An Epistemic Epidemic: The Role of Risk in the Crisis of Scientific Authority

Maya Sophia McClatchy
Bard College

An Epistemic Epidemic: The Role of Risk in the Crisis of Scientific Authority

Senior Project Submitted to The Division of Social Studies
of Bard College

by
Maya McClatchy

Annandale-on-Hudson, New York
May 2020

"It is not a matter of learning how to repair cognitive deficiencies, but rather of how to live in the same world, share the same culture, face up to the same stakes, perceive a landscape that can be explored in concert."

Bruno Latour, Down to Earth

Acknowledgments

This would not have been possible without the amazing, endless support from my parents, my aunt Ilene, and uncle Daniel. Thank you all for supporting me from beginning to end. I am also extremely grateful to Daisy Noe, for the writing advice and for listening to and talking about this project for entirely too many hours. It would have been much less enjoyable without you. Finally, thank you to Gregory Moynahan, Michelle Hoffman, and Kathryn Tabb, this project could not have happened without your many insights and your reassuring encouragement.

Table of Contents

✧ INTRODUCTION ✧

Whether seen in the slow response to climate change, the rising belief in creationism, or the anti-vaccination movement, the present crisis of scientific authority has become obvious. Why has society been so slow to act on the science of climate change? Why has the safety of vaccination come under attack after decades of incredible accomplishment? Why has trust in science not grown with its increasing success? In part, the undermining of scientific authority in twenty-first century America can be dismissed as the result of the misinformation, disinformation, or simple misunderstanding resulting from internet research or so-called “fake news.”[1] However, even more fundamental to the incoherency of the modern American culture of science is a misconception of the actual intellectual authority of a scientific fact.

In the twenty-first century United States, the I pose of rejecting the policy recommendations of the scientific community is generally dismissed as fundamentally non-scientific. I argue that it is not a rejection of science itself, but the result of a misinformed perception of the meaning of scientific knowledge. Exploring the intricacies of the problems posed by inductive risk, the risk in a scientific claim being made and acted upon in error, can help clarify both this misunderstanding and its prevalence. Despite popular perception, scientific authority is ultimately *not* grounded on independent reasoning and completely definitive evidence. Instead, the strength of scientific objectivity comes definitively from the social, plural, devices of a diverse thought collective which exists within a degree of certainty. The difference between the two ideas of scientific authority become particularly clear when we consider the

---

[1] Nicole A. Cooke, *Fake News and Alternative Facts : Information Literacy in a Post-Truth Era*, ALA Editions Special Reports (ALA Editions, 2018).

problem of inductive risk. The former definition of science sees scientific facts as absolute and given, and thus inductive risk as settled – risk is known, and does not have to be mediated by society. Yet the actual establishment of a scientific fact always involves collective calculations of inductive risk. The assessment of scientific risk has become often misunderstood, because it is seen as an unambiguous absolute matter when the reality of scientific risk is inherently collective and social. Reconciliation of the currently inconsistent ideal of science in modern culture should be in regard to a common understanding of the collective authority of science and its associated risk.

In regards to the question of undermined trust in scientific authority, arguments often appeal to a socially reflexive philosophy of science. This problem of mistrust in science, which has been of continuous interest in the philosophy of science, has been recently addressed by philosophers including Naomi Oreskes in her book *Why Trust Science*, in which she makes a case that the social character of science makes it trustworthy. She holds that science should not be trusted through blind faith, but that the social accountability of scientific development means that it is fundamentally dependable. A related point is made in the new book *Down to Earth*, where Bruno Latour argues that the destruction wrought by climate change is exacerbated by the loss of a commonly understood reality. Heather Douglas in her book *Science Policy and the Value-Free Ideal*, and Kevin Elliot and Ted Richards in their book *Exploring Inductive Risk*, respectively argue for the necessary presence of social values in science by virtue of its uncertainty, and illustrate through case studies how risk in science necessarily brings social values into scientific reasoning. Both emphasize the importance of a heterogeneous assessment of risk for a successful practice of science, and that the concept of risk in scientific uncertainty is fundamental to both the social authority *and* social mistrust in science. I posit that the socially reflexive grounds for trust, as argued for by people like Oreskes and Latour, are fundamentally organized by the characterization of risk. Only the heterogeneous assessment of risk as emphasized by Doulgas and Elliot can be successful in the modern context of a socially reflexive authority of science.

Chapter one outlines the history and philosophy of science as a social epistemology, concluding that the authority of science in its modern state is necessarily collective. While many traditional philosophies of science have held that its objective authority is derived from indivdualist logic, I argue on the basis of intersectional feminist philosophy of science that there is greater objective strength in a collective assessment of evidence. By investigating the reasoning behind both sides of the vaccination controversy, chapter two argues that the anti-vaccination movement should not be dismissed as fundamentally un-scientific, but corrected in its misconceived understanding of scientific authority. This acts as a case study for the phenomena of risk-based rejections of science in modern America. Finally, chapter three concludes that the American ideal of science is incoherent as a whole, as it currently stands. While the ideal of the independent authority of science is not illogical in itself, it leads to unreasonable judgments when used in the context of a system based in collective authority.

The consequences of a misguided characterization of scientific authority have already been felt in changes in the global climate, and in the resurgence of eliminable diseases.[2] Most recently, they were demonstrated in the appalling underperformance of the United States' civilian response to the global Coronavirus pandemic of 2019 and 2020. Although this argument

---

[2] CDC, "Measles Cases and Outbreaks," Centers for Disease Control and Prevention, November 12, 2019, https://www.cdc.gov/measles/cases-outbreaks.html.

preceded the development of this pandemic, the implications of a misconceived authority of science are most clearly realized in responses to the new reality of Coronavirus. The 2020 pandemic is the result of an outbreak of a newly discovered type of Coronavirus which causes the sometimes deadly and very contagious respiratory illness COVID-19. The best and most effective way of curbing the spread of this virus, and thus saving countless lives, is to limit viral spread by practicing social distancing: simply staying away from others. In the absence of an effective vaccine, which, at present, is not on the near horizon,[3] only social distancing can keep this virus from spreading unchecked through the world's population.

The public health principle of social distancing as a response to COVID-19 has led to the implementation of national stay-at-home orders in the United States and in many other nations. These orders mandate that all individuals in the community physically distance themselves whenever and wherever it is possible, until the spread of COVID-19 has been brought under control. The mandate for social distancing is based on a scientific understanding of the Coronavirus, its spread, effects, and how to best cope with its presence. However, there is surprising resistance to the policy of social distancing among certain groups of Americans. I believe that it is a misguided understanding of scientific risk and authority, in the common ideal of science, that has prevented an appropriate response in light of the scientific knowledge about the Coronavirus.

This could not be more explicitly illustrated than in the protests against social-distancing policy. In April 2020, several U.S. states including Michigan, Washington, and Colorado saw demonstrators on the street protesting lockdown policies put in place by national and state

[3] Nir Eyal, Marc Lipsitch, and Peter G. Smith, "Human Challenge Studies to Accelerate Coronavirus Vaccine Licensure," The Journal of Infectious Diseases, accessed April 30, 2020, https://doi.org/10.1093/infdis/jiaa152.

governments. Protestors did not say their disagreement on the prudence of social distancing was due to disbelief in the science regarding Coronavirus, instead "they were concerned that their constitutional rights and freedom were being curtailed in the fight to contain the pandemic. Many were also frustrated that they could not work or lost their jobs due to state lockdowns."[4] In other words, they resisted the stay-at-home orders because of a different and misinformed perception of risk.[5] The disagreement is not about the empirical reality of the Coronavirus. The point of contention is that the risks and benefits of social-distancing as a *response* to this empirical reality are judged differently. The different judgments of its risk are the result of weighing individually incurred losses over that of the collective.[6] Rather than following the collectively-objective determination of risk, society's focus on the independent authority of science allowed people to determine the risk in social-distancing to be greater than the risk in unchecked spread of COVID-19.

However, the real risk in this context is decidedly not at the individual scale, but faced by society as a whole. Because the consequences of violating social distancing measures are collective, the objective judgement of its risks must also be collectively informed. Personal judgment of this risk is simply less objectively accurate than a collective one. The distinctions between these two assessments are lost to the misconception of scientific authority as independently determined, thus leading to a truly dangerous epistemic standard. If the individual outweighs the collective in judgment on scientific evidence, even in this unprecedented

[4] "What and Who Is behind the US Anti-Lockdown Protests?," accessed April 28, 2020, https://www.aljazeera.com/news/2020/04/anti-lockdown-protests-200420180415064.html.
[5] Hunt Allcott et al., "Polarization and Public Health: Partisan Differences in Social Distancing during the Coronavirus Pandemic" (Cambridge, MA: National Bureau of Economic Research, April 2020), https://doi.org/10.3386/w26946.
[6] Nicholas Bogel-Burroughs, "Anti-Vaccination Activists Are Growing Force at Virus Protests," *The New York Times*, May 2, 2020, sec. U.S., https://www.nytimes.com/2020/05/02/us/anti-vaxxers-coronavirus-protests.html.

circumstance of a global pandemic, it is certain that the independent outweighs the collective authority in less obviously mutual questions as well.

CHAPTER 1. EPISTEMIC CULTURE

From space travel to dental floss, from the internet to clean water, the organization of modern society is contingent on the trusted application of scientific knowledge. Scientific concepts are the basis of the societal understanding of contemporary food and health systems, transportation, manufacturing, and even modern metaphysics. They have pushed the bounds of what was once thought possible, and have changed the human capacities for controlling the environment. Given a culture that is physically and intellectually dependent on a comprehensive understanding of scientific epistemology, a consistent and rational vision of the intellectual basis for scientific authority is paramount in maintaining a functional cultural epistemic space. Otherwise, idiosyncrasies inherent in the assessment of scientific risk will inevitably erode the common understanding of scientific claims, making them useless for policy making or other recommendations.

The grounds for a social trust in science depend on a coherent vision of scientific authority. The traditional understanding of this authority is based on individualist reasoning, but the evolution of science in modern society dictates that its authority is necessarily collective. As science becomes increasingly social in its applications, and thus in its consequences, the assessment of its risk becomes less specific to individual perception and can only be accurately understood through the diverse perspective of the community as a whole. I will argue that the intellectual authority of science comes from the social process of the rigorous vetting of empirical evidence through transformative interrogation and socially reflexive[7] dialogue. It is only after such vetting that the fears and mistrust of the public can be alleviated, making a social understanding of scientific authority essential to its continued authority. Scientific authority has traditionally been attributed to the independent objectivity of science, as established through the assessment of the individual scientist. Nevertheless, the real authority of science is in its collective reasoning. As risk in science can only be made sense of in terms of collective assessment, the strength of a scientific claim is not independent but cooperative. Scientific authority comes from the plural activities of corrective criticism and mutual modulation of risk.

