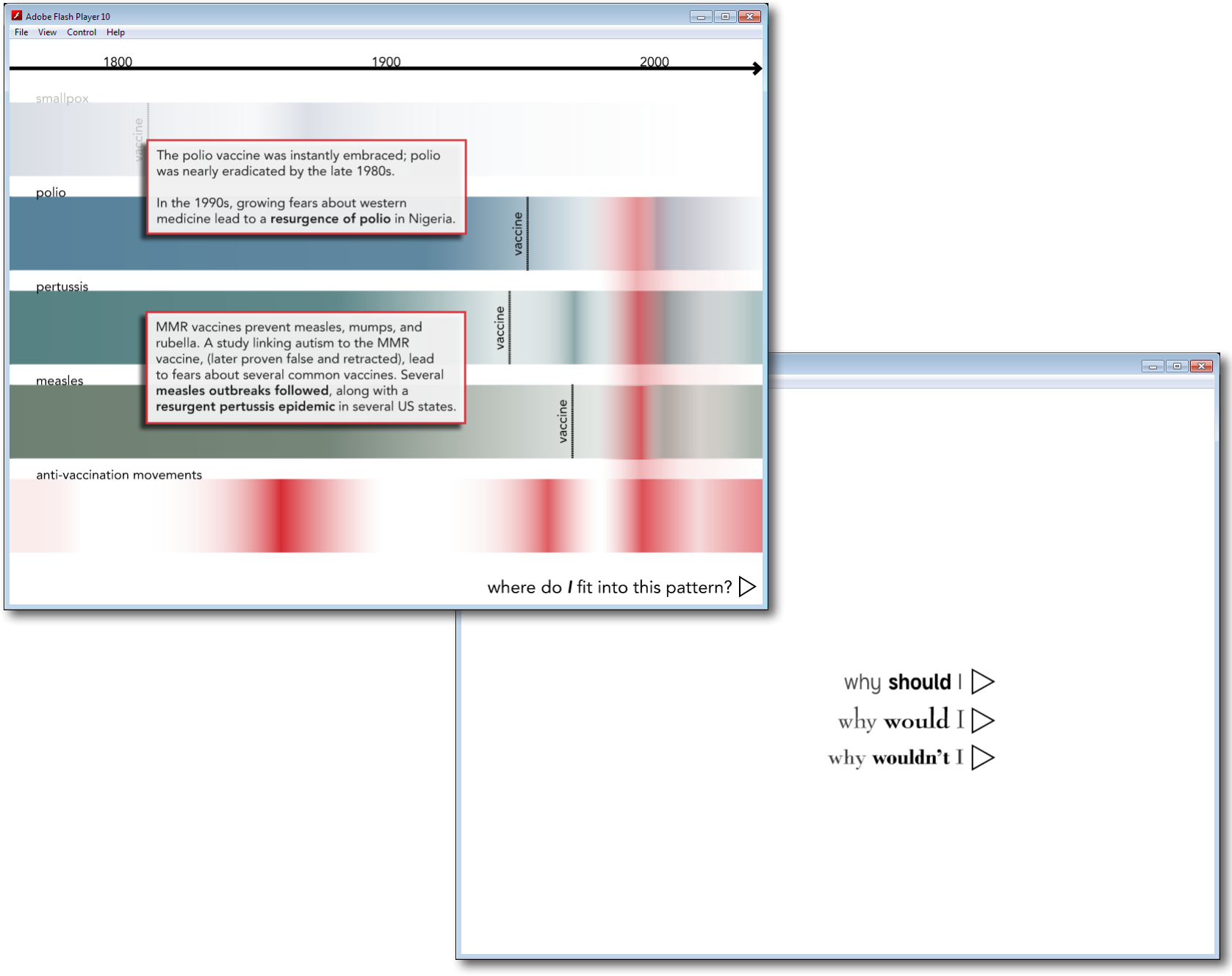
Anyway, my kids are safe in my car.
I'm a safe driver.
We don't need safety belts.
What about other people?
You ne
Maybe.
The re
you ca
Adobe Flash Player 10
File View Control Help
Anyway, my kids are healthy.
They'll develop natural immunity.
And no one really gets the measles any more.
What about other people?
You never know.
Maybe...
The real threat comes from others
you can't anticipate.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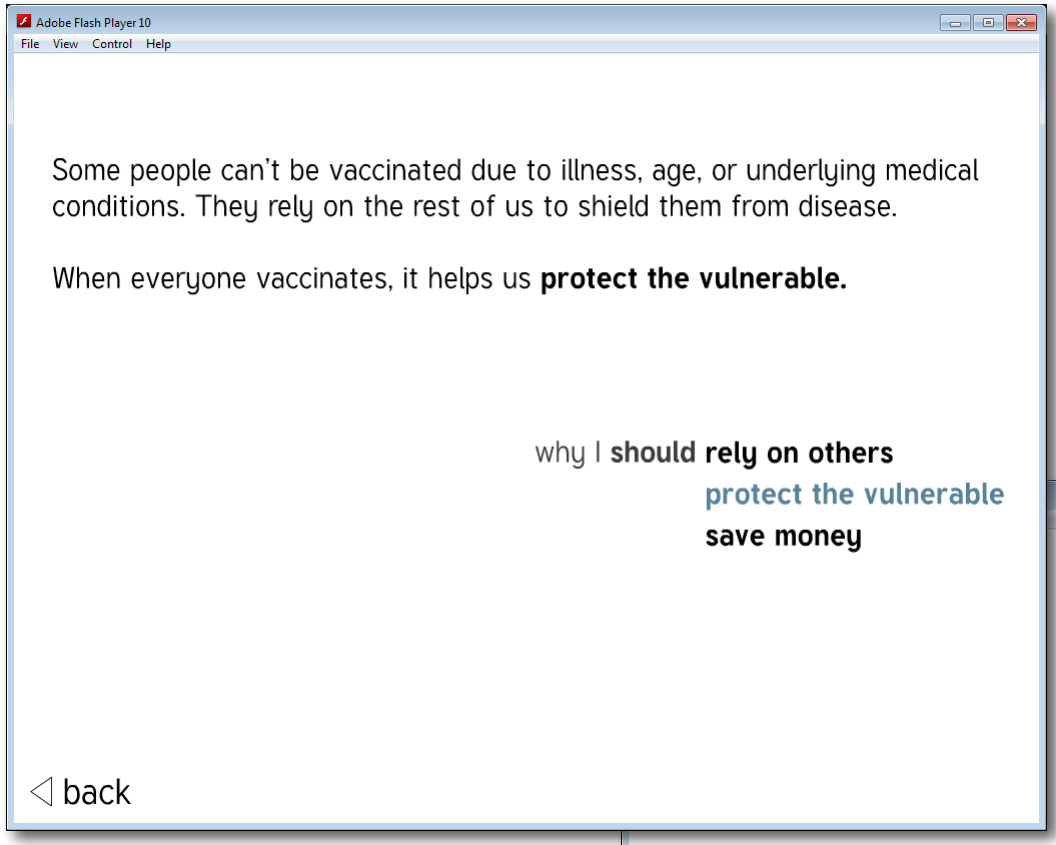
1800
1900
2000
smallpox
vaccine
The polio vaccine was instantly embraced; polio was nearly eradicated by the late 1980s.
In the 1990s, growing fears about western medicine lead to a resurgence of polio in Nigeria.
polio
vaccine
pertussis
vaccine
