Master's Thesis – master Innovation Science

BOUNDARY-WORK IN THE AGE OF POST-TRUTH

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Abstract

Introduction

The rise of post-truth and the 2016 presidential election of Donald Trump posed a new threat to the scientific enterprise of the USA. Previous research focused on demarcating fact from non-fact to deal with the issue of loss of trust in science stemming from post-truth. I propose to analyze the demarcation efforts of scientists themselves, through the March for Science protests of 2017. This yields new insights on how the scientific community, the most affected by post-truth, deals with this complex issue.

Theory

To analyze the demarcation effort of the scientific community, I adopt a constructivist perspective on the authority and legitimacy of science as a knowledge practice. I use a boundary-work framework consisting of three interrelated components: the attribution of selected characteristics to science, the type of boundary-work employed, and the professional interests pursued.

Methodology

I collect my data from a combination of google search, an official livestream video and official photography galleries for the Marches for Science in Washington D.C., San Francisco, and Seattle. I collect images of signs, posters and banners from the three Marches and code the displayed slogans, statements and sentences according to the boundary-work framework.

Results

I find that science is characterized as objective, engaged and beneficial. These attributes are employed to expel post-truth and Trump from legitimate epistemology, and from controlling and influencing the federal scientific enterprise. I find that the attributions of engaged and beneficial are part of a novel demarcation strategy employed specifically against post-truth. There are some inconsistencies in the three attributes, hinting at possible weaknesses of the strategy.

Conclusion and discussion

The findings suggest that future strategies could benefit from adapting the attributes in order to eliminate contradictions and inconsistencies which could hinder the success of the boundary-work. In terms of limitations and generalizability, the presented research can benefit from a more exhaustive sampling with inclusion of more diverse sources of data, in combination with an extension of the sampled countries, in order to increase the generalizability.

Introduction

In recent years, science has found itself under attack by the political and public sphere. The rise of populism around the world and the exponential political polarization of the U.S.A., have brought along widespread dismissal, distortion and desecration of scientific knowledge (Scheufele & Krause, 2019) and a notable loss in trust toward science and expertise (Gauchat, 2012; Funk et al., 2019). Recent political and societal developments have triggered a collective sentiment of change in our society - a sentiment of a new time. The highly controversial campaigns of both Donald Trump and the Brexit referendum in 2016, are associated with having exacerbated societal issues such as overflowing of fake news, misinformation, and disinformation, political (and societal) polarization and an overarching dismissal of rationality (d'Ancona, 2017). The impact of both successful campaigns triggered a global socio-political turmoil, referred to as "post-truth". In fact, Oxford Dictionaries named "post-truth" word of the year 2016, defining it as: "relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief" (Johnson, 2016).

In this post-truth world, science faces a threat to its epistemological authority and overall functioning. While it is not unheard of for scientific truths to be questioned and for debates to be artificially kept alive, to protect vested interests outside of science (e.g., the tobacco industry's efforts to dismiss the link between smoking and cancer (Oreskes & Conway, 2011)), post-truth poses a new type of threat to the scientific enterprise. As implied in Oxford's definition of post-truth, we are living in a time in which institutionally established facts are regarded with mistrust and appeals to rationality and objectivity fall short to emotional and ideological appeals. The public now is more susceptible to alternative truth claims that resonate with their emotions and beliefs but defy scientific standards of evidence (Aradau & Huysmans, 2019), and has shied away from scientific expertise and its cold and uncompromising truths (d'Ancona, 2017). This becomes particularly problematic when the truths being challenged carry heavy implications and need to be acted upon, such as anthropogenic climate change. Studies on this regard have shown that any instance of perceived scientific dissent negatively affects public support for climate policies (Aklin & Urpelainen, 2014). Undoubtedly, this phenomenon is exponentially worsened when the president-elect tweets about climate change being a Chinese hoax designed to undercut the US manufacturing industry (Jacobson, 2016). On top of public science skepticism being on the rise and helping him to power, Donald Trump's presidency is considered an "anti-science disaster" (Frickel & Rea, 2020). The Union of Concerned Scientists even compiled a list of Trump's "attacks on science" on the federal scientific enterprise (accessible at: https://www.ucsusa.org/resources/attacks-on-science, last accessed on 07.07.2021). In light of these developments, the challenge arises to repair the trust in science and in its institutions, and to reinstate science's place and role in society, needed to contrast post-truth and to enable science to tackle the great societal issues facing us today.

Knowing what post-truth is, and what it means for science and for us as a society, the question now arises: how did we get here, and – perhaps more importantly – where do we go from here? Different strands of literature have given their input on the issue. Kelkar (2019), sees post-truth as the culmination of an ongoing process of political polarization in the U.S. in combination with a transformation of how knowledge is produced. Since the 1960s, the Democratic and the Republican Party have become more and more polarized, having little to no ideological overlap and thus creating two opposing ideological poles. This spilled over to knowledge production sites such as newspapers and academia, considered to be objective and factual. However, some republicans considered those objective knowledge sites as biased towards the Democratic Party. So, they sought to create their own information ecosystem, with

knowledge production sites such as think-tanks and newspapers established explicitly to contrast the mainstream information – thus constituting the alternative to the mainstream (Kelkar, 2019, p. 92). This alternative, conservative and ideological information system gradually expanded, until it exploded onto the internet and social media, addressing and connecting to a broader audience and gaining more and more traction. The proliferation of fake news and disinformation on social media is thus just a symptom of the underlying problem. Literature focused on the social media issue has shown that the design and architecture of platforms such as Twitter or Facebook are fundamentally flawed, allowing for the proliferation of fake news (Rochlin, 2017). It also points out that the design flaw renders fact-checking initiatives virtually useless (Marres, 2018). More importantly, Marres (2018) recognizes that fact-checking initiatives are an attempt of demarcation on the level of truth claims, or rather they attempt to separate the "real" truth from the "fake" truth. As such, factual demarcations are somewhat of a lazy attempt to separate post-truth from science that misses out on the harder work of demarcating the two on a more fundamental level. It also misses to consider the active role of science and its community in dealing with this conundrum.

Fact-checking and other demarcation efforts based on truth claims assume that science has intrinsic qualities that separate it from post-truth, and that it thus makes sense to attempt to separate "good" knowledge from "bad" based on its origin (source-checking) (Marres, 2018). This approach misses to consider how post-truth poses and acts as scientific in its knowledge production, blurring the differences of rigorous science from pseudo-science. Science and technology studies (STS) scholars recognize the efforts of post-truth, stating that like scientific knowledge production, post-truth epistemology "is hard work" (Collins et al, 2017, p. 581), too. "[T]he construction of knowledge [...] requires infrastructure, effort, ingenuity and validation structures" (Sismondo, 2017a, p.3), and post-truth has achieved all that by gradually creating their alternative to the mainstream media and academia, as outlined previously. As such, STS shows how post-truth constitutes a "fringe science", and some suggest "to compare the forms of life of fringe science and mainstream science and find the ways in which they differ", to effectively separate post-truth from science (Collins et al., 2019). This suggests that the success of post-truth can traced back to a "failure of scientists to maintain a clear demarcation between intra-scientific and extra-scientific considerations" (Lewandowsky et al, 2015, p. 9) - or simply "[their] inability [...] to persuade the lay public of the correctness of scientific conclusions" (p. 9).

So far, there has not been significant consideration of the active role of science and its community in demarcating the scientific enterprise from outsiders' efforts to undermine its professional authority and legitimacy. Previous efforts assumed intrinsic qualities of science and focused on demarcating post-truth and science on the outputs of either, without considering how and why one's claims are "good" and the other's "bad". Consequently, I suggest the adoption of a constructivist approach to the professional authority and legitimacy of science, meaning that demarcation criteria are constituted externally and not inherently. The role and place of science in society today and over time is continuously negotiated and adapted by scientists themselves, in public disputes over epistemic authority – credibility contests (Gieryn, 1999). In these contests, boundaries are erected rhetorically that demarcate one practice from the other. This is achieved through boundary-work, a rhetorical strategy to demarcate one's knowledge practices from others' (Gieryn, 1983). When these boundaries are externally recognized, science secures its legitimate cultural space (Gieryn, 1999). A constructivist approach thus considers the agency of science in such credibility contests and yields insights into how the scientific community secures authority, legitimacy and resources for its enterprise.

