Communicating science policy controversies: How the fields of science journalism, science and politics interact through the lens of Bourdieu's conceptual triad

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Abstract

Science controversies and how they play out in the media can affect national policy. Examining how these debates are communicated sheds light on the underlying motivations of certain players that have a stake in the outcome. Looking at the communication of science policy controversies gives us a glimpse into the alliances or oppositions between these players. This thesis examined how three key fields – politics, science and science journalism – interacted to shape how selected science policy controversies are communicated. This examination allows us to situate the stance of science journalists relative to the fields of science and politics, and gain better insight into their motivations when participating in the debate on science policy controversies. Three examples of science policy controversies are investigated. The first two examples (the implementation of a national science policy and the application of an environmental policy) are culled from the *Science Forum*, which is a journal published in the 1970s. This historical example of Canadian national science policy debates is employed to situate the third more contemporary example of science policy controversy – the 'muzzling' of government scientists. Pierre Bourdieu's conceptual triad of practice, habitus and social fields is used as a historicized methodological tool to map the social interactions found in the science policy controversies examined. This theoretical approach also provides a deeper analysis of the patterns of interaction that emerged.

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Chapter 1: Introduction

Science controversies and how they play out in the media can affect national policy and can impact how we live our lives in surprisingly direct ways. For example, the outcome of a science controversy could mean a policy that makes crucial childhood vaccinations mandatory (Boyce, 2006; Mikulak, 2011) or result in a policy that restricts the use of stem cells to investigate cures for debilitating diseases (Levine, 2006).

When science controversies are debated in the media, opinions from scientists and politicians often take centre stage (Nisbet et al., 2003; Nelkin, 1995; Nisbet and Lewenstein, 2002) while journalists have traditionally reported on these issues without actively voicing their opinions, basing this practice on notions of independence and objectivity – even as these notions are heavily debated in the field. However, journalists are key players who often decide who gets a voice in the media (Rothman, 1990) and what information is disseminated to the public, so it is equally important to understand their role in how scientific controversies play out. My research goal was to illuminate the relationships between science journalists, scientists and policymakers and thereby explore any underlying power struggles between these key players in the face of science policy controversies.

To this end, this thesis examined how three key fields – politics, science and science journalism – interacted to shape how selected science policy controversies are communicated. Examining the communication of scientific controversy sheds light on the underlying motivations of certain key players that have a stake in the outcome of said conflict (Nelkin, 1992; Mukerji, 2007; Endres, 2010). Thus, looking at the communication of controversies gives us a glimpse into the power struggle that can ensue and the alliances or conflicts between key players.

Existing research on communicating scientific controversy that have taken a sociological view tends to focus on how agents from two of the fields in question interact – for example, scientists and journalists or scientists and policymakers or policymakers and journalists (e.g. Anderson, 2012; Jensen, 2010). However, research on how agents from all three fields (journalists, scientists and policymakers) interact during a scientific

controversy is limited.[1] As such, research is limited on how journalists are connected in a broader sociological context to other key players (i.e. scientists and policymakers in this case) in the face of scientific controversy. An examination of the interaction between agents from these three fields may help reveal previously hidden patterns and deepen our understanding of what factors impact media discussions on a given scientific controversy. In a broader sense, this line of study is significant because scientific controversies and how they are communicated to the public tend to impact national science policy (Endres, 2010).

The limited attention paid to the interactions of multiple fields may be due to the lack of bounded, researchable examples and/or the lack of methods able to give insight into these complex interactions. One way to explore how journalists interact with politicians and scientists during scientific controversies is by using Pierre Bourdieu's conceptual triad of practice, habitus and social fields (Rawolle and Lingard, 2008), which represents the main "thinking tools" in Bourdieu's body of work (Bourdieu, 1989). This conceptual triad – social fields in particular – enables us to view key players as agents of their field and view their interactions with each other in terms of class and power relations (Bourdieu, 2005). The question of bounded examples where science journalists, scientists and politicians interact and are researchable is addressed through the historical artifact of the *Science Forum* (1968-1977). The *Science Forum* is a journal that features contributions from science journalists, scientists and policymakers. While not a typical mass media form, many prominent players in the science journalism field who did contribute prolifically and regularly to scientific news and debate in several mass media outlets at the time were regular contributors. Taking into consideration that the *Forum* was spearheaded by a prominent science journalist and that the topics and controversies covered mirrored those that were discussed in the mass media at the time, a close examination of this artifact is indeed warranted as it provides a larger and clearer window into the views and opinions of many key players that shaped the outcome of those controversies.

Pierre Bourdieu's key concepts constitute a "theory of practice" or more precisely a "theory of research practice" and thus only take shape when used in the practice of

[1] For example, an Ebsco database search on August 29, 2016 of the databases Academic Search Complete, Communication & Mass Media Complete, Communication Abstracts, Political Science Complete, International Political Scince Abstracts and SocINDEX using "controversy", "scien*", "politic*" and "journalis*" produced 213 hits – none of which examine all three fields in a single investigation.

research (Grenfell, 2012). Bourdieu proposes that there be an ongoing reflexive interplay between theoretical explanation and empirical research investigation when constructing a social object of study (Grenfell, 2012). In a Bourdieuian analysis, data are first collected and analyzed before a theory can be constructed (Grenfell, 2012). This also holds true in the formation of my premise in the case of my analysis of the *Science Forum*. The journal was published mainly throughout the '70s and is heavily populated with opinion pieces. It is a forum that was used by prominent science journalists at the time (e.g. Peter Calamai, David Spurgeon) to editorialize their views on science and its impact on society. It represents a researchable historical example of how science journalists, scientists and politicians interact. The main goal of the journal was to discuss controversies that impact national policy and to provide a platform for all sides of the debate in the op-ed and letters sections, which were quite robust. After a preliminary review of much of the correspondence in the *Science Forum* between the key players representing different fields, a premise took shape that when faced with scientific controversy that impacts national policy, the science and science journalism field tend to collaborate to oppose the political field. This thesis was designed to explore this premise more deeply within the correspondence found in the *Science Forum,* as well as explore whether this premise repeats itself in a contemporary example of science policy controversy. The following research question guided this thesis: ***how do the fields of science journalism, science and politics interact in discussions on science policy controversies in the media?***

Why study scientific controversies?

The examination of scientific controversies can provide a window to the interactions and agendas of certain key players and reveal previously hidden social aspects of scientific, journalistic and political practice (Collins, 1985; Martin and Richards, 1995; Endres, 2010; Mukerji, 2007). When studied empirically, controversies or contests of knowledge have been found to be deeply rooted social processes (Mukerji, 2007).

In general, the voices of government, industry and societal elites (i.e. scientists, doctors, lawyers and celebrities) tend to take centre stage in the media. Historically, their influence on agenda setting and framing cannot be understated (Sigal, 1973; Tuchman, 1978; Berkowitz, 1992; Cobb and Elder, 1971). In media coverage of scientific controversies, government sources, industry members and scientists are more likely to

be the dominant voices in the media (Nisbet et al., 2003; Nelkin, 1995; Nisbet and Lewenstein, 2002). As such, Nelkin (1992) argues that scientific controversies tend to "revolve around the question of political control." Often, as the conflict unfolds, "the special interests, vital concerns, and hidden assumptions of various actors" will be clearly revealed (Nelkin, 1992). Public science controversies not only involve debates between scientists but "contestation over the role of science in decision making" (Endres, 2010) or how much science and research should influence subsequent policymaking decisions. The study of scientific controversy represents a very important area of study because "when science enters the realm of public deliberation, it is no longer insulated from interaction with policy concerns" (Endres, 2010). This can be seen in the examples of science policy controversies in this thesis as science is used to justify or contest specific policy concerns by the key players examined here.

Media coverage of controversies certainly can have an impact on policy outcomes and key political players will try to lobby the media to gain public support for their position (Nisbet, 2003). In fact, using the theories of agenda building, Nisbet (2003) has found that in the face of controversy, competing interests function as news sources, feeding the media packaged news items that serve their purpose.

Past research points to a correlation between the media coverage of a scientific issue and societal debates on the topic in question – with coverage increasing drastically when the topic enters the realm of political controversy (Nisbet, Brossard and Kroepsch, 2003; Nisbet and Huge, 2006). Given the apparent link between science controversies covered in the media and the impact of debates on science policy (e.g., Boyce, 2006; Mikulak, 2011), it seems warranted to examine the key players involved in these overlapping spheres (i.e. science controversies and science policy).

Scientists have a long tradition of playing an advisory role to policymakers in most democratic societies. They have served on advisory panels and through expert testimony have shaped policy in numerous instances (Jasanoff, 1990). These close couplings are centuries old and have served to blur the boundaries between science and politics (Scheufele, 2013; Westfall, 1985; Scheufele, 2014).

Likewise, there is a blurring of lines between the media and science. The media plays a role in shaping public opinion and perception while at the same time there is a growing

expectation that scientists advocate for the public understanding of science, the funding of science, and other goals (Scheufele, 2014; Weingart, 1998; for a good historical discussion, see Logan, 2001). The result is a growing interconnection between science and the media, which Weingart (1998) has termed “medialization” (Weingart 1998). As such, a closer examination of the interactions of key players in debates on science policy controversies – science journalists and scientists in particular – as is done in this thesis analysis helps further clarify the nature of these interconnections.

Research design and specific aims

The overall objective of this thesis was to use Pierre Bourdieu’s conceptual triad of practice, habitus and social fields (Rawolle and Lingard, 2008) as a lens to examine the interactions between the fields of science journalism, science and politics. The presented work charts new territory by identifying and examining alliances and oppositions between the fields of science, science journalism and politics. The research sheds light on the interactions of scientists, science journalists and policymakers when debating science controversies that affect policy. Its results help improve our understanding of the actions of science journalists who cover science policy controversies.

The thesis was undertaken in four phases, which are detailed in Chapters 3, 4, 5 and 6. Qualitative analysis was used throughout the thesis due to its strengths in identifying patterns and themes that can emerge from an observable frequency of occurrence (Sandelowski and Barroso, 2003a; 2003b). This design was seen as appropriate due to its strengths in providing a deeper analysis of the opinions and comments of agents in the fields examined here. In addition, a historical construction was done for each of the controversies explored in this thesis to help situate the analysis into the broader historical genesis of the controversies under examination. This was an essential step of using Bourdieu’s conceptual triad as a lens of analysis. Given that the analysis of interactions between fields is a historicized methodological tool, the historical construction of these controversies is essential in providing a basis to better understand what motivations may be driving different players in their actions. The specific aims of this thesis and the chapters in which they are discussed include:

1. To test the premise that in the face of controversy that impacts science policy, the science journalism and scientific fields collaborate to oppose the political field (i.e. the field of power) (Chapter 4).
2. To examine if this premise can be found in an historical example and if it is replicated in a contemporary example of science policy controversy (Chapter 4 and 5).
3. To explore the relevance of the *Science Forum* as a historical artifact of debates in the media on science policy controversy and the shaping of science policy (Chapter 5 and 6).

Chapter 2: Literature review

Lewenstein argues that past research on controversies reported in the media has tended to rely on a simple diffusion model of science communication (where information is filtered through the media to the public in a linear fashion), thus failing to provide a complete view of the media's role in scientific controversies (Lewenstein, 1995). In her examination of the roles mass media and scientific journals play in the construction of controversies, Brossard states that "science communication is a complex phenomenon, for which boundaries between scientific journals and mass media can be permeable, rather than rigid as traditionally assumed" (Brossard, 2009). This further justifies looking at the *Science Forum* (a journal that is part science news outlet and part discussion forum) and the Canadian Science Writers Association (CSWA) website as sources that are not typical mass media outlets to examine science policy controversies. As opposed to the simple diffusion model, some argue that science communication should be viewed as a "continuum" that allows for the back and forth flow of information between different forms of scientific communication (Hilgartner, 1995). A circular or web communications model has also been proposed where all forms of communications are linked and lead back to each other (Lewenstein in Jassanoff, 1995). Regardless of the model, mass media occupies a central place and is a common node in the network (Brossard, 2009). In her analysis, Brossard found that mass media and scientific journals can interchange their traditional roles in science communication in the face of controversy and conflict. She concludes that "proper analysis of mass media's role (or any other communication media) within this process cannot accurately be achieved without taking simultaneously into consideration other players" (Brossard, 2009).

The following sections will present existing literature that looks specifically at the interactions between (a) science journalism and science, (b) science and policymaking, and (c) science journalism, science and policymaking – all within the context of science policy controversies covered in the media.[2]

[2] Papers included in this section were culled from a search performed on March 17, 2016. The Ebsco database was used including the following databases: "Academic Search Complete", "SocINDEX", "MEDLINE", Communication & Mass Media Complete," Communications Abstracts" and "Political Science Complete" from 2010-2016. There were 144 hits. The search words used were "scientist" and "journalist" and "media controversy" in all text. Studies that kept a North American focus were included, with a few exceptions that were relevant to my research that were drawn from European studies.

Journalism and science interface

The literature presented in this section detail studies that examined the interaction between journalists and scientists in the context of scientific communication and controversies that played out in the media.

In terms of the interactions between journalists and scientists, a five-country survey found that “interactions between scientists and journalists are more frequent and smooth than previously thought” (Peters et al., 2008). A study by Eyck and Williment (2004) investigated the journalistic practices used in the *New York Times* in three separate food technology controversies (milk pasteurization, food irradiation and biotechnology). They found that across the span of over a century reporters have consistently relied on larger social values to shape their role as “interpretive communities” (Eyck and Williment, 2004). The idea that journalists act as interpretive communities supposes that they draw on larger social values of their time when reporting and that this tendency then colours how the news is framed and disseminated to the public. This suggests scientific topics that generate controversy and are discussed in the media are shaped by the societal values and norms of their time. This lends credence to the need for social and historical context when reviewing scientific controversies discussed in the media. The study also found that reporters tended to quote the same types of experts and claimsmakers when reporting on science controversies.

While investigating the relationships between journalists and their sources in constructing media controversy, Nisbet et al. (2003) showed that government sources and societal elites, including scientists, are more likely to influence the agenda setting and framing of an issue. Past studies do indeed point to government officials and scientists dominating as sources in U.S. media coverage (Nelkin, 1995; Nisbet and Lewenstein, 2002). Furthermore, investigation into sourcing practices has shown that journalists chose scientific experts based on the criteria of being relevant to the audience, their visibility in their field and in the public eye, as well as their accessibility (Rothman, 1990). Two German studies, which matched scientists and journalists who had contact with each other, found a strong “co-orientation” between the two camps, except when it came to issues of control over communication (Peters, 1995; Peters and

Heinrichs, 2005). This suggests that there can be an alliance between journalists and scientists, which is fragile when issues of control over communication to the public arise – a situation in which journalists would naturally want to maintain power.