✧ SOCIAL EPISTEMOLOGY OF SCIENCE ✧

The centrality of science in contemporary culture has lent it toward many different applications, and this diversity has prompted many different visions of scientific rationality. These varying characterizations have, in turn, clouded the lay recognition of the source of scientific authority, without which there is no basis for the public to trust the claims of the institution of science. The process of the scientific institution's solidification into a cultural ideal has, on one hand, facilitated the potential of scientific and technological thinking at every level of society. Unfortunately, over the course of this shift, the institutionalization of science has overwhelmed much of the opportunity for appreciation of the actual basis of scientific truth. In understanding science merely as the products of its institution, the non-scientist has come to act as a consumer of scientific facts, such that these facts are perceived as final, static products of a perfect, objectively-true knowledge-making machine. This impression of independent

[7] "As a method or theory characteristic in social sciences, reflexivity means 'taking account of itself or of the effect of the personality or presence of the researcher on what is being investigated.'" [Popoveniuc, "Self Reflexivity. The Ultimate End of Knowledge."]

infallibility in the understanding of the actual social rationality of science does a disservice. By detracting from the collective understanding of scientific authority, this narrative chips away at the cultural foundations of trust in science.

This is the purview of the philosophy of science; an academic tradition developed to articulate the source of the special authority of scientific knowledge. As science has become evermore central to the behavior of people in modern society, the field of the philosophy of science emerged in an attempt to understand and to define with greater nuance the actual epistemic value of scientific inquiry. While arguments for the authority of science have historically favored the independent objectivity of empirical facts, those that have come out of the deeper reflection afforded by the new philosophy of science lean toward a socially reflexive ideal. Following its mid-twentieth-century solidification as a discrete academic field,[8] philosophers of science fell into and became tangled in an ideal of science that can be summed up in the popular, but ultimately misleading, catch-all ideal of *logical positivism*.[9] This philosophy, also known as 'logical empiricism,' holds that the strength of science lies in the capacity of individual reasoning to come to an understanding of independent, necessary truths.

The late nineteenth and early twentieth centuries was a period of overwhelming emphasis on logical positivism as the standard characterization of scientific authority. Rudolf Carnap and his contemporaries in the Vienna Circle, who are credited with defining this field, held that direct empirical verification was the only legitimate means to true knowledge. This circle believed that it was through the reasoning of an individual rational agent that empiricism establishes absolute

[8]Janet A. Kourany, *Philosophy of Science After Feminism*, Studies in Feminist Philosophy: (Oxford University Press, 2010), 21.
[9]Ibid, 22.

and necessary truths.[10] The view that science provides certain knowledge "is an old one, but it was most clearly articulated by the late-nineteenth century positivists, who held out a dream of positive knowledge–in the familiar sense of absolutely, positively true."[11] The concept of the 'positive truth' of science (as both independently and absolutely true) has been sustained in the popular ideal of scientific authority, despite its perpetually deficient epistemic logic.

Even during the twentieth-century era dominated by logical positivist thought, there were a number of academics who consistently challenged the strength of this view of scientific authority. Among these dissenters were people like Karl Popper, who argued against the possibility of positive knowledge, establishing "critical rationalism."[12] Through his focus on falsification in science, Popper argued that science could only ever disprove (i.e. negatively prove) a claim, that it was incapable of creating any "positively" certain knowledge, and that science can thus only definitively say what is *not* true. In contrast to Popper's criticism of logical positivism was Willard Van Orman Quine's popularization of the radically skeptical view of the under-determination in science. Quine argued that empirical knowledge is merely "a web of belief" rather than necessary truth.[13] Because of the problem of the underdetermination of evidence, Quine argued that there are no robust grounds for scientific claims, setting the stage for the emergence of the new critical field of science studies. These arguments challenged the logical-positivist principle, which has been widely sustained in contemporary thought, that facts of science have an untarnished and necessary objective reality.

---

[10]Kourany 2010 24.
[11]Naomi Oreskes and Erik M Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York, NY: Bloomsbury Press, 2010). 267.
[12]Naomi Oreskes, *Why Trust Science?* (Princeton, New Jersey: Princeton University Press, 2019), 26.
[13]Ibid, 38.

There is nothing inherently negative in holding science to be the truth, except when the value of scientific knowledge is falsely attributed to its characterization as invulnerable objective fact. This view that science is positively-certain in its uncompromisingly independent reasoning is not recent, and has been solidified in the common cultural understanding of scientific authority. Contrary to this impression, science can be understood as a primarily social system of epistemology. This slant was posed by Ludwik Fleck in his book *Genesis and Development of a Scientific Fact* (published 1935)*,* where he reframed science as an inherently communal activity and argued for a thought collective. Fleck opened up a new avenue for a social understanding of science, arguing that "the conceptual creations of science, like other works of the mind, become accepted as fact through a complex process of social consolidation."[14] By this standard, the objective value of scientific knowledge is not because it is beyond human bias, but because principles of critical dialogue and experiential evidence hold it empirically as well as socially accountable. It is *because* science is social, not because it is somehow extra-social, that individual observation and experiment are valuable in the creation of knowledge.

The understanding of science as having inherently independent authority eventually led to the development of the "value-free ideal" of modern science, which holds that the authority of scientific knowledge is because it is fundamentally value-neutral.[15] The critical mistake in this sort of 'objective' characterization of scientific knowledge is that it fails to recognize the actual intellectual, rational authority that *can* give science a special value in the world of competing narratives of truth, namely its collective accountability. It facilitates control and imparts

[14]Ludwik Fleck et al., *Genesis and Development of a Scientific Fact*, Repr. 11. Aufl, Sociology of Science (Chicago [u.a]: Univ. of Chicago Press, 2008). Preface, viii.
[15]Heather E. Douglas, *Science, Policy, and the Value-Free Ideal* (Pittsburgh, Pa.: University of Pittsburgh Press, 2009).

invaluable insight; it does not need to grant categorical ontological perfection to be epistemically valuable.[16] The emphasis in the criticism of each of these modern cultures of empiricism –logical empiricism and the value-free ideal– is directed at the false impression of the infallibility of information labeled as scientific.

✧ RISK & UNCERTAINTY ✧

Debates about the strength of scientific authority are recurrent through the entire history of science. Social trust in science is tested whenever something like Darwin's theory of evolution or Einstein's theory of relativity is poised to overturn the foundations of previous metaphysical understanding. In light of the history of overturned scientific facts, what affirms that the claims of science are more absolute than alternative competing explanations? The greater epistemic weight granted to science begins at its empirical-evidential basis, and its objectivity is sustained beyond evidence through its systems of intellectual and social accountability. This is accomplished within the scientific community by the challenging and adjusting of a theory through critical dialogue, thus revealing and correcting assumptions that might have made a claim less than accurate.

Before the testing and correction of a theory, the authority of science is constructed on the collection and organization of physical observations. This is a more concrete kind of intellectual building block than things like opinion or faith that, while of irreplaceable value in social knowledge, do not indicate any necessary truths. The epistemic rationality of principles like faith are mutable by nature, while experience and experimental conclusions are only

[16] This argument leaves aside the question of the ontological accuracy of scientific inquiry. While it is closely related to the question at hand, it is a more fundamental question of semantics of scientific thought, and its resolution has different concerns than the practical reality of science. This argument starts from a position assuming, on the whole, the ontological reality of scientific inquiry.

amended by new, further-informed, evidence. The kind of knowledge that faith based systems like religion, or opinion based systems like politics, give rise to is essential to society, but is less than successful in accurately explaining the nature of anything beyond an individual human perception. Although science has a degree of inevitable uncertainty, scientific facts nevertheless have a stronger foundation than do ideas based in inherently mutable reasoning.

Scientific knowledge is exceedingly successful in its predictive utility. It does not discriminate in its laws, and this lends it a universal invariability that is not present in most knowledge systems. It is an empirical fact that hitting a glass that is sitting on the edge of the kitchen table with force will knock it onto the floor–scientific knowledge can tell you that the glass will fall to the floor every time it is hit, and in this way can inform future actions and behaviors. If the desired goal is to keep the glass on the table one could choose not to hit it, and if for some reason the desire is to remove the glass from the table one could choose to knock it onto the ground. The glass will fall to the floor regardless of the kind of person knocking it, the location of the table on earth, or the original intent behind the motion. The laws of gravity and the conservation of energy will always dictate the same outcome in the case of the same action–they are universally inclusive. Science cannot tell you what outcome of a given action is preferable, but it can predict the likelihood of an outcome that will occur in the case of a certain action. Because it can indicate, without the bias of an independent personal perspective, the outcomes likely to occur in the case of a certain action, science is uniquely qualified for informing decisions.

The universality of scientific claims is owed to the method of inductive logic: the derivation of universal laws from particular evidence. Induction is the epistemic principle of the organization of particular evidence to indicate general trends. It is the move from a collection of evidence (e.g. the observation that all swans one has encountered have been white) to a general law (e.g. that *all* swans must be white). Once a general principle is inductively established and tested, such as the rule that all swans are white, this can serve as a foundation for further rational extrapolation through *de*duction. Deduction is the companion to induction, which works by the application of a general law onto a specific phenomenon (if all swans are white and one encounters a black bird, they can deduct that this bird is not a swan). With inductive logic a general law can be established by specific evidence, and through deduction an insight about a particular phenomena can be gained from the application of general law. Scientific facts are most often supported by a combination of inductive and deductive reasoning, and thus empirical laws are true both generally and explicitly.

The maneuverability of scientific knowledge between the scales of general and particular is the origin of the universal invariability of scientific facts, but this generality is also what makes science vulnerable to uncertainty. As Heather Douglas has written:

> "the generality that opens up scientific claims to future refutation is the source of uncertainty in science, and the source of its utility. Without this generality, we could not use scientific theories to make predictions about what will happen in the next case we encounter. If we want useful knowledge with predictions, we have to accept the latent uncertainty endemic in that knowledge."[17]

This latent uncertainty is owing to the "chronic incompleteness of evidential support"[18] in empirical claims, the unavoidable reality of science. This uncertainty does not mean that science is inaccurate, but that there is a degree of risk in acting on its claims.

---

[17] Douglas 2009, 3.
[18] Ibid.

Although the principles of scientific inquiry are an unparalleled means for understanding the real nature of the world, this does mean science is entirely certain. Because of the inductive foundations of scientific reasoning, there is always a possibility, no matter how slight, that a theory is in error. This problem of the uncertainty of evidence is illustrated in the archetypal thought experiment the Black Swan Dilemma. Imagine: a person observes many white swans. Every swan they have ever seen is perfectly white, and every time they encounter another swan it is entirely white as well. Now imagine this bird watcher goes on an expedition and sees hundreds, or even thousands, of swans in many places and each and every one is perfectly white. They might declare it to be a rule that every bird that is a swan must be white, and, by the rules of inductive logic, they would be largely justified in doing so. However, it would always remain a possibility that around the next corner there is a *black* swan, an outlier case. Unless this swan-obsessed person were to collect each and every specimen of swan that is in existence, there would always be a chance that they are in error in claiming that it is a general rule that *all swans are white*. It is only from the empirical evidence which has been collected that a scientist can build out a deeper understanding of natural laws, but it is perpetually possible that their evidence is lacking.