MMR vaccines prevent measles, mumps, and rubella. A study linking autism to the MMR vaccine, (later proven false and retracted), lead to fears about several common vaccines. Several measles outbreaks followed, along with a resurgent pertussis epidemic in several US states.
measles
vaccine
anti-vaccination movements
where do I fit into this pattern?
why should I
why would I
why wouldn't I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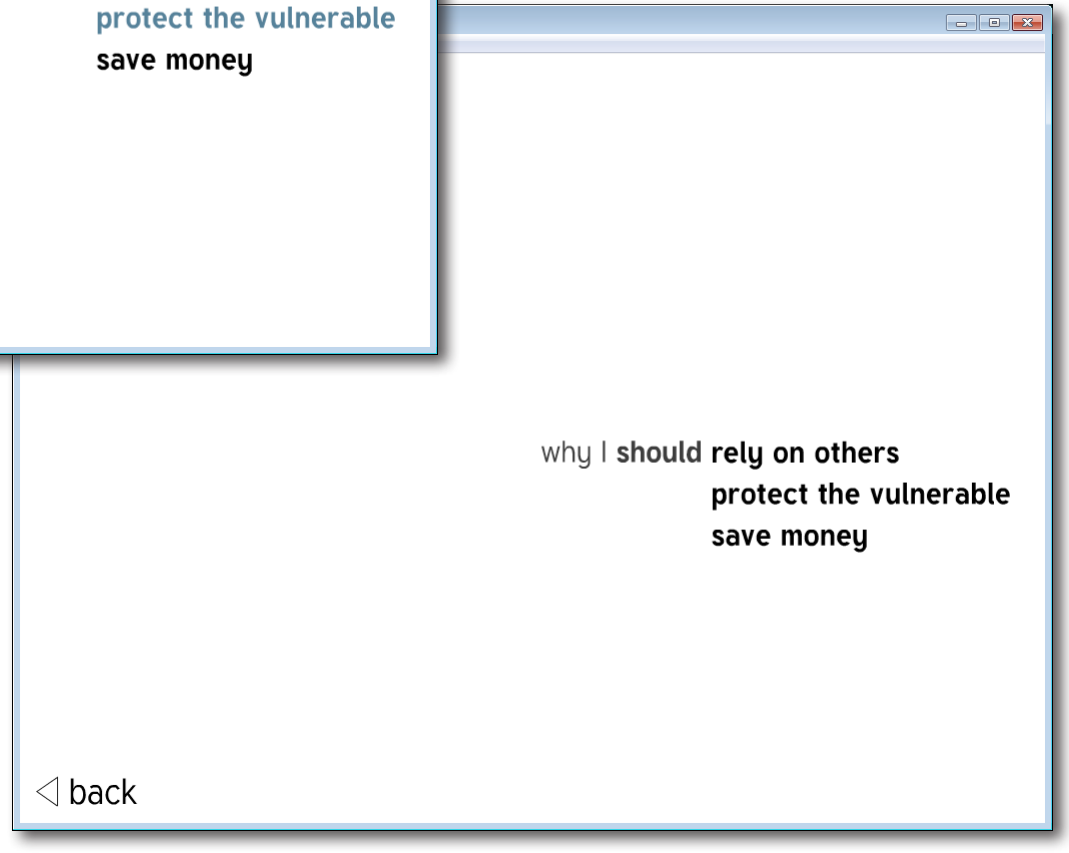
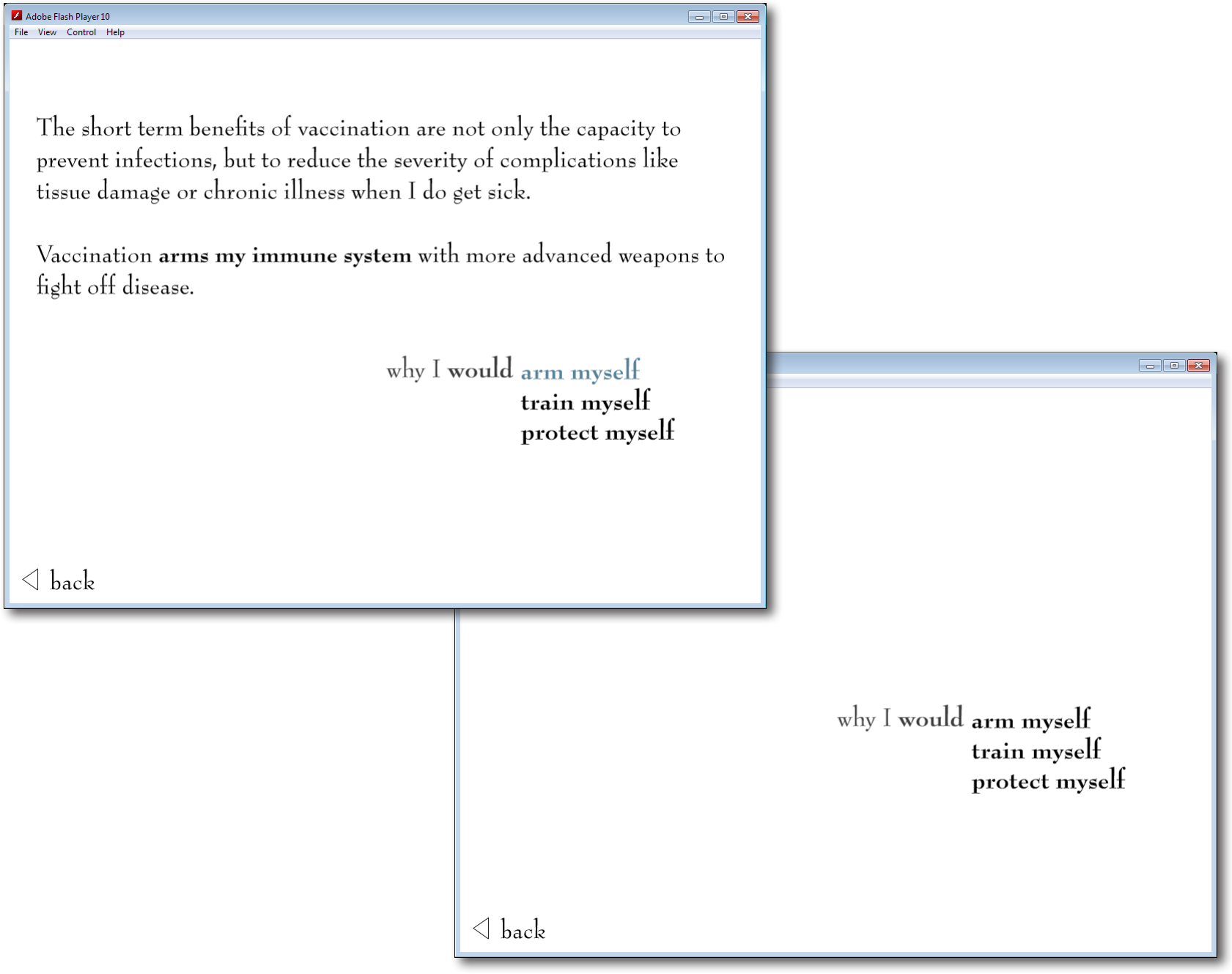
Some people can't be vaccinated due to illness, age, or underlying medical conditions. They rely on the rest of us to shield them from disease.
When everyone vaccinates, it helps us **protect the vulnerable.**
why I **should** **rely on others**
protect the vulnerable
save money
◁ back