A study by Allgaier et al. (2013) on the perceptions of German and U.S. neuroscientists towards journalists found that these scientists saw their interactions as beneficial to gaining public visibility for their research. Allgaier et al. (2013) also reported that the interviews conducted with neuroscientists showed "little evidence of strong conflicts between scientists and journalists." One of the tensions noted between these two groups was the quality or accuracy of coverage that may lead to a biased or sensationalized representation of this field, according to the authors. Overall, the common thread in the interviews by Allgaier et al. (2013) was that neuroscientists today understand more about journalism norms and processes than their predecessors and that they tend to use their media knowledge as a competitive edge to advance their own standing in their professional organizations.

A study by Brewer et al. (2014) on the frames journalists in Canada and the U.S. used in the controversy over health concerns associated with Bisphenol A (BPA) found that journalists from the *Globe and Mail* relied heavily on science framing from government sources (largely from a report by Health Canada and Environment Canada that recommended the classification of BPA as a toxic substance) (Brewer et al., 2014). The U.S. newspapers included in the study were the *New York Times*, the *Washington Post* and the Milwaukee *Journal Sentinel*. Journalists from all four newspapers emphasized the health concerns associated with BPA in keeping with the academic studies by scientists referring to health concerns associated with BPA. In Canada, policies were put in place to address the health issue that largely served to resolve the controversy in the media when the government issued a ban on the use of BPA in 2008. This study points to the alliance between journalists and scientists to oppose industry interests (i.e. in the continued use of BPA).

Jensen (2010) studied the frames used in the reporting on human cloning to underscore the failure of the fourth estate – the failure of science journalists to uphold the journalistic ideal of acting as a watchdog when it comes to the coverage of human cloning (Jensen, 2010). He concludes from his own research along with a literature review of other

research done on the media coverage of human cloning that there is a pattern of journalistic credulity. He charges science journalists with a tendency to give into the hype surrounding scientific developments and the failure to be skeptical of and challenge powerful institutional norms (Jensen, 2010). This again suggests that journalists tend not to challenge scientists when reporting on science, which may allow scientists to over sell the impact or importance of their work. What would compel science journalists to react in this manner? One reason could be that scientists are becoming more active in publicizing their views and opinions.

A review of science journalism today by Sharon Dunwoody notes that scientists are becoming more media savvy and are now more active in contacting the public directly (Dunwoody, 2008). This changes the communication playing field as journalists and scientists engage in creating what British researchers Blumler and Gurevitch (1981) termed a “shared culture” where the two fields acknowledge that they need each other and so create a space where they can collaborate to achieve their own goals (Dunwoody, 2008).

In a study of the controversy over the MMR vaccine and its supposed link to autism, Boyce (2006) investigated how journalists use “expert-sources” and how scientist sources presented themselves in the publicized debate. He also examined how both groups influenced the way the story was reported and received. In this instance, the author notes that often journalists chose to “balance” their coverage by pitting expert-sources against non-experts (most commonly politicians). This further highlights the need to investigate how these three camps interact in the face of science policy controversies. Boyce also notes that journalists often choose sources based on their news values, editorial agenda, time pressures or to provide “objectivity” or “balance” to a story. Further research by Mikulak (2011) into the MMR vaccine-autism controversy looked at the different ways knowledge is acquired. She notes that in this controversy many scientists blamed media coverage of the initial study published in the medical journal the *Lancet* (which was later retracted) as driving the decision by parents to not immunize their children. Mikulak notes that in this instance, scientists and journalists acted in opposition to each other as blame was placed on the media for ‘distorting’ the science used to legitimize what most scientists believe to be a false claim. She states that “scientists wariness of science reporting reveals the fundamentally different

methods by which scientists and journalists engage in inquiry." Certain media coverage of this controversy showcases "some of the journalistic conventions that are thought to contribute to scientific controversies," according to Mikulak. She notes that the journalistic approach to achieving balance in reporting can represent an "all-sides-are-equal" approach that "ultimately does not provide the public with a full representation of the context surrounding the scientific issue at hand." In this controversy, Mikulak concludes that scientific and journalistic practices interact in a way that contributes to a fragmented and contradictory public discourse.

In an investigation into how the debate on climate change became publicized, Aykut et al. (2012) performed a content analysis of three French newspapers (*Le Monde*, *L'Express* and *Sud Ouest* from 1987 to 2007) and two leading French channels (TF1 and France2 from 1997 to 2006) as well as conducted interviews with key actors from various fields who are implicated in the framing of the climate change issue. The key actors that the researchers identified are scientists, politicians, journalists and non-government organization (NGO) activists. The authors characterize the climate change controversy as one that yields media, scientific and political capital. They looked at the rise of climate change as a controversy and identified three phases that occur in succession in the evolution of this controversy in the media. The first phase is characterized by the authors as a science controversy couched in language of uncertainty in keeping with the cautious stance by climate scientists who were wary about drawing hasty conclusions on the issue. Political action was nonetheless called for in this early phase. They found that in the first phase when climate change was coming to the fore in the media in France, scientists played a seminal role in legitimizing environmental journalists in their newsrooms. The political system in this phase is characterized by the authors as a body that categorized the issue as a problem of international relations with little bearing on domestic politics. In the second phase, focus in the media appeared to shift to highlight the dramatic consequences of climate change. The paper also points to complicity between the two camps of journalists and scientists in the second phase as both groups united to promote lifestyle changes in the public's daily practices to help reduce greenhouse gas emissions. The interviews conducted by the authors shows a shift in journalists' treatment of the issue that coincides with a change in attitudes among French environmental scientists. Opposition to scientifically driven "environmentalism" appears to come from a minority of scientists and political

agents, according to the authors. However, dissonant voices were given less media attention in the second phase of this controversy. The paper stresses that environmental journalists and scientists took ownership of the issue and worked to restrict the access of the opposition to public discourse. The authors conclude by hypothesizing a third phase in the climate change debate where new actors emerge (e.g. scientists who contest the claims as to the extent of harmful consequences of climate change) as well as new themes (e.g. impacts of the climate change debate on the science-policy relationship). From a journalistic perspective, the authors note that climate change is a high-profile controversy that now includes ownership by journalists who specialize in political, social and economic fields instead of remaining the sole domain of science/environmental journalists. The authors view the unfolding of this controversy as a struggle over the ownership and framing of the debate as a public problem.

Science and policymaking interface

The research presented in this section detail studies that examined the interaction between scientists and political agents in the context of publicized scientific controversies.

A survey of 378 stem cell scientists in the U.S. in 2006 showed that many of these scientists were considering leaving their posts to pursue their research in other countries or other states, such as California, that are investing in the field after the human embryonic stem cell research controversy prompted policymakers to impose funding restrictions on this field of study in several states (Levine, 2006). Significant media coverage of the “brain drain” is a factor that is credited with shedding light on the issue of restrictive policies that have incited stem cell researchers to move to more favourable research climates. The role of media coverage, however, is not extensively considered in this study by Levine (2006).

In an empirical study of the debate over whether exposure to electromagnetic fields (EMF) had adverse health effects, Spruijt et al. (2015), presented 32 EMF experts with a list of 38 statements. EMF experts could either agree or disagree with the statements and based on their choices the authors determined if there were different roles that these experts play when they provide policy advice. EMF experts were chosen based on a structured nominee process and 47% provided policy advice as their main task.

Experts (European, American and Australian) were primarily from the fields of epidemiology, public health, toxicology, risk assessment, biology and risk communication. The statements included in the questionnaire were compiled based on a pilot study, literature review and input from colleagues working in the EMF domain. The authors found that in this controversy, the degree of uncertainty for this issue as assessed by experts is highly associated with their role. In this particular controversy, the authors note that current policy is provided "against a background of scientific uncertainty," which they argue allows for a "certain degree of subjectivity" and that policy advice given by experts as a result may be influenced by personal opinions, values, worldviews and the larger social-cultural context. The expert roles identified by the authors were: early warners, pro-science experts, status quo experts and issue advocates. Early warners disagreed with current policy. Pro-science experts called for evidence-based policies and generally wanted to monitor the risks before proceeding. Status quo experts agreed with current policies and did not advocate for additional regulatory measures. Issue advocates pushed for scientists to interact with policymakers and stakeholders – they saw no value for explaining the differences of opinions between experts on the issue of EMF. This latter category of experts is the only one where experts felt that the public should be involved in the advisory process, according to the authors. In this paradigm, early warners appear at odds with political agents while the other three categories (pro-science, status quo and issue advocates) were more or less in line with policymakers, depending on their stance on the issue.

In an exercise to help improve the "mutual understanding and effectiveness of those working at the interface of science and policy," Sutherland et al. (2012) conducted a collaborative process among 52 participants with both science and policy backgrounds that included participants from government, non-governmental organizations, academia and industry. The authors noted that science-policy relationships are at times difficult and occasionally erupts in controversy that makes this disconnect ever more visible due to debates on scientific issues or on the relationship between these two camps, or both. Participants consulted with colleagues and submitted questions to be voted on. A total of 239 key unanswered questions were submitted by participants on the relationship between science and policy. These were distilled to 40 questions identified through voting. The final list included questions about "the effectiveness of science-based decision-making structures; the nature and legitimacy of expertise; choices among

different sources of evidence; and ways in which policy and political processes affect what counts as authoritative evidence." Sutherland et al. (2012) note that although the importance of using science for public policy making has long been recognized, there is no consensus on how this can best be achieved. They also note that "evidence-based policy" has become a desired norm which has led to a "greater embedding of scientists" in policymaking processes. The authors suggest that "we need to ask not just how science can best inform policy but also how policy and political process affect what counts as authoritative evidence." Sutherland et al. conclude that the questions put forth by participants allude to a "maturing appreciation of complexity and mutual interdependence in these relations; [and] of the value and ubiquity of science in contemporary policymaking." Although this research yields some common ground held between scientists, policymakers and agents that play both roles, it does not examine a specific controversy.

Journalism, science and policymaking interactions

The literature detailed in this section presents studies examining the interaction between journalists, scientists and political agents in the context of scientific controversies.

Ceccarelli (2011) examined three cases that "have been identified by scholars as 'manufactured' scientific controversies" where political gain is sought by delaying or promoting public policy. According to the author, this is achieved by exploiting journalism's balancing norms and making appeals to the public's democratic values to suggest ongoing scientific debate exists in matters for which there is "overwhelming scientific consensus." The three cases examined in this paper are AIDS dissent (doubt shed on the link between HIV and AIDS), global warming skepticism and intelligent design (antievolution lobbyists seeking for creationism to be taught in schools). Ceccarelli states that "manufactured scientific controversy" is a specific category of controversy where "strategically distorted communication" is employed to spark debate for political gain. The author examines common arguments used in all three cases to manufacture controversy. She points to tactics used by political agents, such as recruiting/grooming "maverick/opposition" scientists to voice dissent and by exploiting journalism's balancing norm – where "the appearance of objectivity" is achieved by assuming that there are two sides to every issue, necessitating the provision of both

sides with equal time and equal representation in public discourse. The author notes that these strategies give rise to misperception among publics that there is a lot of disagreement among scientists over issues where consensus exists among the vast majority. The dynamic presented in this paper that examines commonalities among three cases of scientific controversies is one where political agents (i.e. agents with an agenda to sway policy one way or another) are accused of using a few "maverick/mercenary" scientists and exploiting journalism norms to oppose a perceived consensus in mainstream science.

Likewise, Clarke (2008) investigated the impact of the balancing norm in journalism on the controversy over the measles, mumps and rubella (MMR) vaccine's supposed link to autism in children. The author does not discount the value of the journalistic balancing norm but calls into question how this norm is interpreted by journalists – as quantity (equal time/weight given to both sides in a debate) instead of as quality of different viewpoints. Clarke examines the claim that balanced reporting created a skewed view among publics on an established consensus in the scientific community. He examines coverage of this controversy in British and American newspapers as a case study to investigate this claim. A total of 279 articles (72 from U.S. newspapers and 207 from British newspapers) were examined between 1998 and 2006. When the controversial paper that sparked this debate was first published in the *Lancet* in 1998, journalists had to report on a controversial issue before a scientific consensus had taken shape. Clarke looks at the consequences when the media continued to hold to the balancing norm even after a consensus did emerge. The author claims that by covering both perspectives in the interest of balance, journalists may have instead sacrificed accuracy to promote a view among publics that the epidemiological evidence was in fact uncertain despite a "preponderance of scientific evidence" of a consensus to the contrary. The author found that although there was coverage that adhered to the balancing norm, there was also much coverage that focused on only one perspective (pro- or anti-link). He also notes that the balancing norm tells only part of the story of how this controversy gained traction. The autism-vaccine link story emerged at the same time as the Mad Cow Disease debate. In the latter case, both the government and mainstream science initially denied the link between beef consumption and a potential risk of Mad Cow Disease. Thus, publics were sensitive to the idea that the government and scientific experts could potentially be wrong. Against this backdrop of skepticism for public policy,

British newspapers provided much more emphasis for the pro-link between autism and the MMR vaccine, which may have helped cultivate the belief that there was equal division on the issue among scientists. In this instance, the paper presents a controversy where mainstream scientists and government political agents are in solidarity and are pitted against a minority of scientists and activists who gained media access through journalists exercising the balancing norm, which helped them propagate a viewpoint that was deemed unsubstantiated by scientific consensus.

An examination by Palfreman (2006) of the debate on whether power line electromagnetic fields (EMF) causes diseases, such as cancer, sought to explore the challenges faced by scientists, policymakers and citizens when dealing with a complex case study of scientific controversy. The story of the potential link was first broken by a journalist who also helped to keep the controversy afloat in the media through his continued reporting and published books. The author observes that the debate among scientists to find consensus on the existence of this link and growing public concern ultimately put a burden on policymakers on what action would best serve the public. Palfreman details the "precautionary principle" model that dictates when "the uncertainty is large, the potential public consequences significant, and the proposed changes relatively inexpensive," that precautionary action be taken. He notes that this is relatively uncontroversial when the cost of precautionary action is low. He also presents a version of this model called "prudent avoidance" that "argues that if, for a modest cost increase, reasonable changes can be implemented that will reduce an alleged toxin, then such changes should be made even before there is solid scientific evidence supporting a causal link." Unfortunately, the remedial action required in the EMF controversy proved to be quite costly. The author notes that policymakers in this controversy had to contend with political as well as engineering realities. Prohibitive costs aside, by taking precautionary action, the political benefit is that policymakers appear to be taking action in the public eye but on the other hand, the risk is that the wrong message may be sent to the public that a real threat exists when there may not be one. In this case study, Palfreman presents a controversy that began with a journalist and epidemiologists who legitimized a controversy that was later quashed by the larger scientific community and policymakers.

While past research on the interaction between journalism, science and policymaking provides pieces of the puzzle on how these fields interact in the face of controversy,

literature is scarce on the interactions of all three fields at once. The current research is an attempt to analyze the interface between scientists, science journalists and policymakers and tease out patterns of interaction that emerge in a climate of controversy. It is hoped that this will ultimately shed more light on how a science policy controversy plays out in the media and how this may impact media coverage on national science policy.