Following Trump's election and the rise of post-truth, science activists across the globe gathered in rallies to protest this new anti-science sentiment. In 2017, the first of these rallies took place

– the March(es) for Science, which were an unprecedented display of science activism (Appenzeller & Science News Staff, 2017). Thousands of activists held posters, signs and banners that displayed rhetorical demarcation efforts employed in this credibility contest (Gieryn, 1999; 1983) of post-truth versus science. As such, applying a constructivist approach to the demarcation problem of science lends itself well to this case, constituting a novel and relevant research approach which allows for a new perspective on the complex issue that is post-truth. This leads me to the following research question:

How does the scientific community attempt to demarcate itself from post-truth practices through the boundary-work of scientific activists displayed during the March for Science protests?

In order to answer the research question, I analyze the demarcation efforts of scientists through the rhetoric displayed on signs and banners shown during the worldwide March for Science protests. "[T]he March for Science is perceived to be the largest activist effort by scientists to date" (Guenther et al, 2019, p. 999), with millions of participants waving posters, signs and banners for their cause. The signs represent the rhetorical effort of activists to construct the boundaries between science and post-truth. Due to the impressive number of participants and the overall impact of the Marches for Science, they are an excellent source of data on scientists' rhetorical boundary-work strategies.

The new age of post-truth presents new challenges to the scientific enterprise. The loss of trust in science and its knowledge production abilities is critical to society, as the spread of uncertainty and doubt about crucial issues such as anthropogenic climate change or vaccinations undoubtedly slows progress on solving them, which could have fatal consequences. A constructivist approach allows to consider the active role of the scientific community in dealing with external pressure. Previous research has not considered how post-truth can be dealt with by science itself, it simply explored how to demarcate a scientific fact from a post-truth fact. It misses the insights that can be derived from shifting the focus towards science as a profession that competes with other professions for recognition and resources.

Outlining the strategies displayed by the scientific community offers valuable insights into how possible demarcation strategies could be constructed for future contests, as the departure of Donald Trump does not equate to the departure of post-truth. As such, the problem of post-truth and skepticism persists beyond the Trump and Brexit campaigns, as we all have witnessed during the health crisis of the last year. COVID-19 related science skepticism is probably the most prominent example of post-Trump post-truth (Rutjens et al., 2021). Thus, it is imperative to discern the boundary-work used by the scientific community to create a possible template of viable rhetorical strategies that can prove to be useful for future credibility contests.

Theory

Post-truth obfuscates the boundaries between science and pseudo-science, and Trump's administration had a hard impact on the funding and functioning of many scientific institutions and agencies. Mis- and disinformation generated and disseminated by the fringe knowledge practices of post-truth, is used to contrast academic knowledge by casting doubt over the legitimacy of findings and of scientists in general, with the ultimate goal of replacing rationality with ideology. This translates into a loss of trust toward expertise and the erosion of academic authority. While some literature suggests dealing with the issue by demarcating between "real" facts versus "alternative" facts, STS literature hints at the possibility to demarcate at a more fundamental level. Therefore, I suggest a new approach to analyze post-truth. Instead of demarcating fact from non-fact, post-truth invites a demarcation based on the constructivist perspective on the authority of science. A constructivist approach suggests that science's authority is constructed externally and not granted on the grounds of intrinsic qualities of science. Ultimately, the problem lies in the fact that the public is unable to easily distinguish good scientific practice from pseudo-science on the grounds of truth claims alone. Scientists can - and have to - persuade the public of the integrity and importance of their endeavors, and simultaneously discredit those who try to compete for the public's trust. This is achieved by reinstating the boundaries that post-truth has torn down. Analyzing this boundary-work will yield new insights on the post-truth dilemma, and on rhetorical strategies of scientific activism in general.

The question of what sets science apart from other knowledge practices is an age-old one. Philosophers of science such as Karl Popper and Thomas Kuhn were already interested in finding the qualities that made science different from other epistemologies such as astrology. While Popper saw science's uniqueness in its principle of falsifiability, meaning truth claims can and should be falsified by new evidence to ensure testability of such claims, Kuhn argued that science's continuous shifting of paradigms (and consequently the expansion of the understanding of reality) sets it apart. Both falsifiability and paradigm shifts are inherent qualities of science that set it apart from astrology. While scientists will work to falsify claims by new evidence, or to overturn accepted paradigms, all in order to build and expand science's understanding of reality, and thus progress as a knowledge practice, in astrology progress is relinquished as there has never been a falsification or paradigm shift (Popper, 1963; Parmar, 2019; Hansson, 2017). Thus, astrology can not be considered science according to the differing intrinsic qualities of both.

When Kuhn, Popper and others alike identify and describe these inherent values of science, they adopt an essentialist perspective to the demarcation problem (Berg-Sørensen et al, 2010). While essentialists might be able to explain how one knowledge practice differs from the other based on essential values, they are not able to explain why astrology still holds a certain position in society (think of horoscopes in newspapers for instance), even though it is not scientific or accurate per se. Thus, with an essentialist perspective, one can not discern how a knowledge practice can carve out its space in society and culture, where it holds authority, legitimacy and resources. The reality is that the authority of any one knowledge practice is relative, not absolute, and that most importantly, it is externally recognized, considering that "the characteristics that distinguish science from other activities might not be convincing to everybody in all circumstances in time" (Ramírez-i-Ollé, 2015). Since what sets science apart from its epistemological competitors is not purely intrinsic and subject to change over time, consequently needing to be communicated to and accepted by society, the demarcation problem is now more than just an analytical problem, it is a practical one, as there needs to be grounds on which to decide what type of science is worth granting resources and authority to (Gieryn, 1983).

Following the distinction between essentialist and constructivist approaches, I explain how I use a constructivist theory to analyze the demarcation efforts of the science activists of the March for Science movement. First, a brief description of the theory. Following a constructivist point of view, Gieryn (1983) posits that scientists themselves actively engage in demarcation through "ideological efforts [...] to distinguish their work [...] from non-scientific intellectual activities" (Gieryn, 1983, p. 782). Boundary-work thus constitutes the rhetorical style or strategy of the ideological efforts employed by scientists when engaging in public discourse about the importance, relevance and desirability of their endeavors. This boundary-work is needed to secure material and nonmaterial resources for science. Science thus carves out its legitimate cultural space of authority thanks to members of its community, and their ideological "attribution of selected characteristics to the institution of science [...] for purposes of constructing a social boundary" (Gieryn, 1983, p. 782). In the construction of the social boundary, the selection of the characteristics to be attributed to the ideology of science is dependent on the competitor being faced, and consequently on how the boundary should be drawn in regard to the adversary.

The demarcation problem thus moves from a tacit assumption of what science is, to an explicit formulation by those who practice science. In practice, this occurs whenever the social boundary of science is contested and needs to be redefined. The cultural boundaries are not set in stone but rather are torn down and re-erected accordingly, when the authority of science is challenged externally. Boundary-work is thus relevant in occasions where intrinsic and implicit qualities of science need to be made explicit in order to assert authority and dominance over competitors: "credibility contests" (Gireyn, 1999, p. 2). The rise of post-truth constitutes such a credibility contest for science, having challenged the authority of science and thus dismantled the boundary that now needs to be redrawn. In order to discern the rhetorical strategies of the boundary-work efforts undertaken, one has to identify the three interrelated components of boundary-work: the attribution of characteristics to science, the type of boundary-work and the professional interests. These constitute the theoretical framework which allows for an analysis of the rhetorical strategies of the scientific community displayed at the March(es) for Science. Previous boundary-work research has demonstrated the framework's effectiveness in analyzing instances of science activism (Ramírez-i-Ollé, 2015), and is of inspiration in the operationalization of the threefold boundary-work framework. A detailed explanation of each component (attribution, type and professional interests) follows below.

Engaging in boundary work and erecting the social boundary, begins with scientists describing and characterizing the ideology they represent, through mobilizing and ascribing attributes to their profession. The ideology is presented through an attribution of selected characteristics to science. These attributes of science are derived from collections of different characteristics of science, simply referred to as "cultural repertoires" (Gieryn, 1983, p. 783). These repertoires are simply collections of the intrinsic qualities of science. They could for instance relate to the four Mertonian norms or to the utilitarian aspects of science (Gieryn, 1983). By carefully selecting attributes from these repertoires to formulate an ideological self-description of science, a social boundary is drawn to epistemic competitors who are found to be lacking the attributes of science or found to have inferior attributes. Moreover, since boundary work is required and employed anew in every occurrence of credibility contests, repertoires can emerge from past representations and thus be used for future occasions (Gieryn, 1995, p. 307-308). The attribution of selected characteristics is thus the first step in identifying boundary-work strategies. From each attribution then follow both the type of boundary-work and the professional interests pursued. The boundary-work types and professional interests are explained below.