This black swan phenomenon is an example of the theory of inductive risk: "Inductive risk, a term first used by Hempel (1965), is the chance that one will be wrong in accepting (or rejecting) a hypothesis."[19] Because empirical evidence can never be complete, there is always a chance that a hypothesis can be accepted when it is in fact false, or can be rejected when it is really true. By nature, inductive conclusions are always open to revision. An initial hypothesis is

[19]Heather Douglas, "Inductive Risk and Values in Science," *Philosophy of Science* 67, no. 4 (2000), 561.

based on a given body of evidence, and should that body of evidence change (say with the discovery of a new or contradictory piece of evidence) the original conclusion would have to be revised in light of the new information. If evidence can never indicate an outcome beyond a shadow of a doubt, there will always be a leap of faith when accepting a theory and its evidence as a fact. The risks entailed in making this leap dictate when and whether it is worth making. The chances of this judgment being made in error, as well as the consequences should the theory prove to be wrong, represent the degree of inductive risk.

It is important to note here that the problem of "black swans" in scientific knowledge is exacerbated by the increasing everyday utility of science. The relative importance of the possibility of the unexpected depends on the *consequences* of the unexpected becoming reality. Nassim Taleb's *The Black Swan: The Impact of the Highly Improbable* delves into the difficulties of improbable outcomes for knowledge. According to Taleb, a 'Black Swan' event is identifiable by their "rarity, extreme impact, and retrospective (though not prospective) predictability."[20] Taleb says it is not the expected white swan, but the unexpected black swan that is most important to the progression of knowledge. The black swan is something that is thought to be impossible until it comes to pass, at which point human nature will try to account for its occurrence in hindsight. The trick in science is that, while an outcome might be unexpected, it only has 'extreme impact' in cases where it is socially significant. There is no consequence to a scientific claim unless it is acted upon, and so the prevalence of science in everyday decisions directly increases the possibility of unexpected outcomes, thus increasing risk. The more socially

---

[20] Nassim N. Taleb, *The Black Swan: The Impact of the Highly Improbable* (NY: Random House, 2007), xviii.

ingrained science becomes, the higher the possibility of a black swan event, which complicates the project of tempering scientific uncertainty.

Given that the epistemic principles of science are based in inductive and deductive reasoning, empirical facts are indeed perpetually uncertain. Nevertheless, this uncertainty is not taken as a condemnation of the strength of scientific authority by either philosophers or practitioners of science. Rather, as Douglas argues, "that it is not dogmatic in its understanding of the natural world, that it recognizes the inherent incompleteness of empirical evidence and is willing to change when new evidence arises, is one of the reasons we *should* grant science a prima facie authority."[21] The lack of certainty in its epistemic structure is not an Achilles heel for science if science is understood in its capacity as a social-epistemic enterprise. On the contrary, the recognition of the structural ambiguity of evidence is what allows for that uncertainty to be mediated in the methodology of the scientific community.

✧ CALCULATING INDUCTIVE RISK ✧

The inductive logic of science has the perpetual difficulty of uncertain evidence, as iterated in the earlier story of the black swan. Even with substantial evidence showing that swans are always white, there is a perpetual possibility of error. This story chronicles the difficulty of induction, and the unavoidable uncertainty in its declarations. Even with ample evidence, inductive reasoning (generalization of a rule or principle from the particular case to a universal law) can never claim absolute factual finality. This violates a commonly held expectation for scientific knowledge, namely that its independently-positive empirical reasoning establishes absolute truth. This is precisely the kind of mischaracterization of scientific authority that is

[21]Douglas 2009, 3. (emphasis added)

flagged in this essay; it is not the rational impenetrability of an isolated scientific claim that gives science authority. Instead, the strength of its accuracy is due to a mutually determined objectivity. It is precisely because of the social model of knowledge in the scientific dialogue, motivated by the mitigation of potential risk, that science *is* authoritative in its claims.

Mitigation of risk in science is tangled with the questions of social values in science, and what, if any, role they should fill. Carl Hempel's work is central to the philosophical dialogue on this subject, "[encapsulating] the main arguments over values in science from the debates on that issue from 1945-1965."[22] Hempel's work laid out the principles for many subsequent explorations into both the idea of risk as it relates to social values, and of the spectre of risk in science more generally. To quote Heather Dougals's synthesis of Hempel's argument:

> "According to Hempel, value statements have no logical role to play when one is trying to support a scientific statement. Judgments of value lack 'all logical relevance to the proposed hypothesis since they can contribute neither to its support nor to its disconfirmation.' (91) This traditional view does not encapsulate the entirety of Hempel's thinking on science and values, however. Hempel holds that values can serve as presuppositions to what he calls scientific *method*. Because no evidence can establish a hypothesis with certainty, 'acceptance (of a hypothesis) carries with it the 'inductive risk' ' that the hypothesis may turn out to be incorrect. Inductive risk is the risk of error in accepting or rejecting hypotheses."[23]

The presence of social values in science can be understood as regulatory in terms of mitigating acceptable degrees of risk. Even if social values do not have a reasonable place in all internal mechanics of science (such as in observation, quantification, etc) they remain valid and positive contributors to the aspects of the scientific method which overlap with non-empirical concerns–in this case, the *structure* of the scientific method. Social values can successfully

[22]Douglas 2000, 560.
[23]Ibid, 561.

determine much of a method, from the details of how data should be collected to what questions can or should even be asked in the first place. They also define when, and how much risk is acceptable in a claim. This varies from case to case, as it is of markedly higher consequence to err in claims of the nature of atomic detonation than in the amount of baking soda required for a desired fluffiness in a cake. As there are next to no notable ethical implications from incorrectly defining the proper amount of baking soda in a cake, the tolerance for uncertainty is significantly higher than in, say, the Trinity Test of the first nuclear bomb. Each of these is a question of inductive risk, but the tolerance for uncertainty in each respective instance is determined by associated ethical concerns.

This points to an essential question: how is acceptable risk measured? Risk being such a highly variable principle lends it a sort of mystery. The nature of risk always has to do with the unknown, never what is known for sure. Perceiving risk also requires an ethical investment on the part of whoever is assessing it, as there is only risk in an action if one outcome is valued over the other. To explain how a variable as inconstant as risk can be quantified, an example from the world of professional science is useful. Jacob Stegenga gives just such an example in his 2017 essay "Drug Regulation and the Inductive Risk Calculus," in its illustration of the difficulties surrounding inductive risk in pharmaceutical development. Stegenga says:

> "If regulators reject an experimental drug when it in fact has an unfavorable benefit/harm profile, then a valuable intervention is denied to the public and a company's material interests are needlessly thwarted. Conversely, if regulators approve an experimental drug when it in fact has an unfavorable benefit/harm profile, then resources are wasted, people are needlessly harmed, and other potentially more effective treatments are underutilized."[24]

[24] Jacob Stegenga, "Drug Regulation and the Inductive Risk Calculus," in *Exploring Inductive Risk: Case Studies of Values in Science*, ed. Kevin Christopher Elliott and Ted Richards (Oxford University Press, 2017), 17.

The possibility of either of these two outcomes (as opposed to rejecting a harmful drug, or approving a beneficial one) represent the practical risk of induction. The likelihood of a negative outcome dictates when and whether the risk of induction is worthwhile. The questions of when and whether are not only dependent upon how likely something is to be correct, but also on the implied consequences if it were to prove to be incorrect.

The difficulty of induction comes principally from the necessary uncertainty implied in the word itself. That a fact has to be reached through inductive means seems to indicate that it is not self evident; that it may not be a necessary and inevitable truth. This position has been detangled by philosophers of science who have shown that risk in induction is not necessarily damaging to scientific authority. The ideal of a self evident, necessary, and inevitable truth is a fundamentally misconceived vision of the work done by science. From regulation of acceptable risk in different circumstances, to improving the avenues of knowledge sharing for the best informed perspective, the entire methodology of science is tailored to ensuring that the inductive gap is not too large to prevent a successful explanation of reality through empiricism. Because there are countless approaches to mitigate any problematic uncertainty, the products of science do not need to be absolute to be true.

Jacob Stegenga offers an analysis of one of the clearer mechanisms for the mitigation of this space of uncertainty, the "inductive risk calculus" (IRC). IRC offers a method for actualizing empirical consistency in the matter of assessing risk. In the essay referenced above, Stegenga outlines the procedure for risk assessment as it plays out in pharmaceutical drug production and regulation. It comes down to a balancing act between the fear of withholding drugs which could improve or even save lives, and the possibility of marketing a drug that will negatively impact (or possibly end) the lives of those who take it. Stegenga says:

> "We can conceptualize a scale of inductive risk: on one end of the scale is certainty that the error of unwarranted approvals is avoided (and thus high probability that the error of unwarranted drug rejections is committed) and on the other end of the scale of certainty that the error of unwarranted drug rejections is avoided (and thus a high probability that the error of unwarranted drug approvals is committed). Between these two extreme ends of the scale of inductive risk are intermediate positions."[25]

To establish the inductive risk of any particular claim is a matter of determining where it falls on this scale. In the world of the regulation of drug production this is a formal, quantified matter like a literal calculus. There is a fixed industry standard for the acceptable methodology to be followed in a given scientific endeavour, detailing the required types of trials, the minimum participants, the times the trial has to be run, et cetera.[26] There is also a predetermined industry standard for an acceptable degree of risk.[27] With these standards already codified, the matter of risk assessment is a mathematical calculation. It has a formula, and facts and figures to plug into that formula in order to ascertain whether the risk/benefit profile for any specific drug is acceptable. Only if a newly manufactured drug passes this test will it be brought to market.

I invite you to consider the nature of this scale of risk. When approached with the regulatory specificity of a formal agency, the calculation of risk gives the impression of being able to indicate, with authority, whether the risk in acting on a scientific claim is acceptably minimal or is not worthwhile. In the absence of this imposed (and relatively arbitrary) standard

---

[25]Stegenga 2017, 22.
[26]Ibid, 19-20.
[27] It should be noted that this is a matter of ongoing contention between the FDA and pharmaceutical companies. Each party has a different perception of acceptable risk, determined by their values and responsibilities. (Stegenga 2017, 22.)

for acceptable risk, where does the line of eligibility fall? Is there a certain point on this scale one can locate as the epicenter of morality? Unfortunately, there is no stable or "objective" standard which can be imposed on the question of acceptable risk in acting on a scientific claim. The question is an intrinsically subjective one. The activity of establishing the risk in an action is not, cannot, and should not be an affair aiming for value neutrality.