why I **should** **rely on others**
protect the vulnerable
save money
◁ back


Adobe Flash Player 10
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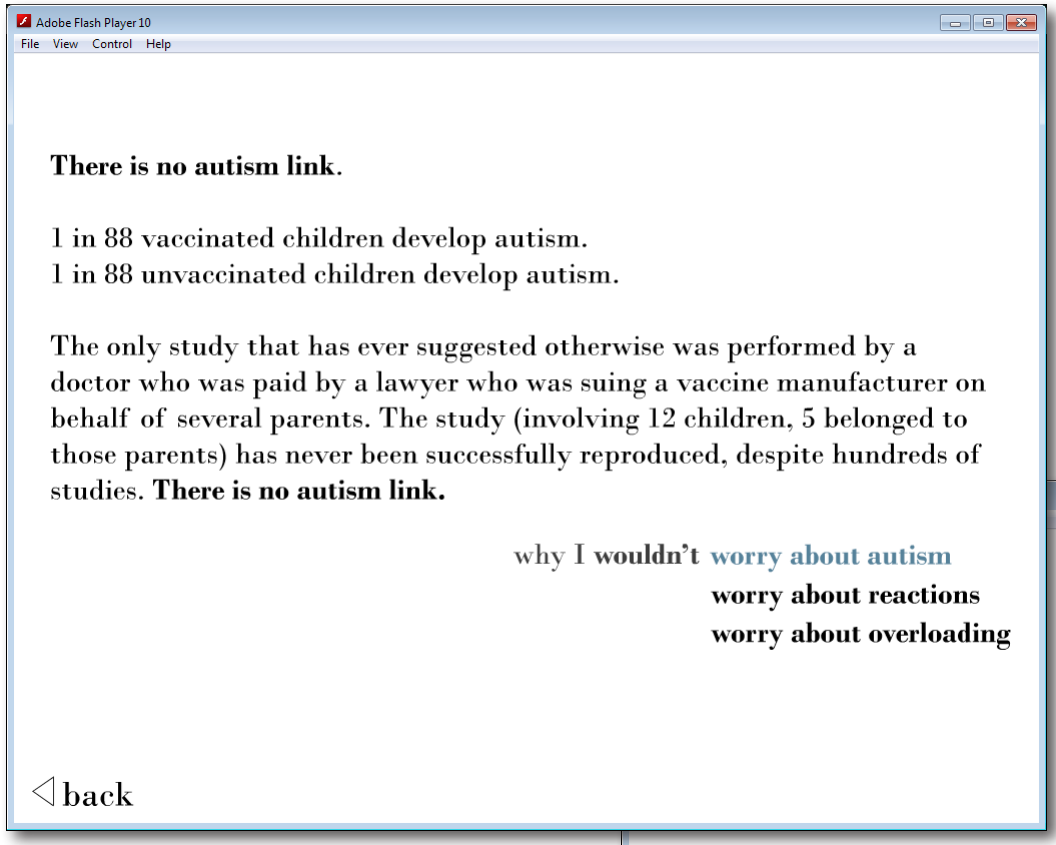
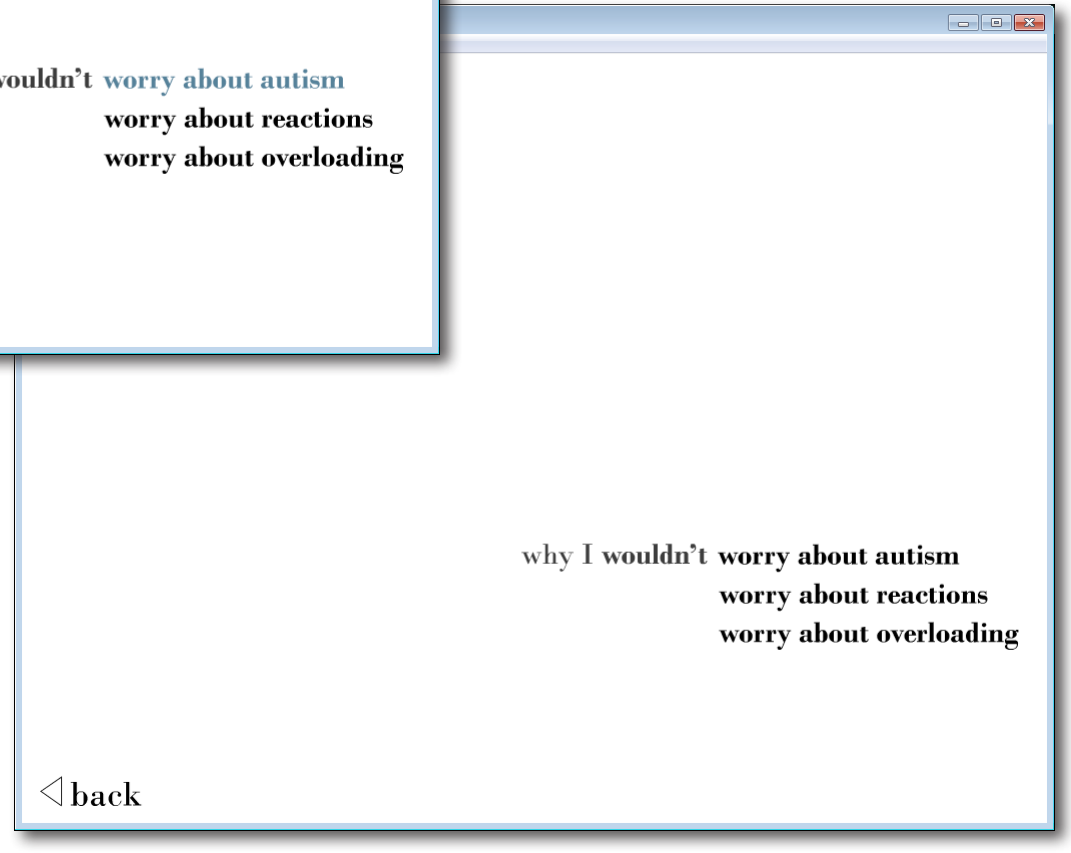
The short term benefits of vaccination are not only the capacity to prevent infections, but to reduce the severity of complications like tissue damage or chronic illness when I do get sick.
Vaccination **arms my immune system** with more advanced weapons to fight off disease.
why I would arm myself
train myself
protect myself
◁ back
why I would arm myself
train myself
protect myself
◁ back