Given that credibility contests involve science and an opposing party contesting its credibility, the boundary work strategy has to consider what the purpose of the demarcation is, in relation to the opponent. For this, Gieryn (1983; 1999) distinguishes three different types of boundary-work that I then use for my analysis. The first type, expulsion, concerns scientists whose authority and legitimacy have been questioned and/or claimed by the external challenger(s). In this case, scientists need to draw their boundary in a way that excludes and expels the other party, thus monopolizing science's authority. This is achieved through the selection of positive repertoires of self-description for science, and a negative, delegitimizing characterization of the challenger. The goal is not to "challenge or attenuate the epistemic authority of science itself, but rather to deny privileges of the space to others who [...] do not belong there." (Gieryn, 1999, p.16). In this context, delegitimizing attributes such as pseudo-scientific or fraudulent are mobilized and attributed to the opponent. Another type of boundary-work is expansion. Here, the coin is flipped, and it is scientists who attempt to enter and occupy the space of expertise and authority of other professions. Rhetorically, this is achieved similarly to expulsion. By attributing positive characteristics to science and pejorative attributes to the rival, scientists highlight the characteristic of their profession over the rival's. This achieves a demarcation of the "good" science from the "bad" alternatives and expands the former's boundaries into areas claimed by the latter. Finally, there is protective boundary-work, which intuitively sounds similar to expulsive, yet concerns different circumstances. In protective boundary work, external powers attempt to exploit science's authority "in ways that compromise the material and symbolic resources of the scientists inside" (Gieryn, 1999, p. 17). This is what sets it apart from expulsion and expansion, as in those cases the opposing party is either trying to claim science's authority and resources for themselves, or it possesses authority and resources in a domain that science wants to claim. For instance, protective boundary-work might occur when scientists establish a boundary between their profession and future consequences derived from it, to escape blame and responsibility for unintended consequences of scientific knowledge being applied outside of science. This is practically useful for scientists discovering something potentially dangerous or harmful, wanting to demarcate their professional effort of discovery from potential adverse and malicious applications further downstream. Or when outsiders such as the media take on the task of distinguishing "good" scientific claims from "bad" scientific claims, the proclaimed "bad" scientists can erect a boundary to exclude outsiders from the authority of establishing distinctions within science. The aim of protective boundary-work is thus to protect science's "members from responsibility for consequences of their work by putting the blame on scapegoats from outside" (Gieryn, 1983, p. 792). The goal behind these three types is simply "to define who can or cannot claim authority over the resources and power associated with the status of 'science'" (Ramírez-i-Ollé, 2015, p. 389).

The third component of boundary-work theory are the professional interests of scientists that they pursue through the demarcation efforts. The different types of boundary-work are employed to pursue resources and legitimacy for the cause of scientists as a professional group, rather than individual interests (Gieryn, 1983). Simply put, the professional interests reflect the goals that science as a profession is pursuing through boundary-work. When boundary efforts are recognized externally, the professional interests are secured.

To operationalize boundary work and apply it to the post-truth and Trump context of the Mach for Science movement, I propose the following. The previous paragraphs illustrated the three interrelated parts that constitute a boundary-work strategy, namely the characterization of science through attributes, the type of boundary-work and the professional interests being pursued. Thus, in order to determine the strategies used in the March(es) for Science, we have to first examine the attributes that science activists mobilize to characterize the scientific enterprise. Then, the type of boundary work needs to be determined. Finally, the professional interests are to be determined as well.

The identification of these three interrelated parts allows me to discern different instances of boundary-work within science's confrontation with post-truth and Trump. For each instance in which science is contested, a distinct rhetorical strategy is employed by scientists.

To illustrate the operationalization of the threefold boundary-work framework, I refer to an example found in Gieryn's seminal paper (1983). The example refers to a Victorian era English scientist named Tyndall. He was opposing the influence and power of religion in those times. In Victorian times, the clergy still held great influence and power over society, and especially over educational institutions of the time, hindering the installment of scientific knowledge practice in their curricula. In terms of attributes used for his characterization of science, Tyndall described science as empirical in its pursuit of truth through "experimentation with observable facts of nature" (Gieryn, 1983, p. 785), while religion is described as "metaphysical because its truths depend on spiritual, unseen forces assumed without verification" (Gieryn, 1983, p. 785). Similarly, he saw science as "skeptical because it respects no authority other than the facts of nature [while] religion is dogmatic because it continues to respect the authority of worn-out ideas and their creators" (Gieryn, 1983, p. 785). Finally, he characterized science as "objective knowledge free from emotions, private interests, bias or prejudice [while] religion is subjective and emotional" (Gieryn, 1983, p. 785).

Tyndall thus favors science's attributes of empiricism, skepticism and objectivity over their religious counterparts methaphysicism, dogmatism and subjectivity/emotionality. Already from the context of science's societal place compared to religion's, and Tyndall's highlighting the good qualities of science over religion's bad qualities we can suspect that expansive boundary-work is taking place. To consolidate that finding, it is helpful to identify specific metaphors used in the rhetoric of the activists. In Tyndall's case, Gieryn identified the use of a martial metaphor, i.e. science is waging war against religion (Gieryn, 1983, p. 786). When countries wage war, it is usually to obtain something that is under control by outsiders, be it territory, resources or power. Here, Tyndall wants the Victorian age clergy's control over the cultural space that determines truth over reality, and thus expand science's own authority and influence.

From Tyndall's example, we can also see how the type of boundary-work is closely related to the professional interests that are being pursued. In his efforts to expand science's authority he simultaneously "battles for [science's] legitimate power to define and explain nature, and for government patronage, public respect, a larger presence in educational institutions" (Gieryn, 1999, p. 30). The professional interests of Tyndall's science are thus to obtain support from the government and the public, and to instate it in educational curricula. This example illustrates the analytical value of the boundary-work framework in considering the strategies employed by science activists in credibility contests. For the analysis of science facing post-truth and Trump, I apply the framework to the statements made by science activists on signs, posters and banners during the March(es) for Science.

Methodology

In order to answer the research question and gain insight into the boundary-work strategies of scientists displayed at the March for Science protests, I employed a qualitative concept-driven research design to collect and analyze the data. The primary and central data source were the statements, slogans and sentences depicted on the signs, banners and posters held at the Marches. While it was an international event, the majority of participants and cities in which the Marches took place were in the USA, with Washington D.C. alone drawing in an attendance of over 150.000 people (Milman, 2017), compared to

the March with highest attendance outside of the USA being in Berlin, with around 11.000 (Berliner Zeitung, 2017). Furthermore, the USA is arguably the best example of post-truth and its consequences for science considering the impact of the Trump campaign on the public perception of truth, and more importantly the impact of his administration on the functioning of the federal scientific enterprise. This is also manifested in the fact that the March for Science movement originated in the US as a response to Donald Trump's election (Milman, 2017), and then spread globally. Such a choice also follows naturally from the introductory literature review on post-truth, that traces its origins to the effects of the extreme polarization of politics and society, catalyzed by the conservatives' alternative media and information ecosystem, and by the rise of social media.

I thus focused on several Marches in American cities in 2017. On Earth Day, the 22nd of April 2017, the first Marches were taking place, receiving high interest from the media and the public. Furthermore, the magnitude of the 2017 Marches led to them being recognized as the biggest science-related activist effort thus far (Guenther et al, 2019), a status that was not reached by the follow-up Marches in the two years after the original Marches. To gain more in depth insights of the Marches for Science through contextual factors and background information, I also considered and consulted secondary sources. These include the Science Not Silence book from MIT Press (Fine Sasse & Tran, 2018), with detailed accounts of March participants and organizers, and the official website of the event (https://marchforscience.org). These secondary sources offered valuable aid in coding the signs and posters in form of background and contextual information.