Risk is never static. The perception of risk in a given action can be shifted by countless factors, from potential consequences, access to evidence, and ability to navigate said evidence, to the personal experiences and unconscious biases of the individual assessing a risk. Things such as a commonly recognized standard (as in the case of pharmaceutical regulation above) can help to stabilize and lend consistency to how these factors are weighed, but even in these circumstances the question of what to weigh in this calculus and how much weight respective factors should be given is highly antagonistic. Stegenga's 'Drug Regulation and the Inductive Risk Calculus' argues that there is a reasonable and ethically necessary place for certain non-epistemic values in the determination of the IRC itself.[28] He does not argue for indiscriminate inclusion of values, but that certain non-epistemic values can be justly included while others remain inappropriate for the goal of science.

The concept of Inductive Risk Calculus is central to this thesis, but in a somewhat altered form than in Stegenga's own work. His own application of the idea is specifically in matters of professional assessment of risk, through a literal mathematical formula. I am exploring the mechanisms of this IRC in a more abstract application. Stegenga's strictly formalized calculus acts as a metaphor for the weighing of risk that happens in every decision of action, even if

[28]Stegenga 2017, 19.

unconsciously. In making a decision to act one way and not another, or not to act at all, a person has to consider the potential outcomes of their behavior and the respective likelihoods of each. Getting into the car to commute to work is (usually) deemed to be a reasonable action because the risk of injury is relatively low, and the benefit in keeping a job is extremely valuable. This is what I call an 'independent IRC,' through which a person determines a certain action to be worthwhile or otherwise. Given an understanding of science as independently absolute fact, this independently IRC can be mistaken for an objective measure.

In this sort of decision a person is unlikely to articulate each factor and *consciously* consider the weight they ascribe to each, but it holds that there is a more-or-less abstract process of the weighing of different possible outcomes, and of the desirability of each. It is a premise of my argument that, in making a judgment on whether or not to act on a claim of science, an individual must go through some version of this calculation of risk. An independent IRC is likely to be far a simpler model than a formal assessment of risk, and may not be articulated. Nonetheless, belief or disbelief in the authority of a scientific fact has to account for its potential consequences.

✧ REJECTING THE VALUE-FREE IDEAL ✧

Heather Douglas presented a leading argument for the epistemic authority of a social account of science in her 2009 book *Science Policy and the Value-Free Ideal*. She argues for a new philosophy of science that recognizes the unique authority of science, and preserves the promise of scientific objectivity. Her philosophy moves away from the socially autonomous norm of science that was popularized in the twentieth century by rejecting the idea that objectivity requires isolation from social values, and thus renounces the epistemic goal of value-freedom. The value-free ideal in science, solidified in the scientific community during the Cold War era, held that there was no legitimate place for social or ethical values in the steps of scientific reasoning. The authority of scientific inquiry was thought to be grounded in methods entirely uninfluenced and unchanged by anything beyond empirical accuracy. However, "the great irony of this history is that the ideal rests on a faulty presupposition, that science is isolated (or should be isolated) from the rest of society."[29] Douglas's argument rests on the simple fact that science, by virtue of its being done by a scientist, is necessarily embedded in society. By virtue of its being a socially embedded system practiced by social agents, scientific knowledge is inevitably a collective enterprise. Its authority is not due to the infallibility of reasoning, but to the mutual evaluation and mitigation of risk.

Douglas challenges the earlier justifications for the value autonomy of science on the grounds of "the endemic uncertainty in science" and "science's importance for public decision making."[30] She identifies the beginning of the cultural tension around the epistemic characterization of science as the 'Science Wars' and 'junk-science' debates that began around the 1960's and pervaded the 1990's. These debates called into question both the relative authority of science compared to other epistemic systems, and the efficacy of the endemically uncertain claims of science for making policy recommendations. Douglas argues that the " same conceptual framework that led to the Science Wars, the idea of science as autonomous and isolated, shaped the sound science–junk science debates,"[31] and that the very same misinformed idea "became a cornerstone of the value-free ideal of the 1960's." It is the principle of value-isolation in the practice and the products of science that has proven to be contradictory to

[29]Douglas 2009, 65.
[30]Ibid, 13.
[31]Ibid, 11.

the real strength of science. Only a careful reintegration of ethical values into the scientific system can correct the socio-epistemic ideal for science. After all, science is not done in a vacuum.

The value-free ideal emerged alongside the professionalization of the scientific community in the mid-twentieth century. As the recommendations of this institution became ever more central to social organization and policy decisions, "the idealized image of the isolated scientific community gained prominence"[32] and it became the social-epistemic standard that scientists should rely "solely on the canons of inference internal to science."[33] This vision of science assumes that it can function only by its internal epistemic principles, without regard for external values, an ideal that is very closely inspired by logical positivist principles. Douglas rejects the possibility of practicing science without incorporating non-epistemic values.[34] She says:

> "When making empirical claims, scientists have the same moral responsibilities as the general population to consider the consequences of error. This apparently unremarkable statement has some remarkable implications. It means that scientists should consider the potential social and ethical consequences of error in their work, and that they should set burdens of proof accordingly. Social and ethical values are needed to make these judgments, not just as a matter of an accurate description of scientific practice, but as part of an ideal for scientific reasoning. Thus, the value-free ideal for science is a bad ideal."[35]

Douglas' rejection of the value-free ideal does not call for the inclusion of ethical concerns at every point in scientific reasoning, but for the careful incorporation of relevant ethical values at

---

[32] Douglas 2009, 65.
[33] Ibid.
[34] "The clear demarcation between epistemic (acceptable) and non-epistemic (unacceptable) values is crucial for the value-free ideal." (Douglas 2009, 90.)
[35] Douglas 2009, 87.

points where epistemic values are necessarily structurally insufficient. One such moment is in the determination of the burden of proof and an acceptable weight of evidence:

> "Science is a value-laden process. From the decisions to do science, to the decision to pursue a particular project, to the choice of methods, to the characterization and interpretation of data, to the final results drawn from the research, values have a role to play throughout the scientific process. We need social, ethical, and cognitive values to help weigh the importance of uncertainty and to evaluate the consequences of error."[36]

This weighing of uncertainty is a question of assessing the inductive risk of a claim, and because it is dictated by risk there can be no objective standard for acceptable certainty in evidence. Social and ethical values are needed to establish such a standard, and are therefore both inevitable and necessary in scientific reasoning. This is the 'argument from inductive risk,' and will be returned to in the following chapter.

Rather than attempting the impossible task of removing any and all social values from science, Douglas argues for a system which carefully tracks and curates the points in the process of scientific reasoning at which ethical values have a legitimate role to play. It is essential to functional science to limit the role of values because, "values are not evidence; wishing does not make it so."[37] Douglas lays out guiding principles for the legitimate and illegitimate roles for values in science, which allow a *direct* role for social values only in the very earliest stages of science. Ethical values can only directly inform things like which question to pursue, or the method through which to pursue it, without negatively affecting the reliability of the conclusion. *Indirectly*, values can have a legitimate role in the evaluation of the consequences of error and sufficiency of evidence, as this is where epistemic values fall short.[38] The argument against the

---

[36]Douglas 2009, 112.
[37]Ibid, 87.
[38]Ibid, 103.

value-free ideal is not an argument for the indiscriminate influence of ethical values in empirical reasoning, but for just the opposite. Because there will be some inevitable influence of social values throughout the process of scientific reasoning, only by acknowledging their presence can scientists reflect on what these values are, and better consider and control their impacts.

Confronted with the epistemic weakness of the value-free ideal, the value-neutral basis of scientific objectivity is no longer a robust one. In the absence of a socio-epistemic ideal of value-freedom, science needs a new source of objective authority. Douglas says, "for so long, we have been convinced that the value free nature (or ideal) of science was what made it valuable. Being value-free gave science its objectivity; being value-free gave science its superior ability to resolve disputes over contentious empirical issues." It was the perception of science's unique immunity to value bias that was considered to be its source of epistemic authority. But, Douglas continues, "the objectivity of science does not fall within the value-free ideal."[39] If not value-neutrality, what is the source of scientific objectivity? In the late twentieth century, the work of feminist philosophers of science established the foundations for a just such an objective measure: one supported by the understanding of science as a collective achievement.[40]

The arguments of Sandra Harding and Helen Longino, among others, emphasised the potential in a social epistemology of science. In her book *The Science Question in Feminism*, released in 1986, Harding reconceptualized the standard of objectivity so that, instead of it being accomplished by the eradication of the value bias in the individual, objectivity can be understood as a collective achievement. This begins from Harding's concept of 'standpoint epistemology,'[41] the argument that a person's own history and social position will always act as a lens through

---

[39]Douglas 2009, 114.
[40]Kourany 2010.
[41]Sandra G. Harding, *The Science Question in Feminism* (Cornell University Press, 1986).

which they view the world. Perception of an object thus varies depending on the standpoint of the perspective, and this means that any individual will have a standpoint-specific view of the world. A more accurate picture of the world, one that is not limited to the perspective of any particular standpoint (in other words, one that is "objective"), can only be made by weaving together a diversity of perspectives.

Harding argued that most scientific objectivity of the time was *weak objectivity*, because it ignored the perspectives of oppressed groups including those of women, people of color, the working class, and others. Because of the discrimination of the scientific community, scientific claims were biased toward the world-perspective of the wealthy white man. Harding argued to replace this with *strong objectivity,* a method that acknowledges the inevitable bias of perspective, and that accounts for this by drawing from the most diverse community possible. The hope is that the views of others can reveal internal biases that an individual might have become blind to, and in recognizing these biases they can be corrected. In Harding's vision of the epistemic authority of science, "objectivity is not a 0/1 proposition: communities could be more or less objective and greater objectivity in scientific research achieved-or at least made more likely-by greater heterogeneity in the scientific community."[42] Objectivity is not a matter of either/or, but is an ongoing transaction of corrective reflection based in diverse perspectives.

In the 1980's and 1990's, Helen Longino argued on a similar feminist platform for the intersectionality of scientific knowledge. By exploring *how* self-correction of science occurs, she furthered the point that a diverse scientific community increases the objectivity of empirical claims. Through her theory of "transformative criticism," Longino argued that the self-correcting

[42]Oreskes 2019, 51.

quality of science is in the constructively-critical dialogue between individual scientists, and across the community as a whole. Harding's theory argued that "it is not so much that *science* corrects *itself*, but that *scientists* correct *each other* through the social processes that constitute transformative interrogation."[43] As an idea works its way through the network of the community, the opportunities for many a critical eye to identify and eventually correct hidden biases are numerous. This happens in the modern institution of science through the process of peer review, but also through innumerable other instances of idea sharing, constructive criticism, and collective reflection that happen daily in the scientific community. It is through the transformative interrogation of the community that the objectivity of a claim can be established, and the more diverse this community the better equipped it is to efficiently find and correct these biases. Longino says:

> "The objectivity of individuals in this scheme consists in their participation in the collective give-and-take of critical discussion and not in some special relation (of detachment, hardheadedness) they may bear into their observations. Thus understood, objectivity is dependent upon the depth and scope of the transformative interrogation that occurs in any given scientific community."[44]

This understanding of objective authority is not dependent on the objective accuracy of the individual, but on the collective perspective achieved by the community as a whole.