Adobe Flash Player 10
File View Control Help
There is no autism link.
1 in 88 vaccinated children develop autism.
1 in 88 unvaccinated children develop autism.
The only study that has ever suggested otherwise was performed by a doctor who was paid by a lawyer who was suing a vaccine manufacturer on behalf of several parents. The study (involving 12 children, 5 belonged to those parents) has never been successfully reproduced, despite hundreds of studies. There is no autism link.
why I wouldn't worry about autism
worry about reactions
worry about overloading
back


why I wouldn't worry about autism
worry about reactions
worry about overloading
back

Please rate your agreement or disagreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
It seems like blacks, women, homosexuals and other groups don't want equal rights, they want special rights just for them.	○	○	○	○	○
We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women.	○	○	○	○	○
A lot of problems in our society come from the decline in the traditional family, where the man works and the woman stays home.	○	○	○	○	○
We have gone too far in pushing equal rights in this country.	○	○	○	○	○
Discrimination against minorities is still a very serious problem in our society.	○	○	○	○	○
Society as a whole has become too soft and feminine.	○	○	○	○	○
It's old-fashioned and wrong to think that one culture's set of values is better than any other culture's way of seeing the world.	○	○	○	○	○
Our society would be better off if the distribution of wealth was more equal.	○	○	○	○	○

Please rate your agreement or disagreement with the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals.	○	○	○	○	○
The government interferes far too much in our everyday lives.	○	○	○	○	○
It's society's responsibility to make sure everyone's basic needs are met.	○	○	○	○	○
Society works best when it lets individuals take responsibility for their own lives without telling them what to do.	○	○	○	○	○
It's not the government's business to try to protect people from themselves.	○	○	○	○	○
The government should stop telling people how to live their lives.	○	○	○	○	○
Government should put limits on the choices individuals can make so they don't get in the way of what's good for society.	○	○	○	○	○
Sometimes government needs to make laws that keep people from hurting themselves.	○	○	○	○	○

For each of the following items, please indicate where your opinion lies on a spectrum between the two statements.

I will get the flu vaccine this year	○ ○ ○ ○ ○	I will not get the flu vaccine this year.
I would definitely have (or already had) my children vaccinated.	○ ○ ○ ○ ○	I would definitely not (or have already opted not to) have my children vaccinated
Vaccines are safe.	○ ○ ○ ○ ○	Vaccines are not safe.
Vaccination is a good idea.	○ ○ ○ ○ ○	Vaccination is not worth the risk.
Relying on natural immunity instead of getting vaccinated is risky.	○ ○ ○ ○ ○	Natural immunity is better than vaccinating.
Everyone should be required to vaccinate.	○ ○ ○ ○ ○	Vaccination should be completely optional.
Childhood vaccines do not cause autism.	○ ○ ○ ○ ○	Childhood vaccines can cause autism.

For each of the following statements, indicate whether the claim is true, false, or uncertain.

	True	Not Sure	False
The flu vaccine can give you the flu.	○	○	○
Childhood vaccines cause autism.	○	○	○
Natural immunity (from getting sick) is better than immunity from vaccination.	○	○	○
Babies get more vaccinations in 2012 than in 1980.	○	○	○
There is mercury in vaccines.	○	○	○

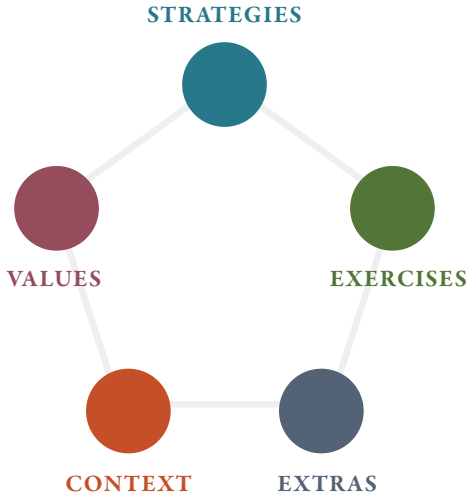
The following points were made about vaccination. Please rank them in the order that you find them most compelling and relevant (at the top), to least compelling and relevant (at the bottom).