Chapter 3: Methodology

This chapter outlines (a) the examples explored, (b) the theoretical approach to their exploration, and finally (c) a description of the methods used for their analysis. The thesis was focused on 'opinion statements' contained in articles from agents of the science, science journalism or political fields. Opinion statements are any written statements by an agent that expresses a value judgement pertaining to the controversy being debated. A qualitative analysis of the articles on science policy controversies helps provide a deeper analysis of the opinion statements when an agent from one field comments on the agents or activities of the agents from the other fields analyzed. Once patterns of interaction were identified and described, a historical construction of each controversy is presented to contextualize the patterns of interactions found. Next, Bourdieu's conceptual triad of practice, habitus and social field was employed to provide a deeper analysis of the patterns of interactions identified. In this instance, each field was viewed in terms of their relationship to other fields in the context of each science policy controversy examined.

Three examples of media discourse on science policy controversy were examined in this thesis – two historical and one contemporary. The discourse in the science policy controversies featured in the *Science Forum* was used to better situate and contextualize the contemporary controversy over the 'muzzling' of government scientists.

A. The examples explored in this thesis: Historical controversies in the *Science Forum* and the government 'muzzling' of scientists on the CSWA website

Example 1 and 2: The Science Forum (historical examples)

The first two examples analyzed were the discourses on the science policy controversies over building a national science policy and the development of environmental policy in the body of work published in the *Science Forum* from 1968-1979. These examples were chosen to ensure a degree of comparability between the historical and contemporary example.

The *Science Forum* provides important, currently uncharacterized insights into science journalism, the coverage of science policy controversies, and policymaking in Canada in the 1970s. It is an example where Canadian science journalists editorialized their views and provided their opinions on the portrayal of science in the media. David Spurgeon

(former science writer for the *Globe and Mail*) served as the publication's editor. The journal was published six times a year and received funding from various Canadian universities. In a statement of the journal's editorial mandate*,* Spurgeon claimed that the purpose of the journal was to produce a publication in which scientists, policymakers and the public could discuss and debate the issues of science policy and the relationship between science and society (Spurgeon, 1973). Prominent science journalists at the time weighed in on the debates in the *Forum*, providing a rare glimpse into their opinions on how science should be conducted, viewed, used and mediated.

The discourse on science policy controversies situated in the 1970s – exemplified by the discourse in the *Science Forum* – is an historical artifact that can be examined with a mind to contemporary debates and conflicts over the current, heavily critiqued state of science journalism (Nelkin, 1992; Dunwoody, 2014). Controversies over science and technology set in this period represent the "crisis of authority" that prevailed in the political realm of that time (Nelkin, 1992). As noted, Dorothy Nelkin expresses the concept that "controversies over science and technology revolve around the question of political control" (Nelkin, 1992). The *Science Forum* is a platform where debates or conflicts over science policy and the mediation of science are dominant themes (see breakdown of topics in Table 1). Controversy studies have played a prominent role in the sociological investigation of science since the 1970s (Mukerji, 2007). The scientists who weighed in on controversies at the time "looked for ways to advance their ideas, enroll allies in their movements, and promote their schools of thought" (Mukerji, 2007). Meanwhile, their critics looked for "fallacies in their arguments, flaws in their data, and reasons to doubt their approaches to problems" (Mukerji, 2007). Thus, the analysis of the controversies surrounding science policy in the 1970s lends itself well to the analysis of interactions between key players using Bourdieu's conceptual triad of practice, habitus and social fields.

Based on the breakdown of topics in Table 1, the controversy surrounding science policy and environmental hazards/pollution are included in this research project as they represent prominent controversies at the time and are topics that align well with the issues that surround the contemporary example examined (i.e. national science policy and climate change). This strategy also helps to provide boundaries to the investigation of this historical artifact. To ensure that opinions of agents were captured, this thesis examined editorials, comments and letters by science journalists, scientists and

policymakers that discuss these topics. These sections (i.e. editorial, letters and comment sections) are clearly designated spaces where opinions are expressed, which fits the criteria of the data required to meet the objectives of this research project (i.e. *opinion* statements).

Table 1: Top 10 Topics Featured in the Table of Contents in the *Science Forum* (1968-1979)

Topics	Prevalence
Science Policy	73
Nuclear energy/power	43
Medical/health science	43
Environmental hazards/Pollution	35
Science communication	30
Ethics in science	23
Nationalism	22
Space exploration/satellites	20
Alternative energy/energy crises	19
Research funding	15

Note: Topics are listed in order of prevalence (i.e. number of times it appears in the journal's table of contents).

Example 3: 'Muzzling' of government scientists on the CSWA website (contemporary example)

The contemporary example examined in this thesis was the media discourse on the Canadian government's 'muzzling' of government scientists. The controversy in this case refers to the Conservative government's media policy that restricted government scientists who are publicly (i.e. government) funded from talking to journalists about their research (Birchard and Lewington, 2013). It is a topic that has been reported in print, online and on television. The controversy itself has mostly played out online where the voices of science journalists, scientists and policymakers have found platforms to communicate their concerns and messages to each other and the public. Research on climate change and on environmental issues appear to be the primary target of the muzzling (Huffington Post Canada, 2013).

To further delineate the boundaries of this topic, ensure that it is comparable to the historical example of the *Science Forum* and make the current study more manageable, online articles culled and presented by the Canadian Science Writers' Association (CSWA) on their website were examined. This section of the CSWA website bears some key similarities to the *Science Forum* – it is a site hosted and curated by Canadian science journalists and features opinions by science journalists on the example controversy. This structural similarity helps make the contemporary example more comparable to the historical examples examined in the *Science Forum*. In addition, David Spurgeon – the editor of the *Science Forum* – led the CSWA in 1972 and was an original member of its former iteration as the Canadian Committee of the National Association of Science Writers (NASW) in 1961 (which he also chaired in 1963) (Visser-deVries, 2015 http://sciencewriters.ca/3581627). This provides further linkages between the sources of data chosen. Articles that featured the opinions (i.e. op eds, blog posts) of agents from the science journalism, science and political fields were included in the data collection and analysis. The articles culled and curated on the CSWA site originate from mainstream online newspaper sites as well as political blogs and science blogs.

The CSWA had a page dedicated to the muzzling of government scientists: http://sciencewriters.ca/initiatives/muzzling_canadian_federal_scientists/. The page was updated on an ongoing basis until March 2016 to include the latest developments in this story as it unfolded as well as capture responses by science journalists, scientists and policymakers from news sites and social media platforms. After this point, the page was removed. An archived version of the page was used to cull the data captured and analyzed in this thesis.

B. Theoretical approach

The theoretical approach used in this thesis is 'Bourdieu's conceptual triad' of practice, habitus and social fields (Rawolle and Lingard, 2008). This triad represents the main "thinking tools' in Bourdieu's body of work (Bourdieu, 1989).

Practice

Bourdieu's research is filled with accounts of social practices – scientific research, marriage strategies, visiting art museums and more. It is a foundational concept in his work and one that he was careful not to oversimplify. Bourdieu portrays practice as a

rich concept that encompasses activities that possess a social character and bears meaning. The details, structure and effects that define a practice are expected to emerge in the course of its study.

Three interconnected aspects are used to define practice in this instance (Warde, 2004). Firstly, that a practice is the performing of an activity. In the case of this thesis, the practice under examination is the participation in media discourse on science policy controversies. Second, practice is the naming of an activity, which lends the practice social organization and boundaries. This does lend itself to this research as a 'scientific controversy' debated in the media is a bounded activity that denotes a familiar activity. Third, practice should unfold over a cycle of time that imbues it with structure, limits and meaning. The practice of participating in media discussions surrounding any particular scientific controversy will meet this criterion when there is a resolution in the topic (at least in the media) or if it dies out as new controversies arise and become the focus of the media. 'Practice' for Bourdieu constitutes a public activity that is open to scrutiny by other agents and is relational at heart. This is a definition that translates well to the debate on science policy controversies in the media.

Bourdieu views 'practice' as distinctly social and not to be chalked up to mental states, ethically informed actions or rational decision-making. According to Rawolle and Lingard (2008), "Bourdieu suggests that knowledge of the intentions or mental states of other agents is tangential to the fit between agents' actions and their contribution to broader practice." He used the concepts of 'habitus' and 'field' to offer explanations of patterns of practice by agents engaged in a 'practice.'

Habitus

Habitus was developed in an attempt to account for the practices of people impacted by colonialism who adopted practices (cultural and economical) acquired in a pre-capitalistic world (Bourdieu, 2005). According to Bourdieu, 'practice' can be theorized through the concept of 'habitus,' which identifies the impetus for actions by agents as predispositions that have roots in social history (Burkitt, 2002). 'Habitus' is a concept that dictates that agents have a socially developed capacity to act a certain way depending on a system of predispositions that guide them to do so.

Depending on their habitus, Bourdieu notes that agents act reflexively rather than rationally but these actions can be "controlled through awakening of consciousness and socioanalysis" (Bourdieu, 1990). Thus, different agents are predisposed to different sets of actions depending on their 'habitus' – scientists to a scientific habitus, politicians to a political habitus and journalists to a journalism habitus.

One criticism of this idea of predispositions is that this alone cannot explain a certain practice. In other words, the concept of 'habitus' alone will not be adequate to explain why decision-makers support some policies and not others. To provide context and explain the stimulus behind the practice of agents who decide to act one way versus another, Bourdieu introduces the concept of 'field.'

Field

Bourdieu defines a 'field' as "a network…of objective relations between positions [occupied by agents]" (Bourdieu, 2005). A field is a space within which a power struggle is waged and where agents are located. The positions of agents are determined by specific rules of the 'field.' 'Fields' represent a hierarchy where all are subordinate to the largest field of power and class relations. It may be applied to all literary, artistic, philosophical and scientific activity.

The three fields examined in this thesis are science, science journalism and politics. In his construction of this theoretical instrument, Bourdieu proposes looking beyond the interactions between persons. Instead he proposes (using the example of a political historian and journalist interacting on a televised event on election night) "that when the historian addresses the journalist it is not an historian who speaks to a journalist…it is an historian occupying a determinate position in the field of the social sciences who speaks to a journalist occupying a determinate position in the journalistic field, and ultimately it is the social science field talking to the journalistic field." Thus, the discourse on science policy controversy will not be viewed as a dialogue between a scientist, a science journalist and a politician but rather as an exchange between agents from their respective 'fields.' Essentially, it is one field speaking to another through their agents (Bourdieu, 2005).

It is also important to keep in mind that certain properties that are granted to agents in a 'field' are not "linked to any intrinsic properties of the person but to the field of which he or she is a part" and constitutes what Bourdieu terms "an objective relationship of symbolic domination" of one field over another (Bourdieu, 2005). Returning to Bourdieu's televised election night example, he proposes that "the statutory objectivity that is granted to the historian is not linked to any intrinsic properties of the person but to the field of which he or she is a part…." He goes on to state that "the fact that the journalist defers to the historian" as an impartial expert represents "an objective relationship of symbolic domination [of the social science field] over the journalistic field." In turn, the journalistic field may "exert a symbolic domination over the social science field in another respect" – for instance, in terms of its ability to access the public.

According to Neveu and Benson, "fields cannot be understood apart from their historical genesis and trajectory" (Neveu and Benson, 2005). This is why fields cannot be fully examined without also considering the concept of 'habitus.' If we view the concept of 'social class' as a generator of social practice, then the action of social agents can be seen as a product of their membership to particular social groups. In this way, interactions between social groups identified by the researcher can be examined using the concept of 'fields' (Grenfell, 2012). However, instead of associating certain practices to particular classes, Bourdieu attempts to construct a model of social space that can account for the practices found within it (Grenfell, 2012). In this model of social space, 'social classes' or 'fields' can be best defined not by their similarities but by their differences in observable practices.

Bourdieu insists that examining the social space in which interactions take place is necessary to fully understand interactions between people. Simply examining what was said or an event or social phenomena on its own is not enough. Examining a social space entails locating an object of investigation in its specific context (i.e. historical, relational, local/national/international context) as well as exploring how past knowledge on the subject had been generated and what purpose this knowledge generation may have served or who it may have benefited (e.g. Bourdieu, 1993; 1990; 2004). In the case of this thesis project, the social space surrounding two past and one present day controversy is studied within its specific historical and relational context.

Critiques of Bourdieuian Analysis

When employing Bourdieu's concepts for analysis, it is important to examine their limitations so that outcomes can be presented accurately and are not over- or mis-stated. One critique is that the methodological borders can be "fuzzy" (Grenfell, 2012). Where to draw the line in terms of where the field effect stops and starts can be difficult to determine. For example, in defining the social object of "life-long learning," one has to consider that companies have divisions dedicated to staff development and public television programmes exist that also serve this purpose. So, it makes it difficult to define where the field of education starts and ends (Grenfell, 2012).

Another critique is that there may be too many 'fields' to consider for a given social object. Back to the education example, the different 'fields' to consider can include the field of higher education, the education discipline as a field, the university, the department, the programme, etc (Grenfell, 2012). Limiting the 'fields' that are considered is a matter of necessity so that the object of study can be examined thoroughly without diluting data in an endless examination of too many fields.

A common critique of field theory is that it is deterministic and puts too much focus on 'field logic' and its ability to reproduce 'field effect' instead of changes that occur in a field (Grenfell, 2012). However, Bourdieu's methodology does stress examining the historical genesis of a field and how it developed into its present form. This view necessitates a look at how a field evolved and changed over time. Drawing connections between fields can, nevertheless, pose a problem. Bourdieu insists on a hierarchy model and that there is always a dominant field connected to other fields that are subordinate. However, it may be difficult to show exactly how this domination plays out.

It is important to remember that the conceptual triad of practice, habitus and social field provides a way to translate "practical problems into concrete empirical operations" (Grenfell, 2012). Thus, the conceptual triad is ***a historicized methodological tool*** that provides a particular view of social interactions. It is a scholastic device to help make sense of the social environment we live in and offers a particular view of social interactions. Although the people, practices and institutions in social fields do have a physical manifestation that can be studied, the 'field' itself is a concept with no equivalent physical manifestation (Grenfell, 2012). As a methodology and theory, it can

provide much useful insight but it is important not to cede it more explanatory power than as a particular view of social interactions through a Bourdieuian lens.