To determine the sample to collect, I began with determining which cities to include. To make the data collection concise and clear, I decided to look at specific cities rather than embarking on an unspecified search for signs, posters and banners across the U.S. I focused my sampling on Washington D.C., Seattle and San Francisco, for several reasons. First of all, limiting the search to three cities allows for a more systematic and exhaustive collection, compared to an unspecified search across all cities. Limiting the number of cities also eliminates the risk of encountering signs, posters and banners of non-U.S. Marches that otherwise might have been considered due to them being written in English. For the choice of cities, I first determined the cities with the most attendance: Washington D.C. (ca. 150.000), Boston (ca. 70.000), San Francisco and Los Angeles (ca. 50.000 each), New York City (ca. 40.000), Seattle (ca. 20.000) and Houston (ca. 15.000) (Blunt, 2017; Milman, 2017; KOMO, 2017). From these cities, I finally selected Washington D.C., San Francisco and Seattle as my sample, mainly based on overall attendance of the March, but also availability and visibility of signs, posters and banners. For D.C., the choice was motivated by it being the pilot March (originally, the founders and organizers of the event wanted to call it Scientists March on Washington, seen as it was a protest directed at Trump's White House), and because it had by far the highest number of participants. The choice of San Francisco and Seattle was justified by the presence of comprehensive photographic collections of high-quality pictures with good visibility of textual and visual elements.

Once I selected the cities, I began the actual data collection process. For Washington D.C., I first searched "washington dc science march 2017 signs and banners" on Google. The results pointed to a number of websites that presented small galleries with pictures from the March. The largest photograph gallery I found for D.C. was from Greenpeace USA photographers and was posted on Flickr's website, containing 134 pictures. I also found smaller sized galleries on the websites of Time, Politico and Vox. Finally, I completed the sample for D.C. by collecting signs, posters and banners from the official event's livestream video on YouTube. The video had some great frames of protesters holding their signs and posters, which I collected through screenshots. I concluded the Washington D.C. sampling when I could not find any new signs that I had not previously collected. For San Francisco,

the official event website (www.marchforsciencesf.com/) provides two photo galleries from two different photography agencies. These were ideal, being comprehensive and consisting of high quality images. Similarly, for the Seattle March, I found an extensive and valuable picture gallery. Unlike San Francisco, it was not provided by the organizers of the event, but rather by the University of Washington, that compiled a great collection of images of protest events across the Pacific Northwest sparked by Trump's 2017 election, including the 2017 March for Science in Seattle (https://content.lib.washington.edu/pnwmarches/index.html).

When collecting the images, I avoided double entries of signs and posters since I noticed that some posters were present simultaneously in D.C. and San Francisco. I did not consider how many times a sign occurred, as each entry is considered as a building brick of the entire boundary strategy. Ultimately, the rhetorical strategy remains the same even if the same sign is found across all three cities. It makes more logical sense to consider a homogeneous rhetorical strategy independent of the location or amount of similar or same posters used to manifest the strategy. A sign proclaiming "scientists use evidence" contributes to the construction of a boundary-work strategy independently of where it is being held or of how many identical or similar signs there are. Thus, it is appropriate to disregard double entries, also to reduce complexity and size of the final sample. In total I collected a sample of 988 signs, posters and banners, of which 324 from Washington D.C., 356 from San Francisco, and 308 from Seattle.

In my analysis, I categorized and treated the data according to the framework consisting of attributes, boundary work type and professional interest. In a first step, I transcribed the text on the posters and signs on the images I had gathered onto an Excel sheet. Iconographic and other visual elements found on the posters were also transcribed if and when they provided necessary contextual information related to the text. This allows me to complement the transcribed text, which could be misinterpreted without proper visual context (Philipps, 2012). Once transcribed, I began the analysis by identifying the attributes used for the ideological self-description of science by the community. For this step, I noted all adjectives, adverbs or verbs and nouns ascribed to science (e.g., "science cures"), and thus used to characterize science and its ideology. To group the attributes into different instances of ideological self-descriptions, I worked towards generalizing my data entries. This was achieved by either noting and associating synonyms of the adjectives and adverbs, or associating verbs such as "giving" and "helping" to related concepts of "utility" or "beneficiality". This allowed me to find similarities and group my data into three attributes, which I will elaborate on further on.

Identifying the attributes ascribed to science is the first and fundamental step in determining the boundary-work strategies, as both the type of boundary-work and the professional interests follow from what science is being characterized as. At the same time, we must consider how the opposing party - the outsider, is being characterized in relation to science. For each of the attributes of science I identified, an antagonistic characterization of the opponent was found as well. Some signs, posters and banners directly addressed post-truth and more often, Trump and his administration. Thus, I had to repeat the process used for the characterization of science to determine the antagonistic characterization. It was also of aid to note the antonyms of adjectives used for science to better envision how the scientific community was characterizing their enemy.

Having identified the attributes, the boundary-work type and professional interests were determined. The best indicators for either expulsion, expansion or protection are metaphors, especially war or military related, such as "scientist being under attack" or "resisting attacks". This can be understood even better, by envisioning the social boundary that science erects as a figurative border

that needs to be policed and/or re-erected following conflict, just like real-life border conflicts. Scientists metaphorically expel intruders from inside their borders, expand their borders into outsiders' areas, or police them to deny access to outsiders. The use of such metaphors hints at the purpose behind the rhetorical strategies of scientists - meaning both type and professional interests pursued. Since the professional interests represent the goal(s) and ambitions of the scientific community pursued through boundary-work strategies, they are also closely related to the boundary-work type, if we recall the previous border analogy. Thus, martial metaphors are of aid in discerning purpose and type of boundary-work in the data.

Results

The data collection yielded 988 posters, signs and banners. In total, I extrapolated three attributes ascribed to science, together with the respective boundary-work type and interests. These are: science as objective, science as engaged, and science as beneficial. All three attributions engage in expulsive boundary-work to monopolize the authority, legitimacy and resource allocation of the federal scientific enterprise. As I explain below, some signs, posters and banners that I collected were not compatible for a boundary-work analysis, for various reasons.

Given the magnitude of both the actual March for Science events and the data collected, a minor fraction of the sample is found to not be suited for a boundary-work analysis, and I thus coded them as residual(s) categories. I encountered two types of these residual entries. First off, some signs and posters were excluded because they failed to formulate an attribute to either science or post-truth because they explicitly spoke on behalf of organizations unrelated to science, thus rendering them invalid for demarcation purposes. *‘‘California Pirate party Stands with science", "This christian supports science" "East Bay Atheists - Berkeley, California", "This is not a church [Capitol] American Atheists atheists.org"*. These are some examples of the 18 signs and posters found to be unsuited for boundary work. Furthermore, a second type of residual signs and posters were expressing general statements on science and research, celebrations of successful and influential scientists, quotations and witty puns. They serve a general purpose of celebrating science and the scientific community, but offer no significant insights on actual ideological demarcations. *"Peace Love Science", "Think like a proton, stay positive" and "For small creatures such as we, the vastness is bearable only through love. - Carl Sagan"*, are some examples of the second type of residual statements. Included in this second residual category are also general statements on the Trump administration with a special focus on the anti-science feelings and stance it brought along: *"Real Presidents invest in Science", "No, Donald, no one paid me to march for science, you idiot!"*. In total, I found 148 posters and signs of the second residual type.

The table below summarizes my findings and is grouped according to the identified attributes. For each attribute the number of coded signs, posters and banners is reported, as well as the type of boundary-work and the professional interests associated with the attribute(s). In the following section, the three attributions to science are laid out in detail as well as the corresponding attributions to post-truth and Trump and the associated boundary-work type and professional interests. The results are illustrated with the aid of selected quotes from the posters, signs and banners. Following the illustration of the three attributes, types and interests, I contextualize my findings in a separate chapter, by comparing them to similar demarcation efforts in the literature. I also briefly reflect on the possible strengths and weaknesses of the boundary-work strategies employed in the March for Science.

Attribute Group	N. of signs, posters & banners	Boundary-work Type	Professional Interests
Objective	349	Expulsive	Monopolize authority over establishing and communicating truth claims for democratic decision making (speaking truth to power). Secure funding and public support for objective science
Engaged	289	Expulsive	Monopolize authority and governance over main national scientific institutions and agencies, with particular focus on the EPA and environmental governance, and the NIH and CRC.
Beneficial	185	Expulsive	Secure sufficient funding to sustain the beneficiality of scientific enterprise, while expelling post-truth and Trump from the space of control over science.
Non-attribute 1: on behalf of non-scientific organizations)	18		
Non-attribute 2: celebratory statements and/or missing ideological demarcation)	148		

Table 1: Summary of findings

Science as objective

The first attribute of science I came across is objective. Across the sample, evidence of a characterization of science as objective was coded for 349 signs, posters and banners. In this attribution, science is depicted as an objective knowledge practice concerned with continuous description of the natural reality of things. As such, it is characterized as a perpetual search for truth, where truth is derived from constant observation of reality and communicated through factual and evidential claims. Several signs and posters point to this characterization: *"Science the search for truth", "Observe Inquire Hypothesize Experiment Repeat", "Science = facts = truth" "Science is but an image of truth"*. In attributing objectivity to science, scientists emphasize several aspects of the scientific knowledge practice that enable this attribution. More precisely, this attribution revolves around the organized skepticisms that the community ascribes to its practice.