Drag & Drop:

- Vaccination protects the vulnerable.
- Vaccination builds herd (community) immunity.
- Vaccination saves money.
- Vaccination arms the immune system with better weapons to fight infection.
- Vaccination trains the immune system to fight better in the long term.
- Vaccination protects the immune system from outside invaders.
- Vaccination is not linked to autism.
- Vaccination rarely causes severe reactions.
- Vaccination does not cause overloading on the immune system.

Which part of the vaccine piece appealed to you, or resonated the MOST with you?

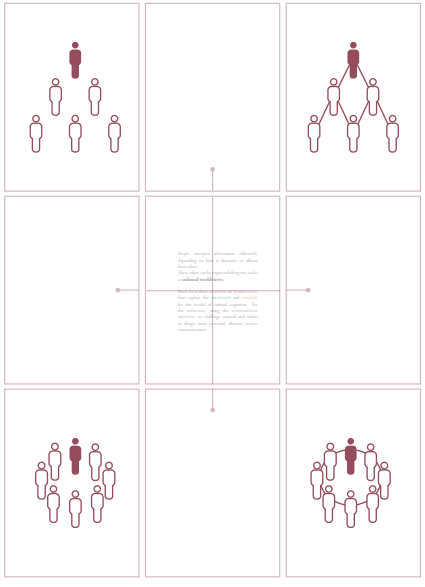
Which part of the vaccine piece did not appeal to you, or resonated LEAST with you?



DESIGNING SCIENCE COMMUNICATION

A RHETORICAL TOOLSET

VALUES

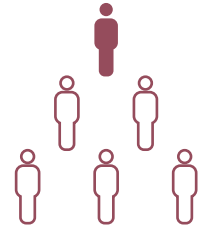


People interpret information differently, depending on how it threatens or affirms their values.
These values can be expressed along two scales as **cultural worldviews.**

Read about these ATTITUDES & WORLDVIEWS, then explore the STRATEGIES and CONTEXT for this model of cultural cognition. Try the EXERCISES, using the SUPPLEMENTAL MATERIAL, to challenge yourself and others to design more powerful, effective science communication.

WORLDVIEWS

HIERARCHICAL INDIVIDUALIST



"Personal ambition is a virtue, not a vice."

values

personal freedom within a traditional social structure

unrestricted opportunities to compete and pursue individual interests

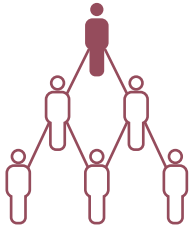
risks

destabilization of traditional social and family structures

outsider interference and externally imposed restrictions

WORLDVIEWS

HIERARCHICAL COMMUNITARIAN



"What's good for the goose is good for the gander."

values

strong community values in a traditional social structure

conventions that support the good of the community over individual needs

risks

policies that threaten traditional family or social hierarchies

individual behaviors that undermine the strength of a community

WORLDVIEWS

EGALITARIAN INDIVIDUALIST

"Everyone should be free to choose their own path."

values

personal freedom & individual rights for everyone, regardless of context

unrestricted opportunities for individuals to compete as desired

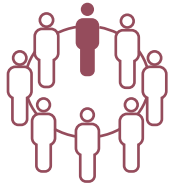
risks

patriarchal social conventions & government oversight

intrusions or restrictions on personal freedom

WORLDVIEWS

EGALITARIAN COMMUNITARIAN



"One for all & all for one!"

values

community stewardship

equal access & participation for everyone, regardless of class, gender, race, age or other context

risks

restrictions on participation or access for certain populations

conventions that reinforce social inequalities or undermine community

ATTITUDES

HIERARCHICAL

It's ok to acknowledge and even emphasize differences.

It's ok to distribute wealth and duty according to class, or expertise.

Policy and social conventions should support traditional hierarchies and stability.

Roles should be differentiated in a traditional manner.

ATTITUDES

EGALITARIAN

Discrimination is harmful.

Everyone deserves equal representation in duty and fair distribution of wealth.

Everyone should be allowed to participate;diversity is good.

Everyone should have access; non-traditional roles are ok.

ATTITUDES

INDIVIDUALIST

Interference from outsiders limits personal freedom.

Collective assistance and welfare structures hold us back.

People should fend for themselves and leave others alone.

Freedom and competition lead to human resourcefulness and innovation.

ATTITUDES

COMMUNITARIAN

Human interaction and compassion are important.

People have a responsibility to take care of each other.

Everyone should be willing to both help and depend on others.

Collaboration and solidarity make strong, safe communities.

STRATEGIES

UNDERSTAND YOUR VALUES

See WORLDVIEW *cards.*

See CONTEXT *cards.*

Considering how your own values and cultural worldview manifest in practice can help put things in perspective and improve your communication. Even when scientists aim to communicate scientific information with objectivity, their personal values influence the message.

Choices in tone, voice, narrative style, metaphors, and visuals all frame information, sometimes very subtly.

Awareness of your own tendencies is the critical first step in the process of communicating more effectively.

consider

Which of the WORLDVIEW *cards resonate most with* ***you****?*

Where have ***you*** *traditionally fallen in your attitudes toward the perspectives described in each of the* CONTEXT *cards?*

STRATEGIES

UNDERSTAND YOUR AUDIENCE'S VALUES

See EXERCISES*:*

ROLE PLAYING

PIN THE VALUES ON THE MESSAGE

Understanding your audience is crucial for effective communication. More than age, gender, education, or political leaning, a person's values and worldview influence how he or she interprets information, especially about technical and risk related information.

It's not essential that you know your individual audience members' worldviews, specifically. In fact, that would be impossible. It's more effective, and certainly more practical, to develop an empathetic understanding of the values within each worldview and build an intuitive sense for the type of information framing that threatens or affims each one.

consider

Which of the perspectives described in the CONTEXT *cards have you debated with others? How might you approach a topic differently if you held a different set of values, or if your audience held a different set of values?*

STRATEGIES

IDENTITY AFFIRMATION

When communicating about scientific topics, look for ways to share information that does not lead to a single, one-sided judgment. Instead, consider a multiplicity of interpretations that may still point to the same general conclusion.

Design your message to allow for slightly different interpretations so that people with different worldviews may reach conclusions that affirm their values.