Bourdieuian analysis can be a useful way to map social interactions and has been used by scholars over many different disciplines, including disciplines as diverse as fashion (Entwistle and Rocamora, 2006), research practice (Grenfell and James, 2004), reform of science education (Melville et al., 2011), food (Wood, 1996), questions of gender (McNay, 1999) and colonial literature (Smith, 2006). The process and methodology in these studies are rarely able to duplicate Bourdieu's own analysis of fields as comprehensively as he did – owing to the wide range of knowledge of qualitative and quantitative methods required as well as the time and funding such an exacting endeavour entails. As such, my limitations as a researcher – who lacks advanced mastery of many quantitative and qualitative methods, and has limited time and funding at my disposal to conduct a thorough field analysis à la Bourdieu – necessitate modifications to my analysis to accommodate the capabilities and resources at my disposal. These modifications include looking at interactions between the fields of science journalism, politics and science without first constructing each field. Ultimately, my goal was to examine the interaction of agents from these three fields within a very specific context – the media discourse surrounding science policy controversies. I do examine 'practice' and 'habitus' for agents within these fields but only to capture their practices specific to the media discourses on the science policy controversies examined. The historical genesis of each 'field' remains outside the scope of this research project. However, the historical genesis of each science policy controversy chosen for this project is relevant and is examined. Ultimately, my overall goal was to determine if there are certain alliances or oppositions between these three fields in times of science policy controversy. Bourdieu's conceptual triad is employed in an attempt to explain any patterns found in the course of my research.

C. The methods used: thematic analysis and Bourdieu's conceptual triad

Following the methods of Bourdieu and Wacquant (1989) and Grenfell (2012), three examples of media discourse on science policy controversy were examined in this thesis – two historical and one contemporary. The contemporary controversy on the supposed gag order on scientists is an important one that affects the communication of science to

the public and represents the domination of the science and journalism fields by the political field. A similar pattern of struggle over power and authority between these fields may be observed in the discourse on various science policy controversies in the *Science Forum*. Ultimately, the debate over controversies featured in the *Forum* help us situate and better understand the contemporary controversy over the muzzling of government scientists.

Data Collection and Inclusion/Exclusion of Articles

All articles included from Examples 1, 2 and 3 represented media discourse on a particular controversy (i.e. national science, environmental pollution and science communication policies). Any articles that were simply descriptive of a scientific technology for example were not included. Statements voiced by agents who are not from the science, science journalism or political field were also not included as this remains outside the scope of this research project.

Media discourse on scientific controversy typically represents a debate and debates necessitate agents representing different 'fields' to weigh in with their support for or opposition to the controversial topic. Thus, to ensure that this support or opposition was captured, only articles that count as opinion pieces of agents written from a first person perspective were included (i.e., letters, comments or editorials). The opinion statements found within these articles were then sorted by topic and by agent. The unit of analysis was the entire article (including the heading) and quotes that represented a judgement on the debate were captured. Opinion statements in this instance were value judgements made by an agent that directly related to a given controversy or the actions of other agents that affect the controversy being analyzed.

To help anchor and clarify the data collection, the controversies were labelled to provide a discreet way to encapsulate a particular controversy. For instance, the controversy surrounding the building of a national science policy in Example 1 encompasses the debate around the creation of a ministry of science, the shift in research grant funding powers from science institutions to politically-controlled institutions and funding cuts to basic science. All these policy changes and actions were encapsulated under the label "national science policy." The environmental pollution controversy over the development of the north and pollution from industrial activities is encapsulated under the label

"government environmental policy." The controversy over the 'muzzling' of scientists in Example 3 that encompasses the closing of science libraries and various environmental research facilities as well as the science information release policy is encapsulated under the label "government science information policy." See Table 2 for inclusion and exclusion criteria.

Table 2: Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
Opinion statement must originate from an agent/agents from the science, science journalism or political field	Opinions from agents in the industrial field or personal relations (PR) field
Agents must be Canadian	Non-Canadian agents
Agents from the science field who represent the physical and life sciences	Agents from the social sciences and political sciences
Articles clearly labelled as opinion, editorial, letters or personal blogs	News articles and quotes of agents from a particular field within articles that were not written by said agent/agents (e.g. interviews of political agents by journalists)
First hand statements clearly representing the value judgement of an agent/agents from a particular field	Statements or matter quoted within an article that cannot be clearly assigned to the science journalism, science or political field

Data Analysis

Data in the form of opinion statements were culled from the included articles from both the historical examples and the contemporary example. Opinion statements in the relevant articles were sorted into themes of support or opposition, and thereby used to capture the value judgement of a given agent on a given controversy. A 'neutral' category was included as well to capture opinion statements that fit in neither category and/or are intended to signify neutrality. An opinion statement was categorized as 'support' if the statement implied agreement for the policy and/or its consequences or reasoning that condoned a controversial policy already in effect (i.e. reduced funding for basic science, the closure of a science library or research facility, the creation of a science ministry, the implementation of restrictions on the release of science information,

etc.). An opinion statement was categorized as opposition ('oppose') if the statement implied resistance or disagreement for an existing policy or the implementation of a controversial policy. An opinion statement was categorized as 'neutral' if the statement discussed the controversial policy in question but implied neither support nor opposition. Together, this helped ensure that all opinion statements on the issue were captured and analyzed.

The resulting data was analyzed first using a qualitative thematic analysis, which was adapted from Sandelowski and Barroso's methodology for creating metasummaries (Sandelowski and Barroso, 2003a; 2003b). This method allowed for a qualitative analysis that was directed to the identification of patterns and themes that emerge from an observable frequency of occurrence (Sandelowski and Barroso, 2003a: 2003b). In this way, patterns were identified within each controversy and across controversies that helped clarify the alliances or oppositions between agents during a particular controversy and over all three controversies. Effect sizes of identified themes were calculated and expressed as percentages by dividing the instances of opinion statements categorized in each particular theme by the total number of opinion statements captured overall. Calculating effect sizes in this way provided a means to ensure that findings were neither over- or under-weighted (Sandelowski and Barroso, 2003a: 2003b). Effect sizes were also calculated within fields. This was done by dividing the instances of opinion statements in each category representing 'support,' 'opposition' and 'neutrality' within each field over the total number of the opinion statements captured. This was done for each theme identified within a given controversy analyzed and then across all three controversies. In cases where the sample size was small, themes were expressed as the total numbers of opinion statements found.

Next, to contextualize the patterns of interactions, a historical construction of each controversy was conducted using existing literature on and reviews of these controversies. The thematic analysis and opinion statements captured in this study were integrated into the historical construction to help situate the analysis done here into the broader historical genesis of the controversies under examination. Bourdieu's conceptual triad of practice, habitus and social fields was then employed to provide a deeper analysis of the patterns of interactions identified. This historicized methodological tool provided a means to view each field in terms of their relationship to other fields in

the context of each scientific controversy analyzed – the recognized field of power in particular. This is ultimately political power and government (Grenfell, 2012). Although a strong hierarchy is at play within fields (i.e. dominant institutions with the power to direct the course of events and actions), there is still room for agency and change (Grenfell, 2012). This is because a field is a human construction, and agents operating within it, use a set of beliefs and abide by a logic of practice that feels "natural" (Grenfell, 2012). Thus, agents occupying positions within the field understand the rules (i.e. the truths or doxa) within a field and stick to them.

Each social field provides a means of accumulating 'capital' and converting 'capital' between fields (Bourdieu, 1985). Four types of 'capital' were considered: economic, social, cultural and symbolic (Grenfell 2012). 'Economic capital' refers to monetary wealth. 'Social capital' refers to access to beneficial networks. 'Cultural capital' refers to attributes derived from education, family and possessions (e.g. forms of knowledge, taste, aesthetic and cultural preferences, such as language and accents). 'Symbolic capital' refers to something that represents all other forms of capital and can be exchanged in other fields (e.g. credentials). All four forms of 'capital' can be used to acquire or "buy" better positioning. According to Bourdieu, the field itself is the site of a "game" where different agents use different strategies to maintain or gain a better position. The object of the game is to acquire 'capital.' The concept of 'field' is viewed alongside the concept of 'habitus' in order to form a more robust social analysis. In this stage, it is important to analyze agents in terms of relationships. Also, only attributes that relate to the 'field' in question are considered so individual idiosyncrasies do not come into play. The concept of 'habitus' then directs and positions agents within the 'field' in terms of the 'capital' they possess and how this helps position them – always abiding by the logic of the 'field' in question.

Bourdieu's conceptual triad allows interaction between individual agents and groups to be analyzed as well as the way in which one field interacts with another. According to Grenfell, in the course of this analysis, it is less important whether a qualitative versus quantitative approach is used (Grenfell, 2012). What is paramount is obtaining the best data analyses to construct a relational analysis of 'fields' and how they interact.

Chapter 4: Results

This chapter presents the main findings from the qualitative thematic analysis that captured opinion statements from agents in the fields of science, science journalism and politics. Each section addresses one of the three examples explored by first reporting a characterization of each field before addressing the emergent themes. The chapter ends with a synthesis off all three examples.

Example 1: Science Policy in the *Science Forum*

In the *Science Forum* from 1968 to 1979 (78 issues) there were 89 articles found with opinion statements (i.e. editorials, letters and comment sections) by agents in the fields of science, science journalism and politics pertaining to the controversy surrounding national science policy. Table 1 presents the number of entries (i.e. individual articles) listed by field and indicates the agent's support, opposition or neutrality for a "national science policy" – which is the statement used to represent the controversy over the government's efforts to formulate a national science policy. The controversy surrounding the building of a national policy began with the debate over the creation of a science ministry and the implementation of a directive for research to target national priorities (i.e. mission-oriented goals). The controversy later encompassed the debates over policies that would effect changes in funding structures and amounts that went to public (basic) versus private (applied) science (see Chapter 5).

Table 1: National science policy: Opinion statements listed by field

Field (Total)	**Position on "national science policy"**		
	Support	Oppose	Neutral
Science (64)	3	58	3
Science journalism (20)		16	4
Politics (5)	4	1 (former medical researcher)	

Scientists in the *Science Forum* were overwhelmingly opposed to the government's national science policy (58 out of the 64 opinion statements captured). The majority of statements from science journalists also reflected the science journalism field's opposition to this control (Table 1). While there are statements of neutrality from the

science journalism field, this was not very prevalent in the *Science Forum*. In addition, there were no science journalists that came out in support of the government's national science policy. Statements from agents in the political field were few. The opinion statements that were captured and analyzed from this field showed that politicians were mostly in support of government science policy. The most prolific field for opinion statements is the science field. Opinion statements captured from this field also had the highest diversity of voices (i.e. from many different agents). The science journalism field yielded a more moderate number of opinion statements and had much less diversity of voices (i.e. statements came from a vocal but small group of prominent agents). Next, the position of each of these fields will be discussed in light of these findings.

Science field

Opinion statements from the science field in opposition to "national science policy" generally expressed broad opposition to any control of the science field by the political field, often due to a resistance to political authority over scientific autonomy that claims that government control will only serve to stifle scientific discovery. This is apparent in a statement on the dangers of bureaucracy from Gerhard Herzberg (National Research Council physics division and Nobel Prize winner[3]) who noted that "[b]ureaucratic control may be necessary for some government departments, but when applied to scientific laboratories it can only lead to the exodus of top-rate scientists and thus to mediocrity…. The greatest enemy of progress in science and technology in Canada is bureaucratic control" (Herzberg, 1970. The dangers of science policy to the creative scientist).

A minority of scientists expressed opinion statements that were neutral or in support of the national science policy. Expressions of neutrality from the science field decried the effects of policies on science but did not take a clear stance in support or opposition of the policies. For instance, David Suzuki (professor of genetics at the University of British Columbia, host of CBC's 'Science Magazine' and CBC Radio's 'Quirks and Quarks) cautioned in his opinion column *Viewpoint* that to "weather the present funding crisis" scientists should not "react in a knee-jerk way" (Suzuki, 1976. Hazards of a public profile). Instead, he suggests that scientists "re-examine the fundamental concepts of science" and reasons that "the incredible power and weight of scientific application calls for a complete rethink of the way we train and do science." Here, Suzuki is expressing

[3] Titles for agents are drawn from the articles in the *Science Forum* and may change with time as agents move to different posts, gain credentials, etc.

his concern over the negative effects of science policies that called for funding cuts but at the same time he does not expressly condemn the attempt at political control over scientific endeavours. He extols the importance of science to society but also notes that the application of scientific discoveries holds much power and must be tempered by careful planning.

Of the three scientists in support of a national science policy that calls for mission-oriented goals, one was a mathematician and another a scientist from private industry who served on the editorial board of the *Science Forum*. In other words, neither were government or university scientists in the life sciences – the field where research funding cuts would be most felt. In fact, national policies that were debated could be construed as benefitting private (applied or industrial) science at the cost of public (basic) science (see Chapter 5). The third was scientist administrator Omond Solandt, Chairman of the Science Council of Canada (SCC) that advised the federal government on national science policy. Solandt's statement sought to assuage the fears of scientists, noting that while the SCC supports the national policy for mission-oriented science, it would also serve as a buffer to ensure that basic (public) science would receive adequate government support:

> "Both the SCC [Science Council of Canada] and the OECD [Organisation for Economic Co-operation and Development] are trying, by their advice, to achieve a better balance in our scientific community…. Once the wave of mission-oriented programs gets well started, I have no doubt that the Science Council will find itself figuratively pushing on the other side of the pendulum trying to prevent it from going too far" (Solandt, 1970. The OECD report: achieving a better balance).

Science journalism field

The opinion statements captured from science journalists in opposition to a "national science policy," which represents the stance of most science journalists captured in the *Science Forum*, generally mirrored the opinion statements of scientists as well as presented arguments that echoed those of scientists. For instance, the comment by science journalist Peter Calamai expresses his concern over political control affecting

scientific endeavours. He notes: “There are obviously dangers in the government's present approach. Basic science could be distorted - or even destroyed - by a simple-minded demand for instant economic payoffs, or by the application of rigid rules of relevance" (Calamai, 1971. Calculating the payoffs from basic research). His statement expresses his concern over the requirement for scientific research to be tailored to national economic goals. Likewise, science journalist Jeff Carruthers wrote that "Rather it is a question of just how much lay politics should and can, be allowed into the kingdom of science. …science and the general welfare can suffer when politics and science are mixed in the wrong proportions" (Carruthers, 1971. Politics vs science in the federal health department).

These statements echo scientists’ opposition to policing of the science field by political agents and mirror scientists’ sentiments that political control will hamper scientific discovery. What science journalists sought to add to the argument against political authority over scientific autonomy is the idea that this approach is not in the best interest of the public.

The neutral statements from science journalists were few and did not make an overt statement clearly in support or opposition of national science policies. For instance, in an editorial by the Editor of the *Science Forum*, David Spurgeon (science writer for the *Globe and Mail*) expressed the opinion that Canada is a nation that differs from others due to its “paternalism in scientific affairs,” adding that he would prefer more transparency in policymaking (Spurgeon, 1973. Searching for a Leader).

No opposition statements to national science policies were captured from science journalists in the *Science Forum*.