First of all, science is characterized as constantly questioning, and skeptical towards any previously established truth claim: *"Never stop questioning your assumptions", "Be a scientist. Read. Question. Think.", "Radical American Skeptic"*. Also, methodological imperatives such as the use of evidence to validate truth claims and peer review are described as fundamental to scientific inquiry: *"Science is based on evidence not B.S." "What do we want? Evidence based science. When do we want it? After peer review", "In peer review we trust"*.

A further aspect integral to science's ascribed objectivity, is the absence of normative authority and of partisanism in producing and validating truth claims. The aim is the positive discovery of truth, not the normative creation of truth: *"[...] In Science we systematically root out error & duplicity. The trajectory is toward truth. Unlike politics."*. As such, science is characterized as non-partisan and free from normative pressure: *"Truth not agenda", "I don't want you to think like me - I just want you to THINK [...]"*. The detachment and independence of science from external normative authority (e.g. religion and the church) is further exemplified by a quote from a scientist who perhaps has had the greatest conflict between his work and external normative authority: *"In questions of science, the authority of a thousand is not worth the humble reasoning of a single individual - Galileo*".

While the scientific community paints the picture of science's objectivity, it also shows how their opponent is everything but objective. Post-truth is often equated to the use of the infamous "alternative facts", which the community delegitimized by labeling them in a pejorative way: *"Alternative facts are irrational", ""Alternative facts" are lies"*. Most importantly, these alternative facts represent the contrast between scientific and post-truth knowledge practices, and are used accordingly by the community for demarcation properties. As we discerned previously, science is attributed objectivity by its reliance on evidence for validating claims, while the absence of evidentiality in post-truth is highlighted here: *„Scientists use evidence lying quacks use alternative facts"*.

Furthermore, I found evidence of demarcation efforts pointing to an attribution of political bias in post-truth. A number of signs and posters characterize science as non-partisan and concerned with positivistic observations of truth. This attribution of non-partisanism to science suggests an antagonistic characterization of post-truth as partisan. Several signs, posters and banners hint at its alignment with republican and conservative values and interests, thus demarcating science from post-truth on grounds of partiality and partisanism. Signs in this category allude to the influence of political agenda and narratives in post-truth epistemology, which is thus attributed a normative character that stands in contrast to the objective, positivistic attribution of science: *"Science is non-partisan", "Science is not liberal or conservative", "Data + facts have no political party"*.

Similarly, I found that the scientific community characterizes their opponent's epistemological attempts as scientific malpractices. Previous statements concerning alternative facts suggested the lack of transparent evidence in post-truth, while the following acknowledge post-truth affiliates' ability to appear scientific in the (mis)use of data and evidence. Signs, posters and banners in this regard point out that post-truth and Trump affiliates are found to pose as pseudo-scientific by appropriating, manipulating and corrupting scientific and objective data through normative bias: *"Get your bias out of our data", "Keep your tiny hands off our data"*. Finally, Trump's interferences on science are thematized and used to characterize his actions as pseudo-scientific attempts of normative corruption: *"Trump science: Delete Deny Defund"*.

In this attribution of objectivity to science, the community is also concerned with the relationship between science and policy. By attributing objectivity to science in its epistemology, the science activists advocate for its suitability in informing democratic decision making processes: *"Science speaking truth to power", "Effective policies require facts not fiction ("alternative facts")"*. This highlights science's objective attribute's ability to observe reality, derive truth and communicate truth to agents in arenas where normative decisions are made, thus demarcating it from post-truth. The boundary is drawn and erected between science, where observations of reality yield positivistic truth, and the political arena where normative truth is decided and derived from positivistic truth: *"Data informs policy"*. As previously discerned, post-truth's characterization is of biased and partisan nature, suggesting that it lacks the boundary between value-free observations and value-laden decisions. Post-truth's character suggests that its normative political influence disqualifies it from positivistic truth claims. This is reflected in signs and posters that point out the disconnect between post-truth's claims and reality: *"You don't get to reinvent reality Mr. Trump", "Science - Make reality great again", "Alternative facts belong in alternative universes"*. As such, science is characterized as necessary for speaking truth to power, in order for a democracy to effectively devise policy: *"No science No evidence No truth No democracy", "Science speaking truth to power"*.

The boundary-work type associated with attributing objectivity to science is of expulsive nature. The scientific community mobilized the metaphor of science being under foreign occupation, infiltrated by post-truth agents acting as an epistemological authority through the use of biased knowledge practice and alternative facts, and under threat by Trump's administration that claims authority over the functioning of science, severely antagonizing its professional autonomy. The metaphor of science being under foreign occupation and thus engaging in expulsive boundary-work, is best exemplified by the signs, posters and banners I found, that call for "resistance" against post-truth and Trump: *"Resist alternative facts", "Resist ignorance", "Resist the republican anti-science agenda!"*. By attributing political bias to post-truth epistemology, their truth-claims are deemed untruthful and expelled from legitimate epistemology. This expulsive boundary work serves to monopolize science's epistemological authority, by referring to its objectivity that allows for a continuous expansion of the understanding of reality. These qualities are found to be missing in post-truth, where objective truth is replaced by subjective, normative truth that sets the tone for the creation of truth claims. In practice, this monopolization serves to secure funding, support and legitimacy for science and scientific research and to delegitimize post-truth: *"I want my tax money to fund unbiased research - question, hypothesis, observation, measurement, data analysis, peer review"*. This extends to policy as well, where science wants to secure and monopolize its position as objective informer of a functioning democracy: *"Science… leads to sound policy. Silencing science… leads to chaos."*. This is achieved through the expulsive boundary work strategy I previously outlined. As a result, the professional interest of science displayed here is to describe the reality we inhabit in an objective and truthful manner, expanding our understanding of it and to objectively inform decision-making processes. In order to fulfill the interests,

the expulsive strategy is needed to draw the boundary to post-truth, to delegitimize its claims to represent legitimate epistemology, and to monopolize science's authority over the creation and communication of objective truth.

Science as engaged

The second most frequently coded attribute was engaged. In contrast to a characterization of science as objective and strictly concerned with describing reality, 289 signs and posters point to a characterization of science as engaged with society. In particular, scientists expressed a strong partiality towards acting for the common good of society, departing from a purely observationist role that emerges from the objective attribution. In this characterization, science is depicted as directing their professional efforts towards what is perceived to be in the interest of a majority. I observed this characterization in two contexts: first in relation to climate change, and then in relation to health, prosperity and longevity in general.

In the first part of this characterization, scientists attempt an ideological demarcation based on the issue of anthropogenic climate change, drawing the boundaries according to the professional ideology on climate change. Primarily, scientists depicted themselves as being engaged and interested in nature. In this description, science's engagement is characterized as the will to direct efforts and attention towards the well-being of the planet and of nature. This is exemplified by the following quotes: *"I march for the bees", "I'm fighting for fins", "Science for shellfish - #OceanAcidificationIsReal, #ProtectNOAA, #ProtectSeaGrant", "I'm causing a commotion for the ocean", "I march for the birds & the bees, the flowers & the trees the rivers & the seas all things wild & free I march for you & me", "Save our salmon runs".* In particular, some signs and posters portrait science's engagement for nature as the act of giving a voice to the voiceless plants and animals, as a means to safeguard them from harmful anthropogenic activities: *"I'm marching for...wildlife: marbled murrelets, spotted owls, gray wolves, killer whales, spotted frogs, Larch Mt. salamanders. They have no voice!", "I speak for the trees for the trees have no tongues - The Lorax".* "The Lorax", a 1971 kid's book by Dr. Seuss, thematizes environmental harm by the hands of humans, and features the popular character named Lorax, who does speak for the trees, voicing their concerns. Furthermore, I observed a sign pointing to previous achievements of an engaged science, further highlighting the efforts and merits of this particular attribute of science: *"Freedom is alive because of the Endangered Species Act".* The all-American symbol of freedom, the bald eagle, was subject to serious harm through the excessive use of a certain pesticide back in the 1950s and 60s, up to the point of near extinction. Fortunately, concerned and engaged scientists directed their efforts towards determining the cause of the bald eagle's near extinction, and ultimately were able to reverse the damages done by having the pesticide banned and influencing legislation to introduce the Endangered Species Act.