This kind of socially reflexive argument laid the foundations for the possibility of Heather Douglas's rejection of the value-free ideal. The tools of a social epistemology of science offer the solution to the continuity of scientific authority, even in the absence of a value-neutral standard for objective truth. While Douglas's argument from inductive risk shows the

---

[43] Oreskes 2019, 51.
[44] Helen E. Longino, *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry* (Princeton, NJ: Princeton University Press, 1990), 79.

inextricable role of values in science and thus the irrationality of upholding the value-free ideal, Longino's and Harding's arguments ensure the possibility of scientific objectivity in its absence. In this understanding, science can be authoritative in the objectivity of its claims, while also defending its socially organized nature.

In summary, science *does* have a stronger claim to insights of objective truth than do most measures of reality, but it is decidedly not because it is somehow an extra-social process untainted by personal values. Science is not extra-social, and so its being outside the reach of social influence cannot be its source of intellectual authority. The independently absolute ideal of science, established by individual reasoning, thus loses its philosophical authority. The combination of empirical premises and the subsequent cross-examination of these premises in the arena of "diverse, 'non-defensive,' and self-critical," scientific debate, together make up the authority of scientific knowledge.[45] The intersectional-feminst understanding of scientific authority reflects the current reality of science: fundamentally social, and socially fundamental. A social characterization is now more necessary than ever, as science is becoming increasingly fundamental in everyday environments and decisions. Because the risk of scientific uncertainty can only be accurately understood in terms of a communal perspective, the authority of modern science values a collective judgment over the reasoning of an individual.

---

[45]Oreskes 2019, 4.

CH 2. INVESTIGATING THE RISK PHENOMENA

The problem of risk based rejection of the scientific consensus appears in many shapes. It is demonstrated in the behavior of groups including the anti-vaccination movement and 'creation scientists,' and can even help to explain the under-regulation of fossil fuels and pharmaceutical development. This phenomena of consensus rejection betrays an understanding of scientific authority as individually determined, a contradiction to the social organization of modern science. Vaccine denialism and other renunciations of the scientific community fail to acknowledge the thought collective that constitutes the authority of socially embedded science; the authority of science in a period where it is as socially ubiquitous as it is today, comes from the communal evaluation and modulation of inductive risk, not individual reasoning. Rejection of the scientific consensus is commonly dismissed and ignored as fundamentally anti-scientific. Through an analysis of the anti vaccination movement, I argue, however, that the reasoning demonstrated by this group does not actually reject science itself. Instead, they are reasoning *with science*, but under a fundamentally misplaced ideal of its authority.

Important to this argument is that the lay scientist is regularly performing a version of an "inductive risk calculus." Even if it is subconscious, the assessment of risk is an inevitable part of the decision process. Just as professional scientists have different moral compasses due to their various roles beyond just that of scientist, and can therefore reach varied conclusions, each individual interacting with scientific knowledge has to assess for themselves whether the risk in accepting a claim is worth incurring. However, the mistake comes when the personal assessment of risk is given more weight than the collective judgment of this risk. In matters of mutual consequence, risk can only be objectively understood through the communal lens. Thus, the elastic reality of independent IRC, paired with an expectation of independently certain objectivity indicates a pseudo-rational reasoning in the rejection of socially consequential scientific claims.

✧ ROLE RESPONSIBILITY ✧

The difficulty in establishing a universally sensible determination of risk comes from the mutability of ethical rules. Everyone has a personal code of morality that is not exactly reflected in any other individual; a sort of ethical fingerprint. There are clear trends of moral standards within groups, such as the systems of morality imposed on a national scale as transcribed in every country's code of law. There are even some principles that are consistent even between cultures, such as the moral good of saving a life. However, these collectively defined rules of ethics do not make up the entirety of the moral compass of any individual. Within these larger systems of ethical expectations there are unique individual standards. Much of the nuance of these personal moral codes can be attributed to a person's *role responsibilities*:

> "Role responsibilities arise when we take on a particular role in society, and thus have obligations over and above the general responsibilities we all share. For example, when one becomes a parent, one takes on the additional responsibility of caring for one's child. This additional responsibility does not excuse one from the general responsibilities we all have, but must be met in conjunction with one's general responsibilities."[46]

It is key to role responsibility that a person is more than likely to be beholden to more than one social occupation at once. As members of society we all have a presupposed responsibility, one derived from our being members of a community in the first place. This is more or less the bare

[46]Douglas 2009, 73.

bones of the concept of a social contract. In the simplest of circumstances this is a straightforward rule to follow: the farmer is responsible for growing food, the teacher for educating the up and coming generation, the politician for overseeing and coordinating the different elements of the community, and each is simultaneously responsible for upholding the basic tenets of society, such as truth-telling and not killing one another. There are certain moral standards that are consistent over all of society, and then there are other layers like a patchwork of responsibilities attached to respective social roles which may or may not overlap.

This is generally a productive social model, but its difficulties come to light where there is a need for a consistent standard of moral behavior. This is precisely the dilemma in the attempt at a determination of a universally acceptable standard for risk. How can any common standard of risk be defined, if every person has a unique set of responsibilities, and thus of ethical concerns? The simple answer is that, it can't. The impossibility of universal standards can be demonstrated by the moral tenet of truth telling, and the respective social roles of a lawyer and of a reporter. In society, it is generally considered a moral good to tell the truth. The justification for the existence of the social occupation of the reporter is founded in precisely this assumption, that it is a productive and worthwhile activity for a person to learn and disseminate the truth about things among the community. Naturally, one of the role responsibilities of a reporter is truth telling. Because of their social occupation, they are under a moral expectation to tell the truth in all circumstances. However, the role responsibilities of a lawyer hold the person in this occupation to precisely the opposite moral standard, as it is the moral expectation that a lawyer will always keep their client's secrets. Attorney-client privilege thus removes the ethical standard of truth telling from the lawyer. Therefore, the morality of a behavior is sometimes determined by the ethical perspective from which it is viewed, as determined by social roles.

The result of these necessary differences in moral perspective is that risk is not an objective factor. It is indelibly tied to its consequences of error, and the rewards and benefits of a consequence will be seen differently depending on one's values. To take an extreme example, the end of the human species by a natural or artificial catastrophe would generally be seen as a negative consequence, but not necessarily. It is negative in regard to the loss of life and civilization, but if one values the richness of non-human nature over the human species in itself it is not a negative outcome. The end of humanity would mean the thriving of the rest of nature, and by the measure of certain value sets this is worth more. Thus, the characterization of consequence depends on moral perspective. As judgment of risk is relative to its consequences, the subjectivity of consequence means that perception of risk will vary between individuals. Therefore, this argument holds that there is no legitimate objectively defined standard for acceptable risk. In their capacity as moral actors whose respective responsibilities are defined by social roles, people will necessarily weigh factors differently in their calculation of risk.

There is no objective, non-valuative standard for risk, but there is also no benefit to having one, as it would be arbitrary. It is detrimental to both the practical and ontological efficacy of science to claim it is value free when this is a functional impossibility. Even without acknowledgment, values will still be incorporated but with less transparency. As a value-free assessment of risk is not possible, in its place the best measure for the accuracy of a socially normative claim is one based on a diverse, multiplicitous perspective. Responsible science should progress with regard to its ethically normative influence, and can only do so with a diversely informed understanding of risk.

✧ VACCINATION CONTROVERSY ✧

Though they are commonly dismissed as thoroughly anti-scientific, I argue that there is some fragment of scientific rationality at the center of the often nonsensical debate about early childhood vaccination. I will identify where the principles of scientific inquiry are followed in the reasoning against vaccination, and where this reasoning proves to fail in scientific principles (as it is far from the epitome of scientific rationality). Inductive risk is at the center of this decision, as one's idea of risk determines the organization of their judgment. It is because of the variability in the personal assessment of risk that varying conclusions can be reached about one and the same body of evidence.

The rationale of the anti-vaccination movement (also referred to "anti-vaxxers"[47]) is an instance of the personal inductive risk calculus, and exemplifies the common missteps in this calculus that lead to a pseudo-rational epistemic space. Vaccination is an unusual debate, if for no other reason than that it questions the efficacy of one of the most well-substantiated scientific technologies of modern society. Recent history can provide mountains of both empirical and social evidence for the efficacy of the science of vaccination. Normal scientific disagreement arises in areas where either evidence is unclear, or where the consequences of action/inaction are not well known. As the case of the anti-vaccination movement can appeal to neither justification,

[47] It is worth noting that members of this group have called out the popular label of "anti-vaxxer" as marginalizing and even derogatory. Instead, they prefer the label of "vaccine risk aware," which reflects that they appreciate that the basis of the disagreement is in regard to understanding of risk. One the other hand, the general refusal of the "risk aware" label is because the conception of risk supported by this group is faulty. They may be risk aware, but their perception of the nature of this risk is fundamentally misconceived. [see citation: "Crazymothers on Twitter."]

what prompts this rejection of this claim of science? I argue that the epistemic flexibility that allows for such drastically divergent conclusions is caused by a combination of (1) the cultural misconception of science as independently absolute knowledge and (2) idiosyncratic ethical concerns as dictated by role responsibilities. If this is the basis of the trend of denying expert consensus, it points to a larger pattern of epistemic confusion rather than irrational behavior of specific individuals within the system.

It cannot be ignored that there are sociological and psychological factors contributing to reluctance to vaccinate, from the culture of mistrust in government interventions (especially of ones which encroach on personal bodily autonomy), to the straightforward physiological reason of an aversion to needles. There are also religious and other grounds for refusal, and any individual's decision about vaccination is assuredly a combination of these and other considerations. There are also many arguments against vaccination that are very simply misinformed, disinformed, or poorly thought out. None of these are the subject in this project, however, as they are epistemically-external rejections of scientific authority. This argument holds that there is a legitimate space given to an assessment of scientific risk over the course of the decision regarding vaccination, and that the character of this assessment is of philosophical interest. As this argument is in response to the element of risk in vaccination, it leaves aside matters such as religious grounds or belief in political conspiracy. It is directed at the group called "vaccine denialists," who refuse vaccination on the grounds that they do not trust the expert consensus. Vaccine denialists, as described by Mark Navin, "refuse vaccination because they reject the current mainstream medical consensus that childhood vaccines are safe and effective."[48] This group is constituted principally by parents who chose not to vaccinate their children because of a perception of an untenable risk that would be incurred in the action. This is not a religiously driven judgment, but one that is a product of pseudo-scientific reasoning.