Political field

There were very few opinions captured from this faction in the *Science Forum* although key players did sound off on the issues. For instance, the Deputy Minister of Finance, S.S. Reisman noted that although funding may not be at a level that scientists would like, all forms of research are nonetheless funded by taxpayers (Reisman, 1970. Reisman: no form of research is unsupported in Canada).

Of the opinion statements in support of national science policy, one opinion statement captured from a politician and former industrial scientist, Frank W. Maine, Liberal MP for

Wellington (organic chemist and former R&D director of a Canadian manufacturing company and soon-to-be Minister of State for Science and Technology in 1977) spoke more on the stance the government and private (industrial) science should take. The statement of support for mission-oriented research goals (i.e. science targeted to national priorities to increase support to private science and industry) was not overt but was implied when he notes, "Obviously, industry must spend more, and the goal of both industry and government must be to translate more of this research into commercial products" (Maine, 1976. The Significance of the RCA Laboratories Closure).

The Deputy Minister of the Ministry of Colleges and Universities, J. Gordon Parr also weighed in on funding cuts to basic science and lent his reasoning as to why the cuts were justified as well as the need for the evaluation of research to be funded. He argues that while avenues of research are limitless, funding isn't, noting that, "unless the quality of research is appraised, the bucket has no bottom" (Parr, 1976. Could scientific R&D survive conserver society restraints?).

There was one instance of opposition to government policy from a political agent (Senator J.A. Sullivan) but this was from a scientist who entered politics and so may be in fact be speaking as an agent of the science field. The senator in this case submitted a letter to dissociate himself from the senate committee and its recommendations on science policy (Sullivan, 1971. A minority of one in the Senate committee).

Themes identified

From the opinion statements captured on science policy, six themes emerged:

1. Opposition to national science policies;
2. Political involvement of scientists;
3. Call for scientists to unite to oppose government policy;
4. Observation of government inaction;
5. Government misinformation or lack of information to the public;
6. More funding needed for science.

These themes represent prevalent ideas/stances expressed or arguments employed by agents in the fields analyzed here. While these are themes found specifically in this controversy, some themes are also found with some frequency in the other two controversies analyzed.

Theme 1 - Opposition to national science policies

The major theme found among 84% of opinion statements captured is the opposition from the science and science journalism field for the government's national science policy (91% of opinion statements from the science field and 80% from the science journalism field). The debate in the *Science Forum* over science policy encompasses the controversy over the creation of a science ministry, the directive to first identify and then fund only mission/goal-oriented programs, the transfer of authority to grant research funding from institutions in the science field to those under the control of the political field and overall government funding cuts to basic research (i.e. public science) from 1969 to 1979. The different angles of the science policy debate all tie back to the main controversy over the creation of a national science policy that began in the late 1960s. The *Science Forum* itself was created in 1968 when the debate on a national science policy first began and was spearheaded by university scientist J.A. Morrison, Director of the Institute for Materials Research at McMaster University and David Spurgeon, then science writer for the *Globe and Mail*.

Theme 2 - Political involvement of scientists

A minor theme (21% of all opinion statements captured) that emerged was the suggested involvement of scientists in the political arena. Mostly scientists (27% of opinion statements captured from the science field) called for this sort of involvement. One example that illustrates a statement calling for more political involvement of scientists is by a geologist from Queen's University who noted that "… scientists must play a dominant role in the formulation and execution of science policy.... The evolution of science policy has been labelled the 'science of science,' but a curious science it will become if scientists exclude themselves or are excluded from its ranks" (Wynne-Edwards, 1969. How competent are scientists to judge science policy?). Another example comes from a chemist from the University of Ottawa: "It is disconcerting that the Senators feel that active scientists should play such an unimportant role in connection with science policy. […] It would not, indeed, be unreasonable for the deputy minister to be a scientist..." (Laidler, 1974. Lamontagne III: a serious fault).

Science journalists on the other hand were mostly silent on the matter. When they did choose to comment, there was a split between support and opposition to this line of thinking. For instance, Lydia Dotto science writer for the *Globe and Mail* expressed

skepticism for the scientists' ability to cope in the political arena, noting that "…outside of their scientific disciplines, scientists appear to have no greater expertise than anyone else in manouevering through the quasi-parliamentary wrangles …" (Dotto, 1973. SCITEC: still groping in search of a role?).

There was also support from science journalist David Spurgeon (Editor of the *Science Forum* and *Globe and Mail* science writer) for scientists' involvement in politics as he opined in an editorial entitled *Why scientists must get into politics* that scientific experts were in a better position than the public to pass judgements on how best to solve social problems, suggesting that policymaking requires the involvement of scientists (Spurgeon, 1971. Why scientists must get into politics).

Opinion statements from politicians on the matter were not found.

Theme 3 - Call for all scientists to unite in opposition

A minor theme was a call almost exclusively from scientists for the agents from this field to act in unison to oppose the political push for national science policies (8% of opinion statements captured from the science field). These opinion statements called for all scientists (government or university and across all disciplines) to unite to oppose the government's national science policy.

Theme 4 - Observation of government inaction

Likewise, the observation that the government was not taking action in terms of science policy making was a minor theme that emerged almost exclusively among scientists (8% of opinion statements captured from the science field).

Theme 5 - Government misinformation or lack of information

A theme that appears in all three controversies discussed – both past and present – is the accusation by agents in the science and science journalism fields that the government lacks transparency in its science policy decision making processes or provides misinformation to the public. In the controversy over the building of a national science policy in the *Science Forum*, this was a minor theme (12% of opinion statements) with more science journalists (20% of opinion statements from the science journalism field) implicated than scientists (9% of opinion statements from the science field). Science journalists were naturally concerned that the lack of transparency in

policymaking impeded their journalistic endeavours and ability to report on the issue to the public. For instance, Jeff Carruthers (*Ottawa Journal* and FP publications) commented on the decision to loosen the existing restrictions on information release policy in the science ministry, noting that “As an indication of how far the science ministry intends to go in this regard, the information will be made available to science journalists!" (Carruthers, 1975. The science ministry takes on a new look). Here, Carruthers employs sarcasm to reinforce his observation that the ministry had not thus far been forthcoming with providing science journalists with information.

A minority of scientists also echoed this concern, as evidenced by Peter A. Forsyth (Director of the Centre for Radio Science, University of Western Ontario) who opined in a commentary entitled *Let's take the secrecy out of science policy* that the Canadian public and scientists were growing “increasingly distrustful of technical decisions announced without public discussion” and “increasingly disenchanted with the secrecy surrounding these decisions” (Forsyth, 1972. Let's take the secrecy out of science policy).

Theme 6 - More funding for science

The call for more funding or the opposition to funding cuts was a common theme in the opinion statements captured among scientists (31% of opinion statements captured in the science field). Scientists opposed funding cuts often using the argument that this would end the careers of agents in the science field, noting that “….if the present trends continue, there may not be any academic research to administer within five years” (Morrison, 1974. Academic research: Down, perhaps on the way out) and that the cuts were “responsible for the destruction of several brilliant research teams” (Nyland, E. et al., 1973. Alberta physicists assess the Lamontagne report).

Science journalists echoed the sentiment, blaming the federal government for actively participating “in the dramatic plunge of Canadian R&D during the previous decade…” and noting that the cuts have “harmed the future of research and development in this country to the point where it may never recover" (Carruthers, 1979. The Lord giveth and the Lord taketh away). Science journalists also noted that cuts were jeopardizing the careers of scientists, stating that budgets were tightened “to the point where some of the country's most talented scientists have been squeezed right out of the top of the purse" (Cohen, 1978. Canadian industrial "strength." R&D the weakest link).

Example 2: Environmental hazards/pollution in the *Science Forum*

In the *Science Forum* from 1968 to 1979 (78 issues) there were 13 articles found with opinion statements (i.e. editorials, letters and comment sections) by agents in the fields of science, science journalism and politics pertaining to the controversy on environmental pollution policy. Table 2 presents the breakdown of opinion statements listed by field and notes the support, opposition or neutrality of these agents on "Government environmental policy."

Table 2: Government environmental policy: Opinion statements listed by field

Field (total)	**Position on "Government environmental policy"**		
	Support	Oppose	Neutral
Science (6)		5	1
Science journalism (6)		5	1
Politics (1)		1	

Science field

Opposition from the science field generally reflects the growing public concern over environmental issues in the 1960s and 1970s as evidenced by a comment from a McMaster University scientist: "The increased public awareness of the problems of pollution has provided an environment which allows government action at all levels" (Lock, 1969. A pollution control plan for co-operative action). Along with the recognition of environmental pollution as a growing public concern is the recurring critique of inaction on the part of the government. This observation of inaction is also combined with an accusation that the government itself is a contributor to environmental pollution, as we can see from the statement, "The reasons for this inaction seem to be complex but I suggest that administrative problems, the unwillingness to tell the taxpayer that action will cost money, and the fact that many government operations are themselves major polluters are the root causes" (Lock, 1969. A pollution control plan for co-operative action).

Science journalism field

Science journalists in the *Science Forum* seem to be of the opinion that scientists have the expertise required to help resolve the issue but that the government's lack of action or recognition of the issue is the main barrier to resolution. A comment by freelance researcher and writer, Jim Lotz provides an example: "Politicians are only too keen to see scientists as parasites who spend huge sums of public money on trivial, academic enquiries. At the same time, they look to them to provide instant solutions to complex problems" (Lotz, 1974. A broker and buffer between government and people).

There were minimal opinion statements that expressed neutrality on the issue of government environmental policy among science journalists in the *Science Forum* (1 out of 5 opinion statements captured in the science journalism field). While the data is limited, the issue appears more polarizing with few agents occupying a middle ground on the controversy over environmental pollution policies. The one instance of an expression of neutrality from a science journalist came from the editor of the *Science Forum*, David Spurgeon who did not condemn or condone government environmental policy but takes the opportunity to exonerate science from blame in the matter of environmental pollution: "The thing to do is not to condemn science and technology, but to strike a sensible balance" (Spurgeon, 1969. The eleventh hour on our last frontier). He goes on to echo the sentiment found in the opinion statements of other science journalists that science has the power to resolve the issue: "…we have an unparalleled opportunity to use science and technology to improve the quality of life rather than to debase it…".

Political field

In the one instance where an agent from the political field also opposed government environmental policy, it appears that the argument was meant to support the need for a science minister and called for science to serve national priorities or mission-oriented goals – something that agents from the science field generally opposed. MP David Lewis (MP, Ottawa) noted: "…our atmosphere and waterways are becoming dangerously polluted… it is the fault of the government in not assigning priorities in accordance with Canadian needs and aspirations, and thereby giving no direction to the great potential role of science and technology to the fulfillment of these needs" (Lewis, 1969. Without a science minister policy is haphazard). We also see from this comment a belief that science can resolve the issue of environmental pollution.

Themes identified

Five themes emerged from the opinion statements on environmental pollution in the *Science Forum*:

7. Opposition to government environmental policy
8. Observation of government inaction on environmental pollution
9. Government misinformation or lack of information on environmental pollution
10. Belief in the ability of science to find solutions
11. More funding for science related to environmental policy

Theme 7 - Opposition to government environmental policy

The theme of opposition to government environmental policy was strongest with 85% (11 out of 13) of opinion statements containing this theme. Mostly agents from the science (5 out of 6 opinion statements) and science journalism (5 out of 6 opinion statements) fields expressed this opinion. This controversy appears to be particularly polarizing with only 2 opinion statements expressing neutrality and none expressing support.

Theme 8 - Observation of government inaction on environmental pollution

Another major theme (10 out of 13 opinion statements) that arose was an observation of government inaction in resolving the issue of environmental pollution. This was found among agents in both the science (5 out of 6 opinion statements) and the science journalism (4 out of 6 opinion statements) fields.

Scientists expressed an observation of inaction on the part of the government as can be witnessed in the comment of an ecologist from McMaster University: “But peering through the dust of political gymnastics one is forced to conclude that so far there has been very little tangible action" (Kershaw, 1971. Has the message got through?). However, there was less of an observation of inaction due to ignorance on the part of the government.

Science journalists tended to echo this observation of inaction. For example, as in the comment by Calamai: “The unwritten rules of the government pollution game appear to be that no action is announced publicly until the problem reaches a crisis state” (Calamai, 1970. How governments play the pollution game). Agents from this field also

tended not to associate government inaction with ignorance and were more likely to assign blame to both government and government scientist administrators.

Theme 9 - Government misinformation or lack of information on environmental pollution

The theme that the government is providing misinformation or failing to provide any information to the public on environmental issues also emerged from the opinion statements captured. This was a minor theme (5 out of 13 opinion statements) among agents and came from both the science (3 opinion statements) and the science journalism (2 opinion statements) fields. Science journalist, Peter Calamai provides an example of this theme by writing "…the public is given only partial information, subjected to the worst type of propaganda about crash programs, and expected to relax with the thought that the job is in capable hands" (Calamai, 1970. How governments play the pollution game).

This sentiment of misinformation or obstruction of information release by the government was echoed by scientists as well. David V. Bates (dean of medicine, University of British Columbia and chairman, Science Council study 'policies and poison') notes, "One can easily visualize a study of levels of body mercury contamination in native peoples being embarrassing to a provincial government and being excluded from obligatory publication on that ground" (Bates, 1977. Opening up governmental decision-making). Bates goes on to note that more bureaucratic control of the flow of information may be forthcoming but that he doubted this would provide the necessary transparency to inform the public.

Theme 10 - Belief in the ability of science to find solutions

The sentiment that the solutions to the environmental pollution issue would be found through scientific endeavours was a minor theme found in this controversy (5 out of 13 opinion statements). This sentiment was found mostly among science journalists (4 out of 6 opinion statements in this field) with the exception of one science journalist who noted that "The problem is more than one of salvation or damnation by technology" (Lotz, 1978. Oil spills in the Arctic spell disaster).

Theme 11 - More funding for science related to environmental policy

The call for more funding or an opposition to the loss of funding was a minor theme found among agents in the science and science journalism fields in the controversy over environmental policy with 2 opinion statements expressing this sentiment.

Example 3: 'Muzzling' of government scientists

The controversy over the 'muzzling' of scientists encompasses cuts to research funding, the closure of various research facilities as well as the science information policy issued by the Harper government. The opinion statements for this contemporary controversy were captured from the archived CSWA web page: http://sciencewriters.ca/initiatives/muzzling_canadian_federal_scientists/. In all, there were 20 opinion statements (i.e. editorials and opinion pieces) posted on this page or linked to this page. Table 3 presents the opinion statements of the agents listed by field and captures their support, opposition or neutrality related to "government science information policy." In this science policy controversy, we see an equal number of opposition statements from both the science and science journalism fields. The sample for politicians is once again small.