While science is attributed engagement and appreciation for the planet (*"Our love for the earth is like π Endless!"*) and its inhabitants, post-truth and Trump are attributed engagement for the interests of a select group (*"Yes, the planet got destroyed. But for a beautiful moment in time, we created a lot of value for shareholders."*). Ideologically, science is depicted as acting in the interest of the environment and humanity, while post-truth is characterized as a servant to the interests of few. This is perhaps best exemplified and explained by the controversial decision of the Trump administration to appoint Scott Pruitt as the new head of the EPA in February 2017. The decision was controversial to say the least, for a number of reasons (Milman, 2016): First off, in classic post-truth fashion, Pruitt heavily insisted on artificially keeping the debate and controversy on climate science alive, expressing a skepticism bordering on climate change denial. Second, Pruitt's ties to the fossil fuel industry were strong and evident, with him receiving upwards of $300,000 in contributions from the industry. Last but not least, his stance on the EPA and all climate change mitigation efforts is painted painfully clear by his actions as attorney general (the position he held before being appointed head of EPA), having sued the EPA a grand total of 14 times.

Pruitt's appointment was taken up by the scientific community in their signs and posters, denouncing this controversial decision: *"Hey Trump it's not the Exxon Protection Agency", "Scott Pruitt is the greatest threat to our environment"* and *"Scott Pruitt Environmental Pollution Agency".* These signs also further point out the conflicting ideologies of science on one side, committed to the environment, and post-truth/Trump on the other, committed to the vested interests of a select few, who see climate change mitigation and environmental preservation efforts as threats to their interest. Overall, the scientific community is concerned with post-truth's professional interests, fearing a threat to both their own ideology and to the actual environment. Again, the rhetorical strategy highlights post-truth's affiliates' engagement for the interests of a select group, which negatively affect the interests of an environmentally engaged science: *"I love all the animals your policies will make extinct", "Species richness not corporate richness", "The ocean is not political Marine science is critical"*.

The engaged attribution also extends to the people and their health and prosperity, for whom scientists are engaged for, by directing efforts towards important advancements such as cures and treatments for diseases. Science is being depicted as directly engaged for the well-being of society at large, as opposed to being particular to - or benefiting - a specific group or segment of the population: *"I'm not in science for the money, I'm in science for us"*. For instance, a significant portion of the signs in this category thematized the immense progress made in the medical field in the past, mainly with the eradication of once so threatening ailments such as Polio: *"Got polio*? Me neither Thanks science *Or smallpox, mumps, measles, rubella, hepatitis… Fund science!", "Remember polio? I don't. #thank a scientist", "When was the last time you worried about polio? Can't remember? That's because of American Scientists", "Didn't die of an infection? Thank a scientist"*. With these past accomplishments, the stage is set for examples of what an engaged science is currently working towards, constantly striving for improvements in health and well-being: *"Cancer does not discriminate! Scientists fighting for future patients", "Want a cure for cancer? Diabetes? Alzheimer's disease? Heart disease? HIV/AIDS? Ebola? Support science!", "Science lets you live long and prosper"*. Here, scientists were concerned with the threats of science defunding stemming from the Trump administration, and thus characterize the post-truth related undermining of the scientific enterprise as an act of societal regression comparable to the Dark Ages: *"Scientific study in nutrition improves health! No science? = Dark ages!", "Scientist purge = great leap backward"*.

In this instance of boundary work, the scientists pursue an expulsion effort. This is supported mainly by the use of the metaphor of science being under assault by post-truth, which is similar to the resistance metaphor, and thus hints at expulsion. With some clever wordplay, this poster displays the metaphor used (being under assault) for the expulsive efforts of the community: *"NaCl / NaOH - Our base is under a salt - Save EPA"*. Having suffered an assault by the hands of post-truth - more precisely, Trump's administration - science based environmental organizations such as the EPA are confronted with a loss of resources and autonomy in their functioning. I also found evidence of the resistance metaphor: *"Tiny hands giant catastrophe Resist"*. This also implies a characterization of Trump and cohorts as dangerous and harmful for the planet, and thus our future. This further suggests a boundary-work effort in which the rhetorical strategy of the scientific community is to expel post-truth from domains where the qualities of science are seen as more fit. Post-truth workers in Trump's administration are labeled as unqualified and unfit to represent the environmental protection efforts of science-based agencies like the EPA, or they are labeled as unqualified to occupy crucial positions such as the U.S. Secretary of Energy: *"The (d)Evolution of Secretaries of Energy: Steven Chu, 2009-2013 - Ph. D. Physics, Nobel Laureate; Ernest Moniz, 2013-2017 - Ph. D. Physics, MIT Professor, Department Head; Rick Perry current - B. S. Animal Husbandry, 1. 88 Science GPA"*.

The professional interests displayed in this effort reflect science's ideology of being engaged and invested in the planet and humanity's well-being. Scientists want to monopolize their authority on climate matters and eliminate external threats to their enterprise stemming from post-truth. In the effort to monopolize their authority over environmental matters, the scientific community highlights the flawed professional interests of post-truth affiliates and juxtaposes them to their own: *"Planet before profit", "Earth needs science facts and carbon tax NOT fat $tacks and super PACs!", "Science for the planet not for b$g business"* and *"Make the barrier reef great again!"*. The strategy is to monopolize science's authority over environmental governance by delegitimizing post-truth and by essentially arguing for the ideology of nature over profit: *"I pledge allegiance to the earth and all the life which it supports. One planet, in our care, irreplaceable, with sustenance and respect for all"*.

In a similar fashion to the expulsion related to environmental efforts, the scientific community attempts to expel post-truth from the domain of governance and control over a science that is engaged for the well-being of the population. Again, the resistance metaphor is being mobilized; although in this context the wordplay is related to health: *"Like staph aureus [antibiotic resistant bacteria] we will resist", "Resistance is not futile. Live long & prosper"*.

Post-truth's engagement for the select few poses the threat of reduction or reallocation of funding and authority for scientific institutions and agencies that are perceived as a threat to the interests of the elites served by post-truth. For scientists, this is detrimental to their professional interests regarding their engagement for society's well-being. The professional interest is to secure the means for scientific institutions and agencies to continue their efforts for human prosperity and health: *"Less science = more cancer", "Fully fund NIH [National Institute of Health] + CDC [Centers for Disease Control and Prevention]"*. Trump's administration is found to have infiltrated the arena of control over science, redirecting and undermining funds meant for science, thus jeopardizing scientists' ability to fulfill the ideology of serving humanity. Post-truth is thus being delegitimized and expelled from influencing decisions on the federal scientific enterprise: *"Support scientists 'cause the game show host and the handbag designer won't be curing cancer anytime soon!"*.

Science as beneficial

185 signs and posters were coded for the beneficial attribute. This characterization revolves around showcasing the various merits of science, in an effort to highlight the extent of how in all its forms, science is an integral and crucial aspect to modern society. This beneficiality is closely related to the utility of science - an attribute that Gieryn (1983) previously observed in two separate cases of boundary-work - but extends beyond the definition of utility as in its ability to fulfill a need or task. Science's utility lies in the ability of fulfilling certain needs such as the need for novel knowledge for technological innovations. The signs and posters I coded for this attribution point to a characterization that builds on science's utility but argue that it is beneficial, not just useful. Beneficiality refers to the ability of bringing an advantage or benefit. In this context, science's beneficiality results from the wide range of utility it offers: From consumer-oriented technological innovations such as smartphones (*"If you have a cellphone thank a scientist"*), to innovations in space travel and exploration (*"Science flies you to the moon"*), to more mundane things such as beer or duct tape (*"Beer comes from science", "Science gave us duct tape 'nuff said!")* - it all can be traced back and credited to basic scientific research. Taken singularly, all these achievements could be attributed to the utility of science to inspire and spark innovation, but it is in the sum of these utilities where science's beneficiality lies: *"I know of no area of human endeavor in which science has not had at least one important thing to say." - Carl Sagan", "Science is what made America great in the first place", "Humanity's greatest tool: The scientific method", "Science opens minds, hearts, possibilities", "Science creates jobs, saves lives"*.