Consider the following appeals to each of the different values:

hierarchical	*stability, authority, expertise*
egalitarian	*equality, access, participation*
individualist	*resourcefulness, independence, privacy*
communitarian	*collaboration, community, stewardship*

STRATEGIES

NON-THREATENING MESSAGING

Sometimes, it's not practical to affirm all cultural worldviews' values in a single message. However, it's important to at least *avoid* threatening or alienating specific worldviews, which can contribute to polarization on a given topic. By becoming more mindful of the way information is framed and how certain judgments may threaten particular worldviews, we can communicate with a wider audience more effectively.

Consider the following threats to each of the different values, and try to **avoid highlighting them where possible:**

hierarchical	*harsh criticism of traditional social roles and industry*
egalitarian	*denial of participation, access, or status*
individualist	*interference, constraints on personal freedoms*
communitarian	*unrestricted competition, threats to social supports*

STRATEGIES

PLURALISTIC ADVOCACY

For CONTEXT, *see:*

STUDY *cards*
PERSPECTIVE *cards*

People tend to assign greater credibility to experts who share their own values. Because of this tendency, people are less likely to become polarized on a topic when they observe trustworthy people who share their values advocating unexpected positions.

Rather than seeking different 'spokespeople' for each set of values to share your message with each cultural worldview, it's a lot more realistic (and equally effective) to find quotes and references and use particular metaphors that appeal to a variety of worldviews.

for example *If you are communicating about a topic related to environmental risk, you might try to include quotes or references from both traditionally egalitarian-communitarian sources (such as The Union of Concerned Scientists) as well as hierarchical-individualist organizations (such as Young Conservatives for Energy Reform) to illustrate and support your message.*

STRATEGIES

EMOTIONAL RESONANCE

See EXERCISES*:*

UNIFY WITH METAPHORS

WRITE THE ENDING FIRST

When information is shared in a compelling narrative form that uses vivid metaphors, not only are the language processing parts of the brain activated, but other areas in the brain that we would use when experiencing the events of the story are engaged too. Studies show that people remember facts told in the context of a story better than any other form.

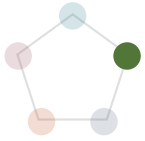
Tell a compelling story.

consider these "must-read" books

Don't Be Such A Scientist by Randy Olson

Resonate by Nancy Duarte

Story Wars by Jonah Sachs



EXERCISES

ROLE PLAY

1. **Select** one of the WORLDVIEW cards.

2. **Select** one of the SAMPLE QUOTES or SAMPLE STORIES from the EXTRAS cards.

3. **Imagine** yourself adopting the cultural worldview described by the card you selected. Consider how your values will shape the way you interpret the quote or story you read.

4. **Answer** the following questions, and share your reasoning with others.

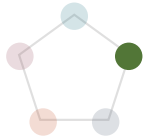
consider

What about this message might be threatening to your values?

What about this message might affirm your values?

Do you feel the author shares your values?

Would you be likely to discuss this quote or story with others that share your values?



EXERCISES

PIN THE VALUES ON THE MESSAGE

1. **Select** one of the SAMPLE QUOTES or SAMPLE STORIES from the EXTRAS cards.

2. **Identify** which cultural WORLDVIEW you think this message will resonate with most.

3. **Answer** the following questions, and share your reasoning with others.

consider *What about this message affirms the worldview you identified? Tone, voice, vivid language, examples?*

How might you improve this message to make it resonate even more with this particular worldview?

EXERCISES

DO OVER

1. **Select** one of the WORLDVIEW cards.

2. **Select** one of the SAMPLE QUOTES or SAMPLE STORIES from the EXTRAS cards.

3. **Rewrite** the QUOTE or STORY in a manner that would be less threatening and affirm the values of the WORLDVIEW you selected.

Consider the following as you write:

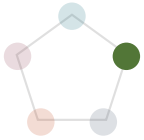
tone *More relaxed? More authoritative?*

metaphor *What comparisons will resonate most?*

example *What examples are most familiar and identity-affirming?*

pluralistic advocacy *Are you drawing on experts or references that represent only one worldview? Try to incorporate more than one worldview.*

open interpretation *Is the reader able to draw individually constructed conclusions that aren't threatening?*



EXERCISES

WRITE FOUR VERSIONS

1. **Select** a topic from the SAMPLE TOPICS EXTRAS card.

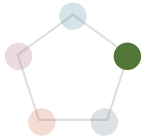
See WORLDVIEW *cards.*

2. **Write** a brief explanatory statement (several sentences) about that topic. Repeat this process for a total of *four versions*; each version of the statement should appeal directly to one of the four worldviews.

3. **Choose** a noun from the SAMPLE METAPHORS EXTRAS cards, (or choose your own), and incorporate that metaphor into each of the four versions.

4. (optional) Continue to the UNIFY WITH METAPHORS EXERCISE.

for example *How might you explain the fundamentals of evolution to each worldview, separately?*



EXERCISES

UNIFY WITH METAPHORS

1. **Try** the WRITE FOUR VERSIONS EXERCISE.

2. **Select** at least four nouns from the SAMPLE METAPHORS EXTRAS card.

3. Within each of the four statements you have written, **complete** the following sentence:

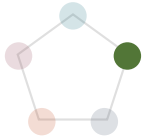
_____ is like a _____ because...

(topic) *(noun)*

4. **Continue** this process, exploring different metaphors and comparisons until one shows potential to explain your topic for all four worldviews by serving multiple interpretations.

5. **Unify** your four statements into a single message, using the metaphor you have crafted and affirming diverse values where possible.

for example *To explain the benefits and risks of childhood vaccines, how might a seat belt be used as a unifying metaphor? Seat belts provide known life saving benefits but some people still associate them with a risk (being trapped) or bristle at the idea of mandatory seat belt laws. Are there similarities to vaccination?*



EXERCISES

WRITE THE ENDING FIRST

1. **Try** the WRITE FOUR VERSIONS EXERCISE.

2. With the four statements you have written, **identify** the type of *conclusion* or *implication* for each version that affirms the values of that worldview.

3. **Combine** these four conclusions into one, by devising a scenario where all four conclusions could come together in a unified message.

See CONTEXT *cards.*

4. Working backward from that single conclusion, **rewrite** the four statements into a unified piece that allows readers with different values roome to reach the same general conclusion through different interpretations.

for example *To write about nuclear power as a positive alternative energy source, how might hierarchical-individualists and egalitarian-communitarians arrive at the same conclusion? How can nuclear power be framed as a symbol of innovation and boon for industry, as well as a safe, clean technology that promotes egalitarian ideals for universal access to electricity, in one message?*

CONTEXT

PERSPECTIVE A: CLIMATE CHANGE

Environmental risk perception is an excellent illustration of the different worldviews. While an increasing number of climate scientists have reached consensus on various aspects of anthropocentric climate change, polls continue to show that different parts of the public discredit this consensus.