Table 3: Government science information policy: Opinion statements listed by field

Field (Total)	**Position on "government science information policy"**		
	Support	Oppose	Neutral
Science (9)		9	
Science Journalism (9)		9	
Politics j2)	1	1	

Science field

Scientists voiced their opposition to this policy with an accusation that the barrier to information release is due to the government's industrial ventures as evidenced by the quote by Stephen Bede Sharper (Centre for Environment, University of Toronto), "While Canadian environmental scientists aren't being placed under house arrest for their findings, they are it seems being silenced, "re-profiled" or downsized by a political power that is seemingly allergic to evidence that challenges its gospel of growth through the

mining and burning of fossil fuels" (Scharper, 2012. Are Canadian federal scientists being muzzled?).

Scientists also spoke out on the persecution by politicians of scientists who did voice their dissent against the information release policy: "Minister of State for Science and Technology, Greg Rickford has continued the tradition of labelling scientists who speak up about science policy radicals and ideologues" (Taylor, 2013. Why don't cabinet ministers know anything about science?). In addition, scientists did comment on the silence of politicians on the controversy, for example, noting that "Minister of Fisheries and Oceans Gail Shea is conspicuous by her absence in the national press" (Taylor, 2013). At the same time, the idea that the Prime Minister was ultimately to blame for the information release policy and not the MPs was prevalent: "Our cabinet should not just be a group of talking heads spouting policy lines crafted in the PMO" (Stephanne Taylor, Oceanography, University of McGill).

Science journalism field

Opinion statements from science journalists were strongly in opposition to the science information release policy. The policy in this instance was perceived as one that hampered both scientists and science journalists directly from performing their respective functions. This sentiment can be seen in the comment by Kathryn O'Hara (CSWA president), "This message manipulation shows a disregard for the values and virtues of both journalism and science, and subverts timely disclosure and access to scientific data" (O'Hara, 2010. Canada must free scientists to talk to journalists). O'Hara also pointed out that this information barrier was a constitutional impediment to the public: "Access to scientific evidence that informs policy is not a luxury. It is an essential part of our right to know."

In addition to the charge that the information release policy is an affront to the public's constitutional right, journalists also alluded to the sentiment that the move is a promotion of an ideology by the government at the time. As Francois Cardinal (journalist, *La Presse*) notes "Ce musellement politique, qui a toutes les apparences d'un musellement idéologique, se traduit par une interdiction formelle de s'adresser directement aux journalistes, et donc au grand public qui finance pourtant leurs recherches" (Cardinal, 2012. La censure). There was also a strong rally from the science journalism field for the abolition of the policy, "Il [Ottawa] doit libérer les chercheurs du huis clos dans lequel il

les confine honteusement. Bref, il doit réviser le protocole de communication qu'il impose à ses scientifiques."

Political field

The one instance of an agent from the political field opposing the government's science information policy was from a Member of Parliament (MP), Stewart Kennedy who also belonged to the New Democratic Party (NDP) as opposed to a member of the Conservative party in power (Kennedy, 2013. Biting through the muzzle on science).

The opinion statement captured from George Enei, Assistant Deputy Minister of Corporate Services and Chief information officer at Environment Canada lent support to the government's science information policy, which includes the closing of scientific libraries. He noted that the move to close the scientific libraries was an attempt by the government to digitize information – as opposed to the destruction of scientific information (Enei, 2014. Modernizing the library system). Although there is a dearth of opinion statements from agents in the political field in this controversy, the opinion statement captured here is from a policymaker who had direct impact on the course of policymaking in this controversy.

Themes identified

Four themes emerged from the analysis of the third example:

12. Opposition to government science information policy;
13. Contemporary government misinformation or lack of information;
14. Contemporary political involvement of scientists;
15. More funding for contemporary science.

Theme 12 - Opposition to government science information policy

The main theme captured among the opinion statements was opposition to the lack of flow of information from government scientists to the media. Of the opinion statements captured, 100% of statements from the science journalism and science fields were in opposition. Science journalists and scientists were strongly aligned to resolve the issue in a joint effort to lobby for a reversal of the government's information release policy, as we can see from this comment issued by the CSWA, "After several unsuccessful attempts to resolve this issue, our organizations — which represent science journalists

and communicators and scientists across Canada and around the world — have agreed to a joint campaign to push for timely and open access to federally funded scientists" (CSWA, 2012. Open letter to Prime Minister Harper. Prime Minister, please unmuzzle the scientists).

Theme 13 - Contemporary government misinformation or lack of information

A strong theme – perhaps unsurprisingly given the nature of this particular controversy – was the accusation by both science journalists and scientists that the government was providing misinformation or a lack of information to the public. Overall, 75% of opinion statements captured expressed this sentiment. Agents from the science (78% of opinion statements from this field) and science journalism (78% of opinion statements from this field) fields were equally likely to level this accusation. Journalists from the *Toronto Star* noted that "If the government hopes to win trust, it might strive for a level of transparency that doesn't include, say, vaguely worded statements" (*Toronto Star*, 2014. The real concerns about Ottawa's 'libricide').

Science journalists were critical of this information release policy as an effective strategy by the government to further their interests and warned that this move would drive science journalists and the public to rally against this policy, as evidenced by the comment "if the government thought that clamping down on the flow of scientific information would help their cause (whatever it may be) then they've really shot themselves in the foot. The more they squeeze, the more the science journalism community and the public in general will feel the need to raise the alarm" (Irving, 2012. Come talk to me: Un-muzzling government scientists).

Opinion statements from scientists were likewise laden with accusations of government misinformation or lack of provision of information to the public, as seen in the comment "Canadians should continue to demand that the muzzle be removed from public service employees to ensure an open flow of communication between the public, the government and the experts who collect and understand the data" (Kerckhove and Phipps, 2013. The Open Data effect: a tool to keep governments honest).

In light of the lack of government response to accusations to confirm or deny the 'muzzling,' scientists also submitted proof to support their claims that the 'muzzling' was indeed an issue: "The Professional Institute of the Public Service of Canada recently

released the first results of a survey of over 4,000 government scientists, 90 per cent of whom reported that they were prevented from speaking publicly about their scientific work" (Findlay and Dufour, 2013. Why Canada needs a science watchdog). Agents from the science field also lobbied for an investigation of the legality of this information release policy: "The evidence of muzzling is sufficiently persuasive to have prompted an investigation by the federal Information Commissioner into the legality of government communication policies, following a petition by the University of Victoria's Environmental Law Clinic" (Findlay and Dufour, 2013. Why Canada needs a science watchdog).

Associations of science journalists and scientists also collaborated to write open letters in opposition to the information policy as can be witnessed in this statement issued by various science and science journalism associations: "Après plusieurs années de dénonciations infructueuses, nos associations, qui représentent la communauté internationale de journalistes scientifiques et les chercheurs canadiens, annoncent par la présente le début d'une campagne au cours de laquelle elles uniront leurs forces afin d'obtenir un libre accès aux scientifiques fédéraux. (Mathieu-Robert Sauvé, président de l'Association des communicateurs scientifiques du Québec; Florence Pilon, présidente de l'Association science et bien commun; Arnold Amber, président de la Canadian journalists for free expression; Peter McMahon, président de la Canadian Science Writers' Association; Jean-Marc Fleury, directeur général de la Fédération mondiale des journalistes scientifiques; Gary Corbett, président de l'Institut professionnel de la fonction publique du Canada, 2012. Science - Liberté pour les chercheurs canadiens).

Theme 14 - Contemporary political involvement of scientists

A minor theme that reoccurred in the opinion statements captured was a call for scientists to enter the political arena. This theme was found only among the opinion statements of scientists with 56% of opinion statements from this field expressing this sentiment. Scientists who rallied behind the push by agents in the science field to see more of their numbers in the political arena cited the lack of scientific experience by policymakers as a significant problem. This can be seen in the comment: "the real problem is not that Stephen Harper appointed a science minister who doesn't have a science background. It's that there aren't enough MPs with science backgrounds to begin with" (Gibbs, K. 2013. Where are all the MPs with PhDs?). Agents from this field argued that scientists were ideal candidates to practice evidence-based policymaking as

this is a core tenet of the science field: "…having more scientists actively engaged in politics will go a long way to improving evidence-based decision making in Canada. If we want politicians who will critically examine and weigh all the evidence, then why not elect more people who are trained to do this as part of their vocation?" (Gibbs, K. 2013. Where are all the MPs with PhDs?).

Theme 15 - More funding for contemporary science

The minor theme of a call for more funding for science or the opposition of funding cuts to science was found in the contemporary controversy. Although this theme was found in the other two controversies examined, only scientists in the contemporary controversy offered opinion statements that fell into this category (33% of opinion statements captured agents from the science field). Among the opinion statements captured in this theme was one that closely echoed those found in the *Science Forum* on the lack of funding for basic science and the opposition of diverting funding from basic science to fund private science: "…academic scientists are sending a message to Ottawa that, although its approach to science policy might be well-intentioned, shifting even more university research funding toward industry partnership programs is a myopic view of how science works — and is likely to backfire…basic research in Canada has begun to atrophy due to chronic funding neglect" (Neufeld, 2013. Blinded to science: The plight of basic research in Canada).

Synthesis of data from all three controversies

Table 4 groups the data from all three controversies capturing the positions of agents from the science, science journalism and political fields related to the government policy examples examined. Table 4 shows that agents from the science and science journalism fields are opposed to government policy that seeks to impose political authority over the science field. This synthesis of data further allowed the recognition of five meta-themes that cut across all three controversies (Table 5, which lists themes by controversy and field). These meta-themes represent a unique qualitative crystallization of the opinion statements from the three fields examined.

Table 4: Opinion statements from all three controversies

Field (Total)	Position on "government policy"

	Support	Oppose	Neutral
Science (78)	2	71	5
Science journalism (35)		28	7
Politics (9)	5	3	1

Table 5: Meta-themes common to the three controversies examined

Meta-theme	**Controversy (n-value of opinion statements of agents captured)**	**Field**
A. Opposition to government science policy	National science policy debate in *Science Forum* (n=89)	Science (58)
		Science journalism (16)
		Politics (1)
	Environmental policy debate in *Science Forum* (n=13)	Science (5)
		Science journalism (5)
		Politics (1)
	Government science information policy on CSWA website (n=20)	Science (9)
		Science journalism (9)
		Politics (1)
B. Political involvement of scientists	National science policy debate in *Science Forum* (n=89)	Science (17)
		Science journalism (2)
		-
	Environmental policy debate in *Science Forum* (n=13)	-
	Government science information policy on CSWA website (n=20)	Science (5)
		-
C. Observation of government inaction	National science policy debate in *Science Forum* (n=89)	Science (5)
		Science journalism (1)
		-
	Environmental policy debate in *Science Forum* (n=13)	Science (5)
		Science journalism (4)
		Politics (1)
	Government science information policy on CSWA website (n=20)	-
D. Government misinformation or lack of information to the public	National science policy debate in *Science Forum* (n=89)	Science (6)
		Science journalism (4)
	Environmental policy debate in *Science Forum*	Science (3)

	(n=13)	Science journalism (2)
		-
	Government science information policy on CSWA website (n=20)	Science (7)
		Science journalism (7)
		Politics (1)
E. More funding for science	National science policy debate in *Science Forum* (n=89)	Science (20)
		Science journalism (5)
		Politics (1)
	Environmental policy debate in *Science Forum* (n=13)	Science (1)
		Science journalism (1)
		-
	Government science information policy on CSWA website (n=20)	Science (3)
		-
		-

Table 5 shows that a major meta-theme of "opposition to government science policy" is common to all three controversies examined here with scientists and science journalists showing a correlation in positioning in the historical and contemporary examples. The accusation of "government misinformation or lack of information to the public" is a second meta-theme that cuts across all three controversies. Science journalists here appear to express this sentiment in almost equal numbers with scientists. To a lesser extent, the third meta-theme calling for "more funding for science" could be observed in all three controversies with agents from the science field leading the cause. This call for more funding for basic science was much more prevalent in the past controversies in the *Science Forum* compared to the current controversy on the 'muzzling' of scientists. A weaker fourth meta-theme calling for the "political involvement of scientists" was found in the controversy on national science policy in the *Science Forum* and in the contemporary controversy. The push for more scientists to enter the political arena came almost exclusively from agents from the science field with a couple of exceptions from agents in the science journalism field in the historical example. This theme was much more prevalent in the historical example compared to the contemporary controversy. Lastly, the "observation of government inaction" was a final weak fifth meta-theme found in the historical controversies in the *Science Forum.* This theme was found among agents in both the science and science journalism fields – although more scientists noted this observation than science journalists.

Chapter 5: Historical construction of past and present science policy controversies

The overall goal of this project is to explore the possibility of certain alliances or oppositions between the three fields of science, science journalism and politics in times of science policy controversy. To accomplish this goal, a historical construction is important as it provides a look at the historical genesis of science policy controversies and helps us more clearly situate the current controversy of the 'muzzling' of scientists in its rightful place and not view it in isolation – abstracted from culture, politics and history. The thematic analysis in Chapter 4 is used here to support the historical construction of the science policy controversies under examination. This chapter presents this analysis before discussing the patterns of opposition and alliance between these fields in Chapter 6.

Bourdieu portrays 'practice' as a rich concept that encompasses activities that possess a social character and bears meaning. In the case of this thesis, the practice under examination is the participation in media discourse on science policy controversies. A 'scientific controversy' debated in the media is a bounded activity that denotes a familiar activity. According to Bourdieu, 'practice' can be theorized through the concept of 'habitus,' which identifies the impetus for actions by agents as predispositions that have roots in social history (Burkitt, 2002). 'Habitus' is a concept that dictates that agents have a socially developed capacity to act a certain way depending on a system of historical, social and cultural predispositions that guide them to do so. Different agents are predisposed to different sets of actions depending on their 'habitus' – scientists to a scientific habitus, politicians to a political habitus and journalists to journalistic habitus. The concept of habitus alone, however, is not enough to explain why agents support some policies and not others. The concept of field is needed to provide context and explain the stimulus behind the practice of agents who decide to act one way versus another. A field is a space within which a power struggle is waged and where agents are located. The positions of agents are determined by specific rules of the 'field.' According to Neveu and Benson, "Fields cannot be understood apart from their historical genesis and trajectory" (Neveu and Benson, 2005). Bourdieu attempts to construct a model of social space that can account for the practices found within it (Grenfell, 2012). Bourdieu insists that examining the social space in which interactions take place is necessary to fully understand interactions between people. Simply examining what was said or an

event or social phenomena in isolation is not enough. Examining a social space entails locating an object of investigation (in this case, science policy controversies) in its specific context (i.e. historical, relational, local/national/international context) as well as exploring how past knowledge on the subject has been generated and what purpose this knowledge generation may have served or who it may have benefited (e.g. Bourdieu 1993; 1990; 2004).

Past literature and reviews of the controversies on building a national science policy, implementing an environmental policy and the enforcing of an information release policy were used to reconstruct these controversies. Opinion statements from the Results Chapter (Chapter 4) were used to supplement the historical constructions of each controversy.