I noted above that vaccine denialists are not a stereotypical example of the lay assessment of scientific risk. This is due, in part, to the efficacy of vaccination being virtually undebated between scientists. Genuine professional doubt about vaccine efficacy is minimal, if existent. As it cannot be put more concisely, I quote: "Simply Put: Vaccination Saves Lives."[49] This is the title of an editorial by Walter Orenstein and Rafi Ahmed, which lays out the overwhelming power and efficacy of the science of inoculation. There is no denying the world shaping positive impacts that have been afforded by the invention of vaccination. Not only do they help to mitigate disease incidence, but, according to Orenstein and Ahmed:

> "A recent analysis of vaccines to protect against 13 diseases estimated that for a single birth cohort nearly 20 million cases of diseases were prevented, including over 40,000 deaths. In addition to saving the lives of our children, vaccination has resulted in net economic benefits to society amounting to almost $69 billion in the United States alone."[50]

Vaccination prevents disease and saves lives, and is sometimes powerful enough to reshape the social state to improve even more lives. The positive impacts of vaccination are nearly incalculable, but the negative outcomes are what have held the public attention regarding this science. This is what is so telling about this example of rejection of scientific consensus; the best empirical evidence that can be asked for is the repeated application of a theory with positive

---

[48]Mark Navin, "Competing Epistemic Spaces: How Social Epistemology Helps Explain and Evaluate Vaccine Denialism," *Social Theory and Practice* 39, no. 2 (2013): 243.
[49]Walter A. Orenstein and Rafi Ahmed, "Simply Put: Vaccination Saves Lives," *Proceedings of the National Academy of Sciences of the United States of America* 114, no. 16 (April 18, 2017): 4031–33.
[50]Orenstein and Ahmed 2017.

results, and the history of vaccination gives precisely this, in ample amounts. Its track record is one of the most well-substantiated technologies in medical history by this measure, yet the recommendation to vaccinate is one of the most stubbornly resisted public health policies.

If it was not prompted by expert hedging or a legitimate dearth of evidence, where does the basis for the rejection of this science come from? It begins as an epistemically legitimate (and even essential) desire to affirm acceptable risk before taking action, but evolves into an unjustifiable demand for what amounts to zero inductive risk. For a lay person to assess the risk in vaccination is scientifically correct, but to take their personal perception of said risk as the final, necessary determination of this risk is unreasonable. It shows that the individual who arrives at this kind of conclusion understands scientific authority as independent rather than collective, which is not a reliable authority for collective concerns.

The assessment of risk in vaccination is a realization of the black swan dilemma. The likelihood of a negative outcome in vaccinating one's child is incredibly low, and it is decidedly lower than the risk should the (currently) eradicated diseases like measles or polio re-emerge.[51] However, it is incorrect to say that vaccination is risk *free*. Take the example of the MMR vaccine (to treat measles, mumps, and rubella) around which there is next to no scientifically legitimate debate, yet remains at the center of the controversy. This vaccine was essential to the project of eradicating measles from the U.S.,[52] and saved countless lives in the process. However, largely due to a single, grossly misinformed study that was quickly retracted, the public perception of this vaccine came to be (falsely) associated with the onset of austistic behavior. This was Andrew Wakefield's study, published in 1998 by the Lancet. Though the

---

[51]CDC, "Measles Cases and Outbreaks."
[52]A project which at many points in history would have been seen as impossible, but which has been achieved!

scientific community immediately challenged and then retracted this paper it had already been taken up as a legitimate argument by many lay readers. Though it was quickly and thoroughly disproved and denounced within the scientific community, the initial paper had already made its way into the public consciousness. The original fear that the MMR vaccine would cause autism is still felt by some vaccine denialists, but more importantly this paper inspired a fear about the unknown risks in vaccination in general. Though it was scientifically overturned, this paper was effective in drawing public attention to the question of invisible risks in the decision to vaccinate.

Vaccination has become a delicate topic, as scientists do not want to encourage over-determination of risk, but also cannot ignore the real degree of risk that is present. Even the CDC's information page on MMR safety has to acknowledge the rare potential for a lethal allergic reaction to this vaccine.[53] What is to be done about the extreme outlier outcomes? You cannot simply claim that they are irrelevant, or that they do not happen. As put by Nassim Taleb, "Black Swan Logic makes *what you don't know* far more relevant than what you do know,"[54] and this is certainly the case for assessment of scientific risk. The unknowns are more important, as they represent risk in error. My concern are these devious outlier moments which manipulate one's perception of reality, and how to bring them back into an empirically rational relationship to action. One cannot discount the possibility of an unexpected outcome, but it is equally essential that the possibility of error not overshadow the reality of an empirical fact.

The response on the part of the institutional and professional scientists to this rejection of the expert consensus is nearly as problematic as the vaccine denialists themselves. Nearly always the reaction has been to explain over and over the indications of the relevant evidence, and to

---

[53] "Safety Information for Measles, Mumps, Rubella (MMR) Vaccine | CDC," January 29, 2020, https://www.cdc.gov/vaccinesafety/vaccines/mmr-vaccine.html.

[54]Taleb 2007, xix. (original emphasis)

reiterate empirical evidence. While there is nothing inherently negative in showing supporting evidence, in this circumstance it does nothing but exacerbate the distrust and sense of misunderstanding on each side. The parents who question the safety of vaccination are not doing so because they are unable to understand the empirical logic supporting vaccine efficacy–this is not what they take issue with. The scientist pointing again and again to the same pieces of evidence expecting a new reaction is nothing but aggravating to everybody involved, because the actual point of contention is differing determinations of acceptable risk. The institutional side of the debate holds that risk is determined as a collective issue, while the vaccine denialists understand their personal perception of the risk as authoritative. Because of this discrepancy in understanding of epistemic principles, each party will approach the problem with fundamentally contradictory concerns. In the absence of a culturally consistent concept of the collective authority of science, there will be a perpetual possibility of disagreement in the individual versus collective judgment of the best action to take in light of available evidence.

✧ CALCULATION OF RISK IN VACCINATION ✧

As outlined in the earlier argument, an individual's perception of acceptable risk in a given circumstance will be commanded in large part by that person's role responsibilities. The controversy around the MMR vaccine illustrates how the moral responsibilities of two distinct social roles could lead the person occupying these respective roles to authentically opposing determinations of risk in the same circumstances. Consider a parent with a newborn, who has to decide whether to follow the institutional recommendation on vaccinating their baby, and a CDC official whose job it is to recommend the safest and most effective regimen of vaccination for the country as a whole. The difference in their favored values is stark. The role-associated-values of the job of the CDC official are primarily organized to facilitate the public health of the country, while the moral responsibility of a parent favors their own child over the greater good. The most central moral tenet of each of these social occupations are shaped by concerns of divergent, if not opposing, goals of health: the communal and individual.

It is the institutional duty of the CDC to protect the public health of the United States. As such, in their capacity as a CDC official, a person becomes morally obligated to work in the interests of protecting the health of the *community*. Their moral concern is to support the best possible health in the greatest number of people in the population. While there is nothing within the code of responsibilities intrinsic to the role of a parent that is directly antithetical to the project of general public health, they are not responsible for upholding public health to the same extent of the official. On the other hand, the primary motivation of the role responsibilities of a parent places the interests of their child ahead of everything else. It can be argued that it is a prescription of the role of a parent to protect the wellbeing of their child, even at the expense of the greater good.[55] In instances where a decision has to be made based (at least in part) on an empirically indicated recommendation, there will inevitably be some kind of weighing of the inductive risk (admittedly with varying conscious recognition of its calculation). Given the opposing concerns of the general benefit and the benefit to a specific individual, the weight given to different factors in the calculus of risk will necessarily vary. In their independent IRC of the risk in vaccination, these two agents are likely to come to different judgments.

The question of inductive risk can be understood as two-fold, encompassing the likelihood of a claim being correct, and a quantification of the consequences of error should it

[55] While the claim that a parent is morally responsible for their child even at the *expense* of general good is debatable, it is certain that a parent's ethical obligations include protecting the health of their child to the extent that it does not put the rest of the community at risk.

prove to be wrong. It is in this second aspect where a parent's and CDC official's concerns are differently guided by their respective moral responsibilities. It is also this aspect of inductive risk that allows non-epistemic values a necessary and legitimate space in scientific reasoning. On this rule, Carl Hempel said: "The problem of formulating adequate rules of acceptance and rejection has no clear meaning unless standards of adequacy have been provided by assigning definite values or disvalues to those different possible *'outcomes'* of acceptance or rejection."[56] By this definition, the determination of how valuable or detrimental any outcome is, is necessarily a matter of non-epistemic values. There *is no epistemic standard* for how much weight the possibility of illness, or the possibility of death, should have in a calculation of risk. These are, and would do well to remain, necessarily subjective considerations. Following this principle of scientific rationality, the parent and the CDC official will necessarily come to different conclusions about acceptable risk in regard to the science of vaccination.

It is the nature of vaccination that the degree of its benefit has an inverse correlation to the scope from which it is considered. When considered from a global scale, the favorability of the benefit/harm profile is almost absolute. Before the invention of effective vaccines, an epidemic of something like measles or smallpox would have inevitably devastating consequences. Compared to the hundreds or thousands of lives that would, without question, fall prey to something like smallpox in the case of no vaccine, the risk of a minute fraction of the population losing their life to gain herd immunity in the community is a negligible sacrifice. It is clear that the outcome of vaccination is preferable to the alternative.

[56] Quote by Hempel, in Douglas, 2000, 562. (emphasis added)

The inverse side of the scale of risk assessment is that from the perspective of the individual, such as the parent of the newborn. When considering the risk-benefit profile of the outcomes of vaccination versus inaction, the favorability of vaccination is not nearly as self-evident from this perspective as from the global one. In the global model, the harms of a negative outcome are minimal. A small amount of the population is lost, but that is an inevitability in a global population, and an abstract one at that. In the individual model of the parent, the devastation experienced in the case of a negative outcome is incomparable. The death of one's child is an almost unquantifiably negative outcome from the moral standpoint of the parent, and as such has legitimately significant weight in that parent's assessment of risk. While the *chances* of a negative outcome increase with a larger scale of consideration, the *devastation* in the case of that negative outcome decreases significantly. This relationship of scale versus consequence supports that a parent would deem the risk of vaccination as unacceptable more often than somebody considering national or global health.