See WORLDVIEW *cards.*

HIERARCHICAL-INDIVIDUALISTS are likely to be very dismissive of climate change risk because crediting those risks would lead to restrictions on commerce and industry. Acknowledging this risk also implies an indictment of the authority of social elites.

Meanwhile, EGALITARIAN-COMMUNITARIANS perceive unregulated commerce and industry as sources of unjust social disparities and symbols of self-serving and community harming behavior. They find it more natural to credit claims of environmental risk, which affirm their own values and criticizes others.

consider *Groups like the conservative Enery & Enterprise Initiative frame their messaging about energy reform as an expression of traditional values and free trade rights. How does this type of framing affirm hierarchical-individualist values?*

CONTEXT

PERSPECTIVE B: NUCLEAR POWER

Nuclear power is often framed as a relatively clean energy source and alternative to fossil fuels. One might expect environmentally-concerned audiences to embrace it. However, nuclear power has historically been perceived as a greater risk by those with strongly EGALITARIAN-COMMUNITARIAN worldviews.

See WORLDVIEW *cards.*

Nuclear power can be threatening to egalitarian and communitarian values when concerns about long term waste management and safety fears are dismissed with risk statistics.

Meanwhile, HIERARCHICAL-INDIVIDUALISTS view nuclear power as a less threatening risk because it empowers industry and commerce and does not threaten traditional hierarchical structures. In fact, many hierarchical-individualists are more willing to accept the existence of climate change when solutions that include nuclear power are highlighted.

consider *How would you change the discussion about nuclear power if you wanted to avoid threatening egalitarian-communitarian values?*

CONTEXT

PERSPECTIVE C: NANOTECHNOLOGY

For CONTEXT*, see:*

STUDY C

Studies have shown that even for topics that are relatively new or unknown to the general public, such as nanotechnology, individuals exposed to opposing sets of anonymous arguments divide along predictable lines. The gap between people who are inclined to credit and those inclined to dismiss claims of risk widens dramatically after exposure to such arguments.

See STRATEGY*:*

PLURALISTIC ADVOCACY

However, when information about nanotechnology *is* attributed to identifiable advocates, the impact of the arguments is highly sensitive to the perceived cultural worldviews of the advocates. In other words, people respond to information very differently depending on whether it comes from someone whose values they share.

consider *Knowing that people's risk perceptions and interpretation of information are heavily influenced by their sense for whether the source shares their values, how might the antidote to that effect- pluralistic advocacy- look in practice? When multiple sources with diverse worldviews cannot be recruited to argue on you behalf, what strategies can you use to still provide authority from multiple worldviews?*

CONTEXT

PERSPECTIVE D: HPV VACCINATION

When the FDA approved an HPV vaccine, and the CDC recommended universal vaccination for adolescent girls and young women, the public response featured intense division:

See WORLDVIEW *cards.*

Conservative religious groups (HIERARCHICAL-COMMUNITARIAN) challenged the vaccine's effectiveness and raised concerns about side-effects. They also argued that vaccination would increase teen pregnancy and other STDs by giving girls a false sense of security, leadning to unprotected, promiscuous sex.

Women's advocacy groups & mandate proponents (EGALITARIAN-COMMUNITARIAN) dismissed these arguments as pretexts motivated by animosity toward violation of traditional gender norms.

consider

Information about the risks and benefits of the HPV vaccine came with culturally charged messaging. The opposing values of hierarchical and egalitarian worldviews were highlighted by a handful of advocacy groups and their stances became cues for ordinary, largely apolitical individuals to take sides.

How might you reframe the discussion to affirm values on both sides of the debate?

CONTEXT

STUDY A: PUBLIC PERCEPTIONS OF CONSENSUS

Kahan, Dan M., Jenkins-Smith, Hank and Braman, Donald, Cultural Cognition of Scientific Consensus (February 7, 2010). Journal of Risk Research, Vol. 14, pp. 147-74, 2011.

This study tests the theory of cultural cognition of scientific consensus as an explanation for continued questioning of established consensus in the scientific community. It presents evidence confirming that cultural cognition shapes individuals' beliefs about the existence of scientific consensus, and the process by which they form such beliefs, relating to climate change, the disposal of nuclear wastes, and the effect of permitting concealed possession of handguns.

main conclusion

People's trust in expertise depends on how closely an expert's values are perceived to match their own.

CONTEXT

STUDY B:
THE POLARIZAING IMPACT OF SCIENCE LITERACY

Kahan, Dan M., Peters, Ellen, Wittlin, Maggie, Slovic, Paul, Ouellette, Lisa Larrimore, Braman, Donald and Mandel, Gregory N., The Polarizing Impact of Science Literacy and Numeracy on Perceived Climate Change Risks (December 23, 2012). Nature Climate Change, Vol. 2, pp. 732-735, 2012.

Public apathy over climate change is often attributed to a deficit in comprehension. The public knows too little science, we often assume, to understand the evidence or avoid being misled. Widespread limits on technical reasoning aggravate the problem by forcing citizens to use unreliable cognitive heuristics to assess risk.

This study finds no support for this position. Members of the public with the highest degrees of science literacy and technical reasoning capacity were not the most concerned about climate change. **Rather, they were the ones among whom cultural polarization was greatest.**

main conclusion

Public divisions stem not from the public's incomprehension of science but from a distinctive conflict of interest between values and worldviews. Greater levels of education and literacy are actually correlated to greater polarization between worldviews.

CONTEXT

STUDY C:
BIASED ASSIMILATION & CULTURAL CREDIBILITY

Kahan, Dan M., Slovic, Paul, Braman, Donald, Gastil, John, Cohen, Geoffrey L. and Kysar, Douglas A., Biased Assimilation, Polarization, and Cultural Credibility: An Experimental Study of Nanotechnology Risk Perceptions (February 4, 2008). Harvard Law School Program on Risk Regulation Research Paper No. 08-25.