Historical construction of the controversy over a national science policy

Traditionally, Canada has had a resource-based economy. Efforts have been made over the decades to transform this to a knowledge-based economy that "would be sustainable in the face of massive globalization" (Halliwell and Smith, 2011). Research, science and technology were the areas identified as drivers that would help attain this goal. Thus, science policies historically have been directed at re-aligning Canadian science and research systems to meet national priorities. A slew of Royal Commissions and innovation strategies at the federal and provincial levels have historically generated much debate mainly between policymakers and scientists as related to this goal (e.g. Science Council Report No. 4: Towards a National Science Policy for Canada, 1968; The Lamontagne Commission, 1968-1977; National Advisory Board on Science and Technology, 1995; Expert Panel on Commercialization, 2006; Innovation Canada, 2011).

Canada's science and innovation systems have a strong British heritage and is supported by an extensive university sector. The original core organization for government science in Canada is the National Research Council (NRC) which was founded in 1916 (Halliwell and Smith, 2011). The NRC's design and function has its origins in the British Department of Scientific and Industrial Research and was the first official science policy institution. Science only became systematically organized in Canada in 1917, which arose when the Canadian government sought to establish formal policies regarding science in an effort to apply science to the wartime effort in the First World War (Holdsworth, 2002; de la Mothe and Paquet, 1994). This ran parallel to a

similar effort in England where the Haldane report to Parliament in 1916 sparked reform to government science. The philosophy of the Haldane report had a strong influence on the conception and organization of the NRC in Canada. The Haldane principle upheld a particular ideal of scientific practice that dictated that the "best scientific results are achieved when the community of scientists is left to its own discretion to allocate its resources internally in such a way as to optimize its production of knowledge" (Holdsworth, 2002). This may not be the only or first point in time where the idea of scientific autonomy took root but it represents an instance that is particularly salient for the historical construction of the science policy controversies examined here.

One of the first tasks of the NRC was to survey industrial research in Canada, the results of which showed that industrial research was still performed on a very small scale and employed very few researchers (Thistle, 1966). Thus, the NRC decided to form an alliance with the universities. The idea of constructing institutes for industrial research on university campuses was initially entertained until a parliamentary sub-committee discovered that most university faculties were adamantly opposed to collaborating with industry (Lamontagne, 1970). Dr. A.R. Macallum, the NRC's first chair, agreed with the universities disinclination to form partnerships with industry and persuaded the government to instead construct a laboratory complex for the research council that would develop new technologies for Canada (Atkinson-Grosjean et al., 2001).

In the 1930s, the NRC took on its own autonomous research projects and gained control over the distribution of government grants to academic research projects. Between 1916 and 1939, the NRC grew from one full-time employee and an annual budget of $91,600 to 2,000 employees and an annual budget of close to $7 million within months of the start of the Second World War (Lamontagne, 1968-77). The structure and function of the NRC as an institute upheld the Haldane principle of scientific autonomy and had a mandate to coordinate Canadian science efforts. Yet, its mission was to serve as an advisory board to the Privy Council. This harbored a fundamental tension between scientific autonomy and government coordination that would serve as the core of the science policy debate that played out in the *Science Forum* (Holdsworth, 2002).

Dr. E.W.R. Steacie who ran the NRC from 1952 until 1962 focused on stabilizing Canada's universities as he believed this path would best serve the needs of industry in the long term through the provision of researchers and basic research to feed the

development pipeline (Atkinson-Grosjean et al., 2001). For Steacie, it was imperative that Canada build a critical mass of scientists on par with Britain and the USA – not to emulate them but in order for Canada to transcend its colonial status and gain more independence (Steacie, 1965). Under his presidency, Steacie stated that the NRC strove "to be as similar to a university laboratory and as unlike a government department."

There was also a tendency until the 1960s for top-tier Canadian scientists to hold interlocking positions of power in government and university sectors (Atkinson-Grosjean et al., 2001). Government science was at this time in large part the enterprise of a small elite group of scientists (e.g. J.W. Dawson, J.H. Grisdale, Charles Camsell, C.J. Mackenzie and E.W.R. Steacie). These men generally shared similar socio-economic backgrounds: Canadian-born of British ancestry, middle-class in origin and Protestant. They personally knew "everyone that mattered" and the scientific research field was relatively small and close knit. This network depended as much on shared social capital as it did on academic or scientific capital (Bourdieu 1969; 1988; Atkinson-Grosjean et al., 2001). For most of Canadian history, science policymaking was personal and tended to function on a "social capital" system. Thus, decisions were made on the basis of whom one knew.

This situation began to be questioned in the 1960s as the personalist system started to be criticized as corrupt and inefficient (Glassco, 1962). This sentiment is echoed in the *Science Forum* as can be seen in an editorial: "…many Canadian scientists and engineers felt that vital decisions were being made by a few people in government, sometimes without all the pertinent facts, sometimes under the undue influence of a small *élite* in a real or imagined Canadian scientific establishment" (*Science Forum*, 1973. After six years: New needs, new responses).

Under the Diefenbaker Conservatives, the Glassco Commission spanned a general election and reported to Lester Pearson's Liberal administration in 1962. In the commission's view, the NRC had placed too much focus and resources in the university grants program. The commission also accused the university grant program members of having vested interests, neglecting national policy goals and compromising its impartiality as a government advisor by operating its own laboratories, as well as failing to promote industrial research (Glassco, 1962). These accusations of incompetence,

neglect and partiality sparked protests from NRC's scientists and bureaucrats who rose to the defense of this institution.

Despite this tension, the NRC continued with its function to fund and support basic or public science until the 1960s. There was a post Second World War emphasis on economic growth that also drove a realignment of universities to accommodate returning soldiers (Holdsworth, 2002). The Canadian science community was part of the expansion of the whole university system. While scientific autonomy continued to thrive in the new scientific and education institutions, the sheer size of the investment called for renewed efforts to coordinate Canadian science – federal expenditures devoted to R&D grew from an estimated $5 million in 1939 to over $200 million in 1959 (Lamontagne, 1968-77).

'Science policy' as a notion entered the realm of public deliberation in the 1960s. Also, in light of demands that decisions follow 'scientific' methods complete with rational justifications, the personalist system went behind the scenes (Atkinson-Grosjean et al., 2001). This can be glimpsed in a commentary in the *Science Forum*: "The core is just three men - Jim Davey, the prime minister's program secretary, Dr. Pierre Gendron, president of the Pulp and Paper Research Institute of Montreal, and Dr. Jim Harrison, a former president of the Royal Society who is assistant deputy minister for science and technology in the Department of Energy, Mines and Resources.... these three have had the prime minister's ear at far closer range than the Science Council of Canada, Senator Lamontagne, or even some say - the Science Secretariat" (Calamai, 1971. Trudeau's technocrats telegraph their punches). Thus, the story of Canadian national science policy is in large part the story of the people who made it.

The Glassco Commission of 1962 recommended a permanent Science Secretariat to advise the government, a Science Council to coordinate long range planning and the appointment of a science minister (Atkinson-Grosjean et al., 2001). In 1964, the Science Secretariat to the Privy Council was established to reconnect science to political power. In 1966, the Science Secretariat was transformed into the Science Council of Canada (SCC) with a mandate to serve as scientific policy advisor and under the leadership of Omond Solandt, the Council had influential access to the centre of political power (de la Mothe, 1992). As the SCC's first chairperson, Omond Solandt had enjoyed a distinguished career in Canadian science and had served on the defense research

board during the Second World War, making him the perfect scientist administrator for the job (Trim, 2015). He remained chairperson until 1972 and was followed by a distinguished group of engineers, scientists and business people.

Among the Glassco Commission recommendations was the establishment of a Science Ministry. However, the government held off on appointing a science minister. The Glassco Commission report also recommended an institutional framework to make government R&D more cohesive. Prime Minister Pearson, however, on receiving the report, consulted former NRC president C.J. Mackenzie who advised against more efforts to coordinate government R&D in existing government institutions (Hayes, 1973; Lamontagne report, 1970). Despite the ultimate dismissal of this recommendation, the Glassco Commission helped establish a policy environment more hospitable to promoting the coordination of R&D and scientific research management by the political field (Atkinson-Grosjean et al., 2001).

In 1967, Omond Solandt called for a closer relationship between Canadian science and industry. He also advocated for the creation of mission- or goal-oriented research and development as a means to achieve national priorities through government support and industrial cooperation (Trim, 2015; Lévi-Lloyd, 1989). The effort to preserve the autonomy of the science field and the goal of the political field to harness science to achieve national priorities led to rising tensions during the economic and environmental crises that began in the 1970s (Holdsworth, 2002). With the oil crisis and the emerging environmental movement, resources no longer flowed as freely into Canadian science. At the end of the 1960s, OECD examiners also concluded, as had the Glassco Commission in 1962, that there was a lack of coordination of the nation's science and technology infrastructures (OECD, 1969). Omond Solandt commented on this in the *Science Forum* noting that "Some Canadian scientists will no doubt be highly critical of the OECD report because of its continued emphasis on the need for relating expenditures on science and technology more closely to national social and economic needs. The Science Council has been similarly criticized" (Solandt, 1970. The OECD report: achieving a better balance). He then offered the reasoning that "Both the SCC [Science Council of Canada] and the OECD are trying, by their advice, to achieve a better balance in our scientific community" as a way to explain his stance to the agents from the science field who were in opposition to the policy.

The Science Council of Canada's 1968 report *Towards a National Science Policy for Canada* also advocated greater collaboration between university, government and industrial scientists to build multidisciplinary teams (Science Council for Canada, 1968). In light of these changes, conflict began to bloom as political authority threatened scientific autonomy. The 1968 report marked the year that the *Science Forum* was founded to "become a national forum in which Canadian scientists and engineers can discuss their vital issues" (*Science Forum*, 1968). An editorial in the *Science Forum* also confirms this arguably deliberate timing in the start of the controversy over national science policy as it notes "…in 1968, the federal government's new science policy machinery had just begun to roll…" (*Science Forum*, 1973. After six years: New needs, new responses).

The Natural Sciences and Engineering Research Council of Canada (NSERC) was created in the mid 1970s with a role as a granting agency for research conducted at Canadian Universities, which is a role it took over from the NRC (Holdsworth, 2002). With the former role of the NRC as national science policy advisor taken over by the Science Council, the NRC was left to conduct research on its own without the power to grant research funding and advise government on science policy. This served ultimately to strip a strong institute in the science field of its political power and autonomy.

The Science Council report *Towards a National Science Policy for Canada* in 1968 along with the OECD report preceded the Senate Committee Report or the "Lamontagne Report" entitled *A Science Policy for Canada*, which formalized a proposal for a framework of science policy. The Special Committee on Science Policy that produced the report was chaired by economist Maurice Lamontagne. The report was issued in three major volumes from 1968-1977. The Lamontagne Report set the stage for policymakers in the political field to coordinate government science efforts and conflicted with the entrenched norms of the science community and the autonomy of the science field. The report questioned the status of academic science as an intellectual endeavour that should somehow be considered apart from society and afforded special rights and privileges. The Lamontagne Report ultimately met with formidable resistance from what has been termed the "Republic of Science"[4] as scientists resisted the attempt at central coordination by the political field. The report demythologised the "Republic of Science"

[4] "Republic of Science" is a metaphor that was first coined by Michael Polanyi. The term was used liberally in the *Science Forum* by agents from all three fields to describe the science field and its agents. It is a term that is still used today.

and repositioned science as a social activity like any other. The committee argued that scientific elitism had driven Canadian science policy from the time the NRC was established in 1916 (Lamontagne report, 1968-77). It was this report that called for scientific research to align with national priorities or mission-oriented goals. It is also this report that recommended the creation of NSERC to take over from the NRC as a funder of academic research (Holdsworth, 2002). Despite the press coverage of the controversial shift, the report “fell dead from the press,” as it failed to garner attention or support from then Prime Minister Pierre Trudeau and his cabinet (Dufour and de la Mothe, 1993).

One recommendation that stuck from the Lamontagne report was the creation of the Ministry of State for Science and Technology (MOSST) in 1971 as it replaced the Science Secretariat. The MOSST was instated to provide science policy advice to the government and it eventually also planned and prioritized Canada’s science and technology efforts – thus, its authority also encroached on the NRC’s mandate (Atkinson-Grosjean et al., 2001). According to Atkinson-Grosjean et al., this move was highly politically motivated as the NRC was a Crown corporation and as such beyond direct interference by politicians. So, stripping away the NRC’s budget and responsibilities was a strategic move to transfer these responsibilities to an agency that could be more easily moved by political will. NSERC also fell under the authority of MOSST. Scientists expressed their concern within the pages of the *Science Forum* over the role of the MOSST and the move to usurp power from the scientific community to influence science policy and have a say in research funding. This can be witnessed in the comment by a University scientist (John Scott Cowan, Associate professor, physiology, University of Ottawa faculty of medicine and Chairman, Canadian Federation of Biological Societies) who noted that "…the realization was still to come that the senior civil servants at MOSST and the granting councils were government's spokesmen to the research community rather than the community's spokesmen to government” (Cowan, 1977. Research lobbying: choosing the next step). He went on to voice his concern that scientists would no longer be implicated in political decisions, asking “Will the research community have real input on the choice of persons to sit on granting councils, the Inter-Council Coordinating Committee, and the Canadian Committee on Financing University Research, or will incestuous consultation within the civil service be the order of the day?"

Likewise, science journalists echoed the concern of scientists in the *Science Forum*. In an article on the MOSST in the *Science Forum*, science journalist Jeff Carruthers noted that "A year ago, when the *Science Forum* tried to obtain the ministry's views on its accomplishments up to that time, officials there balked. They argued, as they have almost from MOSST's inception, that it is a policy ministry (not an operational one) whose responsibilities more often than not involve behind-the-scenes development and co-ordination and whose accomplishments more often than not were difficult to identify as tangible successes (that is, as separate policies)" (Carruthers, 1974. The first three years of the science ministry: what has been achieved?). Carruthers also alludes to the political powers going underground yet continuing to influence policy out of sight: "Therefore, MOSST should remain behind the scenes. … much [of what MOSST set out to accomplish] was in the form of secret advice to the Prime Minister's Office or other government agencies."

The statement again implicates a privileged few that have the social capital to influence policy decisions – C.M. Drury, Minister of the State for Science and Technology in this case. The article goes on to indicate that an information release policy may already be in place: "Both Auréle Beaulnes, then secretary and deputy minister of MOSST (and destined a few days after I interviewed him to be shunted out of his job by former health deputy minister Maurice LeClair, who can be expected to return to the 'shush' period of information policy)" (Carruthers, 1974. The first three years of the science ministry: what has been achieved?). The article by Carruthers also indicates that the publication of scientific work funded by the public was being obstructed. He notes: "until recently, universities were complaining that professors didn't have freedom to publish results of contract work for the government…. A lot of the work of the ministry never surfaces: there are countless studies performed with public money and of use to segments of the public that for a variety of reasons are never released publicly." This marks a much earlier reference to the 'muzzling' of scientists and an information release policy that precedes the contemporary controversy under the Harper government.

By 1973, the MOSST had acquired more power to shape science policies through a strengthened mandate in budgetary powers, science policy framework and the allocation of research funding.

The philosophical intent of the Haldane principle of scientific autonomy, internal allocation of resources and competition for individual excellence through vigorous peer review were key elements that were recognized in the science and political field alike. Despite the push of the political field to assert authority over the autonomy of the scientific field, it still remains a set of principles that continues to be central within the science field to this day.

Historical construction of the controversy over environmental policy

Historically, Canadian federal scientific activities focused on practical applications and the exploitation of the country's national resources. The first ever federally supported science initiative was the Geological Survey of Canada that was founded in 1841, which laid the basis for the mining industry. Marine research stations for the fishing industry developed in the 1890s, followed by forestry experimental stations. Before the end of the 19th century, several national laboratories were established by different government departments for the exploitation of natural resources (Atkinson-Grosjean et al., 2001).

In early 1972, the SCC suggested that Canada should "provide the leadership necessary to work toward a more equitable distribution of the benefits of natural resources to all mankind" at the United Nations Conference on the Human Environment in Stockholm (Science Council of Canada, 1973). This was combined with a call by the Council to embrace environmentalism. The media coverage of this radical statement by a Crown corporation headed by Canada's leading scientists caught the attention of the Canadian media and public (Trim, 2015). In 1973, the SCC announced that Canadians should move from a consumer society obsessed with the exploitation of resources to a 'Conserver Society' that engaged in more constructive endeavors. Driven by the oil crisis and the explosion of environmentalism in the 1970s, Canadians embraced the idea of the Conserver Society, according to Trim (2015). The *Globe and Mail* featured the leading advocates of this switch in national priorities (Marshall, 1976). At the same time, a leading environmental group in the 1970s, Pollution Probe, outlined how Canada could be restructured as a Conserver Society. This also coincided with efforts in the 1960s to early 1970s to base government policy on scientifically founded advice. In 1968, soon after its formation, the government of Pierre Trudeau went about reforming the Canadian state in the name of improving efficiency and democratizing decision-making (Aucoin,

1986). "Rational management" was the order of the day and involved a centralized policy structure around the Cabinet and the use of expert knowledge.

As such, "entire departments were remade around the desire to effectively employ science-based policy" (Trim, 2015). Thus, the Department of Energy, Mines and Resources (EMR) was revamped by the Trudeau government in the early 1970s and mandated to formulate an energy policy and direct resource development. The government also staffed the EMR with highly educated ministers with a background in the oil and gas industry to head the department and act as energy experts with the ability to formulate policy (Fossum, 1997), starting with Donald Macdonald – an "aggressive and nationalist minister" (Trim, 2015). As the EMR transitioned into a policymaking body, it made every effort to integrate scientific expertise as part of Trudeau's "rational management" mandate. The EMR built close ties with the SCC – so much so that advisors on oil and gas and experts in energy analysis, including R.P Charbonnier, moved between the department and the Council. The SCC assisted the EMR in helping formulate policy and studying the nation's energy options (Lévi-Lloyd, 1989). Charbonnier asked the Council in 1971 to spearhead a study to complement the EMR's assessment of Canadian energy policy (Trim, 2015).

The Science Council's report *Towards a National Science Policy* called for a "total systems approach," which emphasized optimization (Science Council for Canada, 1968). The concepts of systems-based optimization was an offshoot of operational research, general systems theory and pre-cyberspace enthusiasm for cybernetic control theory that came about in the post Second World War period (Holdsworth, 2002). The Report noted that innovation was very capital-intensive and should be weighed against economic gain and social benefit. The adoption of this approach in the 1970s is also captured within the pages of the *Science Forum*: "The small budgetary program review and assessment group within the ministry has recently developed a special computerized screening mechanism, designed to measure whether a particular program proposed by a government agency meets various government criteria for science" (Carruthers, 1974. The first three years of the science ministry: what has been achieved?).

The SCC placed a lot of weight on quantitative analysis to shape its approach to the environment (as did the MOSST in its approach to policymaking). In 1972, the Council

put forth its concern for Canada's environment with its report on pollution and resource depletion, *It Is Not Too Late – Yet*, to inform Canadians that the nation was facing serious environmental issues. By 1973, the SCC had produced 21 reports, covering issues including forest management and industrial innovation (Trim, 2015). The Council took the view that if Canadians and their government embraced scientists and their growing knowledge on environmental, social and economic problems, effective solutions could be developed. As a group made up of elite scientists, this view from the Council is hardly surprising. The SCC also embraced two key analytic tools when advising on policy for environmental protection and resource development: input-output analysis and systems analysis. The Council held the opinion that these two techniques would help policymakers gauge the consequences of policies before they are implemented. This viewpoint signals the growing dependence of the SCC on mathematical simulations to conceptualize environmental protection. Environmentalism also relied heavily on the quantitative approach to both understand human impacts on the world and communicate it to the masses.

In this way, the SCC used quantification and the supposed ability to simulate the world and "predict" potential futures as leverage to gain political influence for the science field (Trim, 2015). This reliance on quantitative analysis was also in line with the Trudeau government's mandate for rational management to inform national policy. With the emergence of the oil crisis and the environment as a political issue, the SCC's ability to provide seemingly objective guidance on policy issues became a useful political tool. In this way, agents from the science field with scientific expertise benefited from regimes of quantification to force the state to rely on their knowledge to formulate and defend policy. And this in turn, strengthened the position of experts in the science field when engaging in debates on controversial policy issues (Porter, 1995).

In the 1970s, expanding scientific knowledge about the Canadian arctic and subarctic led to a growing understanding among scientists of the fragility of northern ecosystems and the desire of local populations (including the Inuit) to have a say in northern development plans (Bocking, 2007). This created tension between scientists and advocates of northern development as the potentially harmful environmental impact of mineral extraction and oil pipelines came to light. The Trudeau government's emphasis on science, the national conflict on development and the oil crisis all served to set the stage for the SCC's Conserver Society (Trim, 2015).

In 1975, a socially active physicist and metallurgist, Ursula Franklin took over as head of the SCC and founded the Conserver Society committee (Trim, 2015). Under her leadership, the SCC's committee fleshed out the Conserver Society. The committee rationalized that the Conserver Society arose "from a deep concern for the future, and the realization that decisions taken today, in such areas as energy and resources, may have irreversible and possibly destructive impacts in the medium to long term" (Science Council of Canada, 1977). Under Franklin, the SCC called for environmental responsibility and sought to inform Canadians on the environmental issues at hand. The Council took the view that an informed Canadian society would accept the SCC's view of the country's long-term interests and pressure the government to adopt a program of efficiency and conservation. Informing the public through alliances with agents in the journalism field and an industrial strategy to shift the country's reliance on extractive resource industries to the use of renewable resources were the SCC's main goals. These set the stage to insert the environment and its fragile nature into Canadian politics. This stance clashed with the government's policies of encouraging growth through resource exploitation and it also ran against the idea of consumerism (Trim, 2015).

By the mid-1970s, several environmental groups (including Friends of the Earth and Back-to-the-landers) embraced the Conserver Society (Nash, 1979). As did the Pollution Probe group based in Toronto – Canada's largest environmental group at the time that also championed renewable energy and the Conserver Society (O'Connor, 2014). The rising oil prices, growing environmental concern and the media's attention on this movement put the Conserver Society and the morality of thrift in the minds of Canadians by the late 1970s (Fulford, 1977; Gwyn, 1977). We can observe an alliance here between the science and journalism fields to push the environmentalism agenda.

By the mid 1970s, government departments concerned with the environment also adopted the Conserver Society view, including Environment Canada. Using the discussions around the Conserver Society to define its mission, Environment Canada outlined how it could help Canadians better comprehend their relationship with the environment (Trim, 2015). The SCC's influence drew the ire of Canada's most powerful think tank, the Fraser Institute as it flew in the face of their commitment to free trade and rapid growth (Palda, 1979; Trim, 2015). Critics asserted that the Council failed to understand the impact of foreign ownership and the SCC had become little more than a

means for scientists and engineers to lobby government for more funding and employment.

In the 1980s, the goals of the Conserver Society merged with the Brundtland Commission's formulation of "sustainable development" (World Commission on Environment and Development, 1987). This gradually became a ubiquitous part of politics, contributing to the emergence of the environment as a political issue. The Conserver Society had a significant impact on environmentalism and Canadian politics as it expanded environmental concern to include economic development and the notions of sustainability that have dominated contemporary environmental politics, including those that came into play in the contemporary controversy over the 'muzzling' of scientists.

In the historical construction of this controversy, we see government advisors with financial support from the state analyze the nation's future and suggest ways to mitigate environmental destruction. This group of historical agents from the elite in the science field represented well-financed and largely independent centres of policy analysis that contributed greatly to the public debate on the environment (Trim, 2015). Of all the centres of policy analysis, the SCC was particularly influential in sparking the country's desire to use science as an engine of economic growth and to adopt political rationalization. At its heart was a belief that through the proper application, science could improve the lives of Canadians. This sentiment is prevalent in the commentary from agents in the science and science journalism fields in the *Science Forum*. Even though Canadian environmental politics reflected global environmentalism, the issues remained national. Agents from the science, science journalism and political fields shaped this controversy as an issue that reflected deeply held political, economic and ideological views dominant in each field.

Historical construction of the 'muzzling' of scientists

For much of the second half of the 20th century, the classic linear model of the research process was adhered to where public science performed basic research and then private science developed and commercialized this research (Atkinson-Grosjean et al., 2001). Public science happened in government and universities and was freely disseminated through journal publications. Private science, in contrast, was performed by industry and its commercial techniques were secret and 'protected' as intellectual property. Another

distinction between public (basic) and private (applied) science is that when there was insufficient economic incentives but a public need, public science stepped forward to act for the ‘public good’ while private science stepped aside. Invoking a clean separation between public and private; basic and applied; and open and secret was a politically expedient move geared to maintain wartime levels of government funding for research.

Despite this artificial demarcation of public versus private, the linear model of science research and development dominated science policy until the 1970s. Before then, the funding of public (basic) research was justified in terms of its long-term payoff in the private (applied) sector, which would generate future public returns in terms of employment, innovations and tax revenues.

In the 1970s with the recession, oil crisis and economic instability in industry, many of the post-war welfare state settlements were questioned. As more publicly funded discoveries were privatized in the form of biotechnology patents, the demarcations between public and private began to erode. At the end of the 1970s, market criteria and corporate structures were imported from the private sector and applied to public agencies and government departments (Atkinson-Grosjean et al., 2001). As previously mentioned, the Trudeau government of the 1970s adopted the idea of “rationalization” which called for government decisions to be founded on scientifically-based knowledge. The move by the government was supposedly done to improve efficiency and democratize decision-making (Aucoin, 1986). However, suspicions were raised that “rationalized management” would ultimately serve to garner support for private science at the expense of public science. Science journalist Peter Calamai (Southam News Services) aired his concerns that reflect this sentiment in the pages of the *Science Forum*: "Trudeau's technocrats call the process 'rationalization.' It means that the federal government will emphasize 'little science' [applied science] at the expense of 'big science' [basic science]" (Calamai, 1971. Trudeau's technocrats telegraph their punches).

From the early 1980s on, accountability and relevance translated into closer links between public research and the market. Technology transfer and the commodification of knowledge are defined as the essential foundations for economic restructuring and international competitiveness. The gap between public science and private began to narrow even further. All government institutions were pushed into adopting an

“enterprise culture” by successive federal governments (Burchell, 1996). The science policies that were put into effect in the 1980s represent an increasing effort to tip the balance between economic capital and scientific capital in government research institutions (Bourdieu, 1969; 1988; Atkinson-Grosjean et al., 2001).

In 1986, the Progressive Conservative government introduced a matching funds policy that required the granting councils to build partnerships with the private sector to increase public-private science collaborations in order to strengthen Canada’s international competitiveness (Atkinson-Grosjean et al., 2001). In 1988, under Prime Minister Brian Mulroney, the Networks of Centres of Excellence (NCEs) was founded. The NCEs would be based in universities and would reach out to the private sector for assistance. The principle of drawing closer ties between the public and private sectors of science was the same as for the Industrial Research Assistance Program (IRAP) that was established in 1962. While the NCEs used university financial systems, they were not accountable to the universities but rather to the NCE directorate in Ottawa, allowing the government to circumvent university power and autonomy and provincial jurisdiction. This strategy essentially boils down to a salient example of the domination of the political field over the science field – it represents the imposition of political authority over scientific autonomy.

Stephen Harper took over the prime minister’s office in 2006 and many of the trends from previous decades of the adoption of a corporate culture in government and funding increases for private science as opposed to public science continued. Unfortunate side effects from this adoption of a corporate model for government has been restrictions on media access to publicly funded science, budget cuts for public science, publication restrictions and a focus on science that benefits industry (Douglas, 2015). After the Harper government came into office in 2006, much of its activity served to limit the use of scientific knowledge to constrain or regulate industrial and commercial development, particularly in the resource and energy sectors (Amend and Barney, 2016). A concerted effort was also made by the Conservative government to orient Canada’s public science towards supporting commercial and industrial development. Combined, these efforts resulted from funding and personnel cuts to basic research, information control through new policies imposed on government scientists and structural adjustments to existing scientific funding and research institutes and organizations. Federal agencies that experienced major budget and personnel cuts included Environment Canada, Fisheries

and Oceans Canada, Statistics Canada, Library and Archives Canada, NSERC and the NRC (Amend and Barney, 2016).

The controversy over the 'muzzling' of scientists began in 2006 when a climatologist working for Environment Canada was stopped from attending a press club luncheon for the launch of a fictional book he wrote. Although the press releases did not link the climatologist to Environment Canada, he was ordered not to attend. A spokesperson for Canada's environment minister offered the explanation that proper procedure was not followed, alluding to an existing information release policy (Austen, 2006). By November 2007, Environment Canada had new official media policies in place (Magnuson-Ford and Gibbs, 2014). Scientists were now required to seek approval from media relations or communications offices within the agency prior to answering media requests for interviews or information. Agents in the science journalism field by and large claimed that these requests were not approved in a timely manner and scientists claimed that they were instructed to repeat specific talking points (Gatehouse, 2013; O'Hara, 2010; Greenwood and Sandborn, 2013). The new media protocol came under fire for limiting the freedom of federal scientists to communicate publicly and professionally (Holmes, 2013; Klinkenborg, 2013; Linnitt, 2013; Mancini, 2013). Other federal departments, such as Fisheries and Oceans Canada were said to have similar media policies (Linnitt, 2013).

In 2009, the budget cuts affected three granting councils