Given the necessity of some version of an IRC in choosing a course of action, and the necessarily varying values associated with every social role, there cannot be a universal standard of acceptable risk. Because assessment of risk is inherently idiosyncratic, any individual's assessment of evidence cannot be truly objective. Therefore, the risk in a claim that has communal consequences can only be clearly defined from a mutual perspective.

The lens of role responsibility shows the basis for a valid disagreement of the risk in vaccination at the scale of the individual, but in doing so leads to a point that disproves that it is a truly scientifically rational conclusion to refuse to vaccinate. The collective consequences of vaccination means that an individual assessment of its risk is necessarily incomplete. For it to be truly scientific, an IRC of vaccination has to acknowledge the risk to *collective* health, and would have to weigh this collective risk in its calculus. Because of the concept of herd immunity, both the risks and the benefits of vaccination are only accurately measurable on a community-wide scale. This is the idea that "for most vaccines, achieving high levels of coverage is important not only for individual protection but in preventing disease in vulnerable populations that cannot be directly protected by vacci- nation."[57] Herd immunity references the threshold of vaccination within a community, above which a disease cannot easily spread within that community. This is the means by which vaccination can eliminate disease. The reality of herd immunity means that the benefits of vaccination only come about when most of a population is vaccinated, and similarly the harms of *not* vaccinating will be felt by many more than the individuals who decide not to do so.

Individual conclusions about vaccination do not have individual consequences. Though they may be a decision made on an individual basis, these judgments have collective consequences, and thus the risk of vaccination cannot be properly considered unless it is from the collective point of view. Because herd immunity means that individual decisions have collective consequences, the assessment of inductive risk as perceived by the individual is not only selfish, but less empirically accurate. An accurate characterization of this risk depends on the consolidation of a diversity of experiences and perspectives. The real 'objective' risk in the decision to vaccinate can only be understood by including a heterogeneous survey of perceived risk in the affected community. Because the inductive risk of vaccination is beyond the scope of individual perception, it can only be effectively understood through an intersectional objectivity.

[57]Orenstein and Ahmed, "Simply Put."

As understood through the concept of inductive risk, the phenomenon of vaccine denial is not as easily dismissed as poorly researched, or as simple rejection of science in its entirety. Yes, there are certainly decisions made against vaccination which are based on poorly vetted information and evidence. There are even decisions against vaccination which are the result of ideological rejections of the ascendancy of scientific knowledge. Nonetheless, these cannot explain all judgments counter to the scientific consensus on the subject. It is possible, when reasoning under a concept of scientific authority as independent and absolute, to reject the scientific consensus without rejecting scientific logic entirely. In light of this, it is in the interest of the cultural authority of science to consistently recognize the collective character of its intellectual authority. Although the vaccine denialist reasoning explored above is not entirely successfully scientific, it does attempt to follow scientific principles and only fails due to do so because of a misplaced understanding of the authority of science. Though they correctly recognize the empirical *basis* of science as intellectually definitive, vaccine denialists fail to acknowledge the inherently *collective* authority which is the real determination in the objective accuracy of the science of vaccination. Thus, while vaccine denialists cannot be said to be agents of real scientific rationality, neither can they be dismissed as fundamentally anti-scientific.

CH. 3 CRISIS OF INCOHERENCY

The accuracy of scientific research is supported by the successful applications of a theory in the world, meaning trust in science should therefore be built upon its continued and expanding success. It should follow for the authority of scientific facts to grow with its increasing prevalence and incidence in society. Instead, what we see today is a crisis of faith in the socio-epistemic ideal of scientific authority. Rather than being alone in their irreverence for the scientific consensus, vaccine denialists are symptomatic of a larger culture of an inconsistent and misplaced understanding of the authority of science. These judgments are representative of an intellectual environment with a misplaced emphasis on the individual perception of risk, an emphasis which has grown out of the view of scientific authority as independently absolute. The crisis of scientific authority in contemporary culture is due to a cultural mis-education in this ideal. Although the understanding of an independent authority of science *is* coherent in itself, a culture that upholds this ideal in the face of the necessarily plural reality of modern science is not rational as a *system*. It is this misalignment that creates the problematic potential for individuals to believe they are making truly scientific judgments, when in fact their reasoning fundamentally opposes the actual, collective authority of science.

The diversity of its manifestations underline the pervasive reality of the independent ideal of science. In addition to the controversy of vaccination, risk-based rejections of the scientific consensus can be found in the arguments supporting climate-science denial and creationism, and are even present to a degree in more unconventional theories like those of the flat earth society or Area 51 conspiracists. Behind these lines of reasoning is a misplaced perception of the authority of science, as these judgements neglect that scientific authority in socially consequential claims is to be attributed to the *collective* determination of its certainty. It is precisely the questions which have extended social implications that rely on a diverse perspective to assess their objective accuracy. However, these are the very same claims in which an individual assessment of risk might deviate from the assessment of the collective, and thus prompt the individual to reject the consensus. Although this point is not strictly within the scope of the philosophy of science, I hold that the sociological culture of science today has been largely defined by philosophical understanding of scientific authority. The popular understanding of science may not be in terms of risk and uncertainty, but its form is dictated by this kind of reasoning.

✧ MANUFACTURED DOUBT ✧

The confused ideal of scientific authority is the result of the mis-education of American society. An important aspect of the contemporary public understanding of science was solidified in the debate stemming from the cigarette controversy of the late twentieth century, which pushed the popular understanding of science toward an ideal of independent and positive knowledge. As discussed at greater length in previous chapters, the construction of scientific knowledge is necessarily uncertain. Historically this imperfection in the grounds for knowledge has not stood in the way of the ability, either as a society or as individuals, to accept knowledge as being (at the very least) functionally true. Science has never been perfectly certain nor risk free, "So the question becomes, Why do we expect 'undeniable' evidence in the first place?"[58]

In their book *Merchants of Doubt,* Naomi Oreskes and Erik Conway offer a historical explanation for the development of this impossible expectation. They maintain that it was a small group of scientists working in defense of the tobacco industry that undermined what was essentially the entire cultural basis for trust in the claims of the scientific institution. By campaigning to emphasize the gaps in certainty that are inherent to any body of scientific theory, these people were successful in creating, promoting, and sustaining doubt about a very well-substantiated body of evidence. It was the first instance of a new strategy of fighting

[58] Oreskes and Conway 2010, 267.

science with science, of "fighting facts and merchandising doubt."[59] This was the first significant move toward a culture full of "science wars" and "junk science." This would grow into a more generalized state of doubt about scientific claims, marked by the rise of concepts like "junk science" and "fact fighters," which were most prevalent in the 1980's and 1990's. [60] The campaign of the tobacco industry was the first in a tradition of forcing an absolute standard of truth into a system that is organized around a collective concept of objectivity.

The original strategy deployed in service of the tobacco industry was different from previous attempts to challenge the accuracy of claims put forth by institutionalized science: it attacked the very standards of fact. Because they criticised the standards for truth and not merely the strength of the evidence in this particular case, the tobacco defense was not an isolated ordeal. Oreskes and Conway make a convincing case for how the original approach used by the tobacco industry has had wide reaching and powerful residual effects, the influences of which can be traced more or less directly to current science-based-policy decisions about everything from climate change to vaccination.[61] This narrative begins in the 1950s, when the tobacco industry was first learning of the link between cancer and smoking, and began its crusade against the science supporting this connection.[62] This developed in the following decades into the system that has sustained the tobacco industry for generations; fanning-the-flames-of-doubt around the carcinogenic nature of cigarettes, thus exacerbating the unavoidably present degree of doubt, inherent to any body of scientific evidence. Because of its extensive media presence, this narrative was essential to shaping the societal understanding of

---

[59] Ibid, 9.
[60] Douglas 2009, 5-9.
[61] Oreskes and Conway 2010, 35.
[62] Ibid, 14.

science and its grounds for authority. The shift away from collective judgment in the popular ideal of science is due to the perception of scientific authority in this narrative, and those that followed its suit.

What changed in this instance was *how* the tobacco industry chose to go after the regulations threatening their business. Rather than arguing against unfair enforcement of regulation, or some other bureaucratically directed refutation of this policy, (as has been the reaction on the part of private industry in similar situations)[63] the tobacco industry opted to attack the *authority* of the very scientific claims on which these policy recommendations were being made, on the grounds of inductive risk. Their approach to curbing this policy was even more novel because it's focus was not limited to rejecting the accuracy of the claims on the grounds of poorly collected data, biased study design, or other standard critiques of a claim. Instead, the tobacco-proponent scientists put forth the possibility that the very standards by which scientific truth was measured were insufficient to warrant acting on their recommendations.[64] They were asking for incontrovertible evidence, zero inductive risk, and demanding a degree of certainty that is only possible given a definition of scientific authority as independently absolute, and ergo functionally inert.

When asked outright in a court of law "does cigarette smoking cause lung cancer?"[65] Martin Cline, a biomedical researcher working on behalf of Big Tobacco, said:

---

[63]San Diego Unified School District v. Juul Labs, Inc. (Cal. Super. Ct.). Accessed April 29, 2020.
[64]This sort of argument can be found in a recent attack on science by the Trump administration. A similar rationale was used when, under the guise of furthering scientific certainty, Trump E.P.A. attempted to pass a bill that "would require that scientists disclose all of their raw data, including confidential medical records, before the agency could consider an academic study's conclusions," in any public health policy. [see ⇒ Lisa Friedman, "E.P.A. to Limit Science Used to Write Public Health Rules," *The New York Times*, November 11, 2019, sec. Climate, https://www.nytimes.com/2019/11/11/climate/epa-science-trump.html.
[65]Oreskes and Conway 2010, 30.

> "Well, if by 'cause' you mean a population base or epidemiologic risk factor, then cigarette smoking is related to certain types of lung cancer. If you mean: In a particular individual is the cigarette smoking the cause of his or her cancer? Then . . . it is difficult to say 'yes' or 'no.' There is no evidence."[66]

Here, Cline was opposing the validity of the claim in the terms of scientific reasoning. He was not denying that the overwhelming weight of the collected evidence indicated a correlation between tobacco and lung cancer, but that this correlation was not robust enough to warrant taking action (especially if the action taken would impede freedom or the free market). In other words, he was arguing that the inductive risk was too high to justify any decisive action. Cline was challenging the standards for the weight of evidence and appealing to the precautionary principle, neither of which are empirically inconsistent. Not only does this appear as consistent with the advancement of scientific values, this sort of challenge has been a plague of science for as long as it has been formalized practice. It is baked into the basic activity of practicing empirical investigation, and the unavoidable risk in induction. It is the age-old challenge in the philosophy of science: when is evidence certain *enough*? However, that this has never before had a philosophically definitive answer has not stood in the way of scientific progress and success. In demanding perfection these scientists were *not* furthering the accuracy of scientific knowledge. All that was accomplished was preventing the development of a cultural conception of science as necessarily social in its authority. According to Oreskes and Conway: "This was the tobacco industry's new insight; that you could use normal scientific uncertainty to undermine the status of actual scientific knowledge."[67] By contradicting scientific authority in science's own terms, this argument was made both more plausible and more effective.