This study finds that members of the public, most of whom know little or nothing about nanotechnology, polarize along cultural lines when exposed to information about it. Polarization along expected lines grew even more extreme when subjects of diverse cultural outlooks observed an advocate whose values they share advancing an argument they were predisposed to accept, and an advocate whose values they reject advancing an argument they were predisposed to resist. But when those same advocates were assigned the *opposite* positions, subjects formed risk perceptions diametrically opposed to the ones normally associated with their own cultural predispositions. Finally, when there was no consistent relationship between the perceived values of advocates and positions taken on nanotechnology risk and benefits, cultural polarization was neutralized.

main conclusion

Polarization is increased when people observe adovcates whose values they share arguing for the expected position, and descreased when those same advocates argued for the opposing position.

CONTEXT

STUDY D:
FRAMING INFORMATION FOR IDENTITY AFFIRMATION

A National Survey of Republicans and Republican-leaning Independents On Energy and Climate Change:
Edward Maibach, Connie Roser-Renouf, Emily Vraga, Brittany Bloodhart, Ashley Anderson, Neil Stenhouse and Anthony Leiserowitz

This survey of people who identified themselves as Republican or Republican-leaning Independent finds that 77% support expanding US reliance on clean and renewable energy. It also measured how this population responded to two carefully crafted messages, which were framed to appeal to the conservative sense of moral purity in one case, and individualistic, free market values in the other. After reading the conservative argument, 64% of respondents agreed that the US should take action on climate change. After reading the free market argument, 60% of respondents supported climate action. This contrasts with past research that has shown that messaging that focuses on anti-pollution environmental regulation and community responsibility actually increases denial among this conservative audience.

main conclusion

Framing arguments about climate change and alternative energy in ways that affirm hierarchical and individualist values produces a positive response from those conservative audiences.

EXTRAS

SAMPLE METAPHORS

tablecloth	sock	horse	weapon
curtain	television	seat belt	armor
pizza	book	car	spoon
package	magazine	swing	elbow
cupcake	bag	sprinkler	watch
fridge	monkey	currency	eye
screen	adult	hammer	skin
mouse	train	light bulb	toe
leg	chocolate	highway	frown
stomach	pond	bumper cars	foot
dancer	river	insulation	lettuce
nurse	jam	tree	paper
nail	engine	ocean	floor
garden	bookcase	bear	tractor
bridge	continent	bottle	elephant
sand	planet	kidney	shoe
palm tree	rocket	street	shoulder
camel	star	bowl	tongue
room	wallet	boot	train
pajamas	children	pillow	lungs
socks	population	knee	toenail
dog	dress	shadow	child
dinosaur	lipstick	flowers	nose
subway	bus	soil	custard
sandwich	sandwich	daisy	slime
record	rectangle	fertilizer	beard
sun	waterfall	weed	caravan

EXTRAS

SAMPLE TOPICS

nanotechnology
climate change
HPV vaccination
GMO foods
childhood vaccination
evolution
animal testing
nuclear power
wind power
solar power
electric hybrid vehicles
higgs boson
large hadron collider
acid rain
ozone layer
severe weather
sea levels
biodiversity
fracking
marine biology
cosmology
meteorites
invasive species
mathematical modeling
interplanetary exploration

EXTRAS

SAMPLE QUOTES

Neil deGrasse Tyson — *The good thing about science is that it's true, whether or not you believe in it.*

Richard Feynman — *Science is the belief in the ignorance of the experts.*

Bill Nye — *I say to the grownups, if you want to deny evolution and live in your world, that's completely inconsistent with the world we observe, that's fine. But don't make your kids do it. Because we need them. We need scientifically literate voters and taxpayers for the future. We need engineers that can build stuff and solve problems.*

Johann von Goethe — *Science and art belong to the whole world, and before them vanish the barriers of nationality.*

George Shultz
Secretary of State
Reagan Admin. — *We should make all forms of energy bear their full costs. Many forms of energy produce side effects, like pollution, that are a cost to society. The producers don't bear those costs; society does. There has to be a way to level the playing field and cause those forms of energy to bear their true costs.*

EXTRAS

SAMPLE QUOTES

Ron Paul

While it is evident that the human right to produce and use energy does not extend to activities that actually endanger the climate of the Earth upon which we all depend, bogus claims about climate dangers should not be used as a justification to further limit the American people's freedom.

John Kerry

We can no longer allow America's dependence on foreign oil to compromise our energy security. Instead, we must invest in inventing new ways to power our cars and our economy. I'll put my faith in American science and ingenuity any day before I depend on Saudi Arabia.

Ned Flanders
(The Simpsons)

Science is like a blabbermouth who ruins a movie by telling you how it ends! Well, I say there are some things we don't want to know! Important things!

Russell Moore
Southern Baptist Theological Seminary

The Apostle Paul says in Romans 1 that the Creation itself reflects God's eternal power and divine nature. Good science searches the order of that Creation; faith informs our response to that data. Bob Inglis tells me that the Energy and Enterprise Initiative will be a place of science that understands man cannot live by data alone, but also by awe, wonder, and action. That's a good objective.

EXTRAS

SAMPLE STORY GMO FOODS

from www.infowars.com

America has been decimated by the breakdown of the separation of powers between different branches of government. For example, the executive branch is negotiating laws in secret, and grabbing powers, without telling Congress. And life-and-death decisions about who the government labels an "enemy combatant" and assassinates are being kept away from the judges altogether. At the same time, government agencies like the FDA go to great lengths to cover up the potential health damage from genetically modified foods, and to keep the consumer in the dark about what they're really eating. Remember, genetically engineered foods have been linked to obesity, cancer, liver failure,infertility and all sorts of other diseases.

Things are about to get a lot worse within the next week… unless we stand up and say "NO!" Specifically, a law has been snuck into the Agriculture Appropriations bill – which will be approved by March 27th – which would destroy the separation of powers by stripping courts of the power to challenge genetically modified foods.

How? The "Monsanto Rider" (section 735) uses "farmer-friendly" happy talk, but is an iron-fisted ploy to allow GMO crops to be planted even if a court has ruled that planting them is illegal.

If the United States Department of Agriculture, which suffered "regulatory capture" by the big food companies decades ago, approves a genetically modified food without any testing, a court can enjoin (i.e. halt) production of that food until testing occurs. Yet the Monsanto Rider would strip the courts of power, and would allow GMO crops to be planted and put in our food.

http://www.infowars.com/action-alert-we-have-1-week-or-less-to-stop-genetically-engineered-foods-and-destruction-of-the-separation-of-powers/

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