The benefits of science thus can well be equated to progress in general, as one sign does: *"Science = progress"*. Finally, it is perhaps useful to note the difference between the engaged attribute, which also brings benefits. The distinction lies in the fact that an engaged science actively directs efforts toward bringing benefits by working on a cure for cancer, for instance. Simultaneously, science in general brings benefits as a result of its normal, unengaged activity, such as basic research producing novel insights to be applied in innovations. Just like a medical research effort to find a cure for cancer is different to a company's effort to market the adhesive and durability properties of a material combination of mesh cloth and polyethylene (the components of duct tape), the engaged attribute of science differs from its beneficial attribute. As such, the ideology and interests of both differ.

A significant portion of the signs and posters coded for this category displayed examples of benefits that were directed at Trump himself: *"Golfer-in-chief even this club is designed by scientists", "Hey Trump, science made your hair!", "Mr. President: Science gave us Rogaine [hair loss drug]!"*. Although Trump is being directly addressed by these signs, they are only concerned with attributing beneficiality to science and not with an antagonistic characterization of post-truth or Trump himself. In fact, compared to the other attributes where the characterization of post-truth was explicit through a number of signs and posters, in this instance it is more implicit. The more intuitive and straight-forward antagonistic characterization of post-truth is similar to the one in the previous category, where science is engaged for the planet and humanity and post-truth and Trump are engaged for the interests of few. In similar fashion, here the scientific community argues: *"Science: Where the work of few benefits all", "Science benefits everyone!"*. This implies a characterization of post-truth as beneficial to their select group, which is not far from the previous finding. Also, the difference between an engaged post-truth and a beneficial post-truth is similar to the difference between science's attributes of engaged and beneficial. While engaged means post-truth affiliates work towards the interests of the few, beneficial means their efforts bring several benefits to those select few, in disregard of the benefits or interests of the greater population and of the planet.

I also found that post-truth is attributed the opposite of beneficial in relation to society at large. While post-truth serves a specific few and undoubtedly brings them benefit, the scientific community argues that for the rest of the population, post-truth is actually detrimental. This is expressed in a number of ways. For instance, one sign draws parallels between post-truth's intentions to withdraw resources from science and research, and the Star Wars franchise, in which a similar decision ultimately leads to The Empire's defeat: *"The Empire cut the research budget too…"*. Other signs follow a more straightforward approach and simply state: *"Defunding science destroys progress!"*. Similarly, a number of signs and posters equate these post-truth times to the Dark Ages. It is an appropriate metaphor, if one considers that in the Dark Ages - synonymous to the Early Middle Ages - science was unable to carve out its own appropriate and legitimate niche in the intellectual landscape of the time, famously dominated by dogma and the clergy. Moreover, that directly translates into an obvious lack of all the scientific institutions, and appropriate resource availability, needed for science to fully express their beneficiality. The rhetorical strategy of the scientific community thus mobilizes the Dark Age metaphor to characterize post-truth as detrimental - regressive, even - for the common good and benefit: *"[...] No science? = Dark ages!", "Scientist purge = great leap backward"*.

In regard to the type of boundary work of this attribution, the findings mainly point to expulsion yet again. Supporting this claim, I found the resistance metaphor being mobilized by the community. Specifically, a sign proclaims: *"Resist the dark ages Support science funding"*. From this, we can deduce that post-truth is found to have infiltrated science's professional space and to pose a threat to science's functioning through resource limitation. Again, the Dark Ages comparison is being made to highlight the un-beneficial character of post-truth, justifying an expulsion effort. When attributing a beneficial nature to science, the scientific community argues that the benefits extend to all, while post-truth benefits its affiliates and is detrimental to the benefit of many. Yet, post-truth holds a position of power to decide on matters related to the scientific enterprise, despite the conflicting ideologies and attributes of the two. In order to achieve the expulsion of post-truth from decisions over scientific resource allocation, the scientific community attempts to rhetorically exclude post-truth - and specifically Trump - from enjoying the benefits of science: *"Fund science or don't bother… …boarding an airplane …driving your car …taking medicines …using GPS …tweeting!"*.

The above quote also is a great example of the professional interests being pursued. Scientists demand a resource reallocation to science, following the funding and budget cuts decided by the post-truth White House. The goal is to obtain sufficient funding to ensure a sustained operation of the federal scientific enterprise, in order for it to fulfill its practical utility in all human endeavors, and thus bring greater benefit. The community attempts to expel post-truth from the arena of authority and control over the functioning of science that it was occupying. Scientists also raised the argument that post-truth is a hurdle to science, yet still draws benefits from it, and demand that resources be redirected towards science in order for everybody, including post-truth and Trump, to keep deriving benefits from it: *"Fund science or don't bother… …boarding an airplane …driving your car …taking medicines …using GPS …tweeting!"*.

Different times, different strategies?

The rhetorical strategy of the scientific community facing post-truth revolves around a self-description of science as objective, engaged and beneficial. In all three attributes, the community sees post-truth as an invader and occupier of their own cultural space and thus aims at expelling post-truth. As part of the expulsion, scientists want to monopolize their authority over the functioning of the federal scientific enterprise, with all scientific agencies and institutions such as the EPA and the NIH. Monopolizing the authority also involves appealing to the public to support science as opposed to post-truth. To contextualize my findings to boundary-work in general, I compare the strategies I found to those identified by others.

Climate change as a complex and ubiquitous issue has been the topic of many ongoing discussions between science and the public, and the evolution of this discussion in a boundary-work perspective is interesting and helps understand the findings. In the late 1990s the evidence on climate change suggested that the earth is warming, but the argument of scientific uncertainty was still very strong on both the public and more so on the scientists' side. Speculations were running wild among the press and the public, which led the scientific community to characterize the public as alarmist, overreacting and careless of evidence on the issue (Zehr, 2000). Climate scientists on the other hand characterized their climate research as "skeptical, deliberate, and [having] appropriate respect for uncertainties" (Zehr, 2000, p. 95). With these attributions they aimed to exclude the public from inflating the debate on climate change and to monopolize their authority on climate knowledge.

Some twenty years later Climategate occurred and now the coin is flipped. While previously scientists themselves were emphasizing the uncertainty of many areas in climate science, now the public was mistrusting scientists because of appeals to uncertainty. Following Climategate, climate scientists characterized their science as consensual on crucial topics such as the influence of anthropogenic activity on climate change, in order to expel climate deniers from the outside (Ramírez-i-Ollé, 2015). Also, science is characterized as skeptical in that it is free from external (normative) influence.

We can see how although the public's perception of climate science has changed from more alarmist to more skeptical over time, the production of scientific knowledge on climate change is still characterized as essentially skeptical and consensual. This is comparable to how the community characterized science during the Marches, as objective knowledge production through skepticism, evidence and peer review, which then in turn lead to consensus. In the case of post-truth boundary-work, the rhetorical strategies go beyond talks of consensus and uncertainty. The focus is more on the functioning of science in climate action, and science is depicted as interested and invested in the planet rather than pleasing industrial interests. This signals a change of focus and aim of the rhetorical demarcation strategies.

Climate change has been a topic for decades and while in the early stages it made sense to separate scientific evidential and consensual knowledge production from alarmists and fear-mongers, the need for demarcation has shifted over time. Climategate can be seen as efforts of post-truth precursors to undermine the legitimacy of climate science and thus justifies the need for demarcating again between producing legitimate and illegitimate claims. In post-truth, things change. Climate change deniers are in high places of authority and control, regardless of the legitimacy of their epistemology on the issue. For science, this signifies the need for a demarcation on different grounds. As we have seen, characterizations of environmental science refer to its engagement for the planet, and consequently for all of its inhabitants, while calling out the vested interests of post-truth.

While the attributes evolved accordingly, the type of boundary-work remains similar to previous climate science demarcations. While previous instances were concerned with monopolizing the authority of science over legitimate truth claims, post-truth boundary-work is more concerned with monopolizing the authority over devising actual climate action. In any case, outsiders are found infiltrating the cultural space of science and jeopardizing proper functioning of science.