---

[66]Ibid, 31.
[67]Oreskes and Conway 2010, 34.

While it is correct that a higher burden of proof cannot be reasonably said to be damaging to the accuracy of a scientific theory, the sort of proof being demanded in this case was entirely unreasonable and empirically irrational. In the passage above, Cline is quoted as saying outright that “there is no evidence” that smoking tobacco causes lung cancer. In reality there were mountains of evidence, the strength of which is what caused the industry to go after this body of science in the first place. What *was* lacking was any amount of evidence the tobacco campaign would have accepted as sufficiently certain to be conclusive. This is telling of the primary scientific shortcoming of the tobacco defense: the non-falsifiability of the argument they put forward. Because there was no evidence they would have accepted as proving, finally, that smoking *does* in fact cause lung cancer, they can not have interested or engaged in the betterment of scientific knowledge. Cline was demanding definitive proof not only of the correlation, but of a direct one-to-one causation of smoking and lung cancer. This is beyond the empirical capacity of science, as this is *not* a one to one relationship.

There is always a chance that an individual who smokes their whole life will never get cancer, but this does not disprove the collectively informed reality that smoking is highly *likely* to cause cancer. The strength of the collective perspective of modern science is that it can, nevertheless, show that smoking predisposes a person to lung cancer, regardless of an independent assessment that might conclude differently. It is simply beyond the capacity of individual reasoning to give an objective assessment of this reality. Because the risk of a claim differs based on how wide reaching its consequences, and (as has been made crystal clear in hindsight) tobacco use has massively widespread consequences, the risk in tobacco is only realistically assessable through the collective view. The tobacco defense was based in positivist principles of the authority of independent reasoning, but this is precisely the kind of question where empirical positivist methods fall short.

The insidious cunning of the move made by the tobacco campaign was in how it shifted the public understanding of the goal of a scientific enterprise. It created the impression that "science provides certainty, so if we lack certainty, we think the science must be faulty or incomplete."[68] The fallacy is that science has never provided completely certain knowledge. By telling the public that they should demand absolute certainty from their scientists, all that was accomplished was the emphasis of the *im*possibility of infallible truth over the possibility of imperfect, although *functionally indispensable* truth. In re-writing the public narrative of the goal of science, Big Tobacco ensured that science would never be able to reach its goal. By broadcasting the absence of certainty in scientific knowledge in public media, this discussion brought into the common mind that anything less than absolutely, independently true facts were insufficient.

According to the tobacco narrative, only claims that could be verified through the uncompromising absolute principles of independent reasoning were certain, and anything else had too great a margin of inductive error. Broadcasting the lack of certainty carried the implication that attaining certainty was a reasonably attainable goal of science. There has always been inductive risk in science, but the narrative of the tobacco campaign solidified this at the forefront of the public consciousness as a reason not to trust its results.

The important difference I see in this instance as opposed to other, inevitable revolutions in scientific thought, is that the tobacco campaign created an artificial misalignment between the

---

[68]Oreskes and Conway 2010, 267.

cultural reality of science, and the cultural understanding of its authority. They prolonged the old ideal of an independently absolute standard of truth into a new epistemic era in which the collective perspective is of greater weight than an individual one. Modern science is social, not only in its mechanisms, but also in its content, context and implications. As the reality of scientific authority has shifted with the role of science in society, the tobacco campaign and others following its example have curated a standard of truth that is incompatible with the present reality of scientific inquiry. The larger epistemic environment of modern science has become collective and socially reflexive, but the cultural standard of certainty has nonetheless been convinced to retain an understanding of scientific authority as independent and absolute.

✧ CONCLUSION ✧

The culture of risk-based rejections of the scientific consensus is not as simple as rejecting science entirely, but is symptomatic of a misplaced authority of science. Without articulating this as the basis of disagreement, it is impossible to weigh and understand the different strengths and weaknesses of competing standards of science. Thus, a more successful epistemic culture has to begin with a mutual recognition that the real objective value of science is not independently accessible. Only by voicing this as the subject of disagreement can society as a whole reconcile the principles of scientific authority.

To move forward from this confused vision of scientific authority demands a communally arbitrated standard of acceptable risk. Only with a universally informed standard can there be a universally rational judgement of risk, which requires a better appreciation of the plurality of objective truth. The nature of scientific authority is often glossed over in a scientific education, as it appears to be self-evident that science is objective truth. As the uncertainty of scientific facts can confirm, the objectivity of science is not necessarily and independently absolute. By treating science as necessarily absolute fact it is lost in the translation of education that science is perpetually uncertain, and that its authority thus comes from a mutual measure of objective truth, not from the limited personal perspective of an individual. A more functional culture of science depends on a re-education in the popular understanding of scientific authority, away from an independent and necessary ideal, and towards an ideal of the fruitful and reflexive collective objectivity. Reconstructing the authority of science calls for learning "how to live in the same world, share the same culture, face up to the same stakes, [and] perceive a landscape that can be explored in concert."[69]

---

[69]Bruno Latour, *Down to Earth: Politics in the New Climactic Regime*, trans. Catherine Porter (Cambridge: Polity Press, 2019), 25.

REFERENCES

Allcott, Hunt, Levi Boxell, Jacob Conway, Matthew Gentzkow, Michael Thaler, and David Yang. "Polarization and Public Health: Partisan Differences in Social Distancing during the Coronavirus Pandemic." Cambridge, MA: National Bureau of Economic Research, April 2020. https://doi.org/10.3386/w26946.

Bogel-Burroughs, Nicholas. "Anti-Vaccination Activists Are Growing Force at Virus Protests." *The New York Times*, May 2, 2020, sec. U.S. https://www.nytimes.com/2020/05/02/us/anti-vaxxers-coronavirus-protests.html.

CDC. "Measles Cases and Outbreaks." Centers for Disease Control and Prevention, November 12, 2019. https://www.cdc.gov/measles/cases-outbreaks.html.

CDC."Measles Elimination in the U.S.," Centers for Disease Control and Prevention, October 3, 2019. https://www.cdc.gov/measles/elimination.html.

CDC. "Safety Information for Measles, Mumps, Rubella (MMR) Vaccine," Centers for Disease Control and Prevention, January 29, 2020. https://www.cdc.gov/vaccinesafety/vaccines/mmr-vaccine.html.

Cooke, Nicole A. *Fake News and Alternative Facts : Information Literacy in a Post-Truth Era*. ALA Editions Special Reports. ALA Editions, 2018.

Dixon, Graham, Jay Hmielowski, and Yanni Ma. "Improving Climate Change Acceptance Among U.S. Conservatives Through Value-Based Message Targeting." *Science Communication* 39, no. 4 (August 1, 2017): 520–34. https://doi.org/10.1177/1075547017715473.

Douglas, Heather E. "Inductive Risk and Values in Science." *Philosophy of Science* 67, no. 4 (2000): 559–79.

Douglas, Heather E. *Science, Policy, and the Value-Free Ideal*. Pittsburgh, Pa.: University of Pittsburgh Press, 2009.

Eyal, Nir, Marc Lipsitch, and Peter G. Smith. "Human Challenge Studies to Accelerate Coronavirus Vaccine Licensure." *The Journal of Infectious Diseases*. Accessed April 30, 2020. https://doi.org/10.1093/infdis/jiaa152.

Fleck, Ludwik, Thaddeus J. Trenn, Robert K. Merton, and Fred Bradley. *Genesis and Development of a Scientific Fact*. Repr. 11. Aufl. Sociology of Science. Chicago [u.a]: Univ. of Chicago Press, 2008.

Friedman, Lisa. "E.P.A. to Limit Science Used to Write Public Health Rules." *The New York Times*, November 11, 2019, sec. Climate. https://www.nytimes.com/2019/11/11/climate/epa-science-trump.html.

Gould, Kenneth A., and Tammy L. Lewis. *Twenty Lessons in Environmental Sociology*. 2nd ed. NY: Oxford University Press, 2015.

Harding, Sandra G. *The Science Question in Feminism*. *Fulcrum.Org*. Cornell University Press, n.d.

Kourany, Janet A. *Philosophy of Science After Feminism*. Studies in Feminist Philosophy: Oxford University Press, 2010.

Latour, Bruno. *Down to Earth: Politics in the New Climactic Regime*. Translated by Catherine Porter. Cambridge: Polity Press, 2019.

Longino, Helen E. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press, 1990.

Navin, Mark. "Competing Epistemic Spaces: How Social Epistemology Helps Explain and Evaluate Vaccine Denialism." *Social Theory and Practice* 39, no. 2 (2013): 241–64.

Oreskes, Naomi, and Erik M Conway. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. New York, NY: Bloomsbury Press, 2010.

Oreskes, Naomi. *Why Trust Science?* Princeton, New Jersey: Princeton University Press, 2019.

Orenstein, Walter A., and Rafi Ahmed. “Simply Put: Vaccination Saves Lives.” *Proceedings of the National Academy of Sciences of the United States of America* 114, no. 16 (April 18, 2017): 4031–33. https://doi.org/10.1073/pnas.1704507114.

Popoveniuc, Bogdan. “Self Reflexivity. The Ultimate End of Knowledge.” *Procedia - Social and Behavioral Sciences* 163 (December 2014): 204–13. https://doi.org/10.1016/j.sbspro.2014.12.308.

Stegenga, Jacob. “Drug Regulation and the Inductive Risk Calculus.” In *Exploring Inductive Risk: Case Studies of Values in Science*, edited by Kevin Christopher Elliott and Ted Richards, 17–34. Oxford University Press, 2017.

San Diego Unified School District v. Juul Labs, Inc. (Cal. Super. Ct.). Accessed April 29, 2020. https://www.psblaw.com/wp-content/uploads/2020/01/Complaint-SDUSD-v-JUUL.pdf.

Taleb, Nassim N. *The Black Swan: The Impact of the Highly Improbable*. NY: Random House, 2007.

Twitter. “Crazymothers on Twitter: ‘Dear Media, Please Retire the Use of the Term “Anti-Vaxxer.” It Is Derogatory, Inflammatory, and Marginalizes Both Women and Their Experiences. It Is Dismissively Simplistic, Highly Offensive and Largely False. We Politely Request That You Refer to Us as the Vaccine Risk Aware. Https://T.Co/WtAyFOhLuv’ / Twitter.” Accessed March 1, 2020. https://twitter.com/crazymothers1/status/1201140183695056901.

“What and Who Is behind the US Anti-Lockdown Protests?” Accessed April 28, 2020. https://www.aljazeera.com/news/2020/04/anti-lockdown-protests-200420180415064.html.

“WMO Statement on the State of the Global Climate in 2019,” n.d., 44.