Furthermore, there are interesting similarities to the classic boundary-work strategies of Tyndall versus religion. If we recall, he characterized science as empirical, skeptical and objective as opposed to a metaphysical, authoritative and subjective characterization of religion. There are many parallels between how religion and post-truth are characterized by science activists. In epistemological terms, post-truth is almost like a religion. As previously laid out, it is not empirical (alternative facts), it follows an agenda, is highly subjective and conservatively biased. In his efforts, Tyndall also characterized science as "practically useful in inspiring technological progress to improve the material conditions of the nation" (Gieryn, 1983, p. 785), while denouncing the lack of utility in religion. Similarly, the community of the Marches characterized science as beneficial, due to its many practical utilities that ultimately contribute to a common good, rather than post-truth's particular beneficiality for a select few. It's also interesting to note that Tyndall was pursuing expansion of science's authority, I determined expulsive efforts. This can be explained by the historical context of the power of religion in Victorian England that was overshadowing science, a growing and developing profession. Nowadays, the role of organized science with several institutions and agencies is generally accepted and desired in society. Then, post-truth came and forced its way into the cultural space of science, which then needed to be conquered back.

These findings suggest that the strategies used by science activists change over time and in relation to the contextual factors. Especially interesting is the evolution in regards to climate science. The rhetorical strategies have become more complex in that they went from describing the ideology of (climate) science as wanting to obtain consensual truth on the issue free from external influence, to wanting to fulfill the attributed engagement for the planet, through scientifically devised climate action and governance. To obtain that, the strategy went from characterizing how science makes truth, to how science acts on truth and whose interests are represented through their actions. I see this as a move from the ideology of science as an isolated profession ideally kept separate from society, to an ideology of science as involved with society.

The effectiveness of the rhetorical strategy is hard to determine, as the framework used is suited for describing and not evaluating boundary-work demarcations. Yet, I can point out some possible strengths and weaknesses in the approach taken by science activists facing post-truth.

First off, the first attribution to science depicts it as objective, and thus non-partisan and apolitical, given the absence of normative bias. This is important for securing legitimacy and trust in their truth claims, and delegitimizing pos-truth claims. While all the signs, posters and banners carry strong arguments as to how science is supposedly non-partisan, the act and circumstance of the Marches themselves are cause for concern. First and foremost, the fact that the rallies were born out of the reaction to Donald Trump's election and directly addressed him and his policies, might trigger the suspicion that science indeed is politically biased. In fact, a scientist voiced his concern that the March might actually damage the cause, as it would "reinforce the narrative from skeptical conservatives that scientists are an interest group and politicize their data, research and findings for their own ends" (Young, 2017). The fact that many posters, signs and banners expressed strong anti-Trump and anti-GOP sentiments reinforce these concerns.

Although there is a contradiction in how the community attributes objectivity through non-partisanism and how the rhetorical attacks target Trump and the Republican Party specifically, it can be mitigated by the fact that two more attributes were defined, and not just the objectivity of science. The other attributes are arguments of why the ideology of science is arguably better than the ideology of post-truth. Characterizing science as engaged and beneficial is how the boundary is drawn to post-truth. It highlights that in these uncertain times, science works in favor of all, and exposes how favoring post-truth over science benefits their affiliates, but is detrimental to the common good. These are strong arguments but they are weakened by some inconsistency in how science is presented.

Firstly, there is a contradiction between characterizing science as objective and characterizing it as engaged. An objective science is ideally detached from external influences in defining research problems and creating truth from observation. Yet, a characterization of science as engaged for society alludes that it is not completely detached from society and thus external influence. Second, when science is characterized as beneficial as in not only benefiting a select few, but arguably society at large, some less positive aspects of science are conveniently left out. All the good things that come from scientific research are highlighted and exposed, while less good and even harmful things that derive from science are not thematized. Yes, science enabled smartphones and the moon landing, but it also contributed to the creation of the atomic and the hydrogen bomb, or to the creation of social media which in turn contributed to bringing science to this peculiar position.

Conclusion and discussion

In this research, I explored the boundary work strategies of the scientific community in response to the rise of post-truth and Donald Trump's presidency. Post-truth implies increased science skepticism, abundance in mis- and disinformation, and loss of scientific authority. It also paved the way for the blatant dismissal of scientific facts and various attacks on science by the hands of the Trump administration. Using a constructivist approach to the demarcation problem of science proposed by Gieryn, I analyzed the rhetorical strategies displayed by scientists through signs, banners and posters found in the March for Science protests. This allows for a new perspective on possible responses to post-truth by discerning and analyzing the response of the community directly affected by it, and by Trump's presidency, namely scientists. It also contributes to expanding the literature on the issue of demarcating science from other knowledge practices by applying the boundary-work framework to the post-truth case. This allows for a comparison of the strategies employed in contrasting post-truth, to previous strategies used in demarcations.

I found that the rhetoric strategy revolved around a characterization of science as three main attributes: objective, engaged and beneficial. The ideology of science and scientific knowledge production is characterized as an objective and perpetual search for truth. Objectivity is attributed on the grounds of the values the community adheres to, which are organized skepticism, described as challenging established truth claims, basing truth on evidence and peer review, and being non-partisan. Post-truth's knowledge practice is characterized as highly partisan and authoritative, wherein the use of evidence is either subject to normative bias or lacking altogether, replaced by made-up claims (alternative facts). Thus, post-truth is expelled from legitimate epistemology and science monopolizes the authority of producing (legitimate) truth claims and thus also the authority of speaking truth to power. The professional interests of science are to secure the funding and support to pursue their ideology of objective observation of reality and communicating truth claims freely.

In characterizing science as engaged, science activists highlight the efforts undertaken by science to represent and act in favor of the planet's best interest, and to direct efforts toward health and prosperity of humanity. Post-truth is characterized as engaged for the interests of elite select group(s). The type is once more expulsive, as post-truth and Trump have infiltrated and occupied the federal scientific enterprise (EPA, NIH, CDC etc.), and are thus jeopardizing its proper functioning. The professional interests are to regain control over the enterprise and secure sufficient funding for engaging in the fight against climate change and in advancing health and prosperity.

Finally, scientists were found to attribute beneficiality to scientific research, as it inspires progress and innovation, and in doing so creates benefit for many. Post-truth is characterized as beneficial to their affiliates, but detrimental to science and thus to the benefits it brings. As such, it needs to be expelled from the position of control over the federal scientific enterprise that it infiltrated. The professional interests revolve around securing the resources and public support for the scientific enterprise that are needed to sustain its beneficial nature and to consequently drive progress.

The efficacy and impact of the scientific community's boundary work in the March of Science is a question that lies outside the scope of this research. To determine how the rhetorical strategy affected various science funding, public support and public perception of science would require a longitudinal approach. The presented research presents minor limitations in terms of validity. The data sample was limited to three of the major Marches in terms of participants due to the convenience

sampling approach undertaken in order to obtain a meaningful and concise sample. A more exhaustive sampling could have yielded further insights yet was not pursued due to limited time and resources. Finally, a greater inclusion of other sources and types of data such as newspapers, commentaries or blog entries, official statements and so on could further enhance the findings. In terms of generalizability, this study was focused on the science versus post-truth case in the USA, which means that the Trump administration and its adversities to science represent a substantial part of the boundary work, somewhat limiting the overall generalizability. I believe it would be interesting to do a similar analysis in the European post-truth and March for Science context, which could possibly yield less Trump-related insights and novel insights on other aspects of post-truth.

My findings open a new perspective on how the scientific community deals with post-truth, and consequently adds to the existing literature on possible itineraries out of this post-truth age. The analysis of boundary-work strategies displayed on posters, signs and banners found in science activism protests is a contribution as well. It demonstrates the suitability of the boundary-work framework to derive insights on demarcation strategies with a different kind of source material, as opposed to the one used by previous researchers such as public statements made by scientists in official sources such as newspapers, op-eds or editorials. This proves to be useful for future research in cases where such official sources are hard to come by or when alternative types of sources are taken into consideration. The contextualization and comparison of the rhetorical strategies employed against post-truth to previously employed strategies, such as those by the scientists involved in Climategate or Tyndall, allowed me to identify the use of two novel attributes, or repertoires of self-description. These are science's engagement and its beneficiality.

Finally, discerning the various strategies used for demarcating science from post-truth enabled me to explore some possible strengths and weaknesses of the approach undertaken by the scientific community. As a result, I suggest adapting the rhetorical boundary-work strategies for possible future demarcations against post-truth accordingly. Internal inconsistencies in the ideological self-descriptions of science could be detrimental to the success of the demarcation efforts. Contradictions between the self-descriptions of science and actual actions of science activists also weigh in on the impact of the strategies. I thus suggest addressing these issues in future credibility contests, to positively influence the success of such rhetorical strategies of the scientific community and science activists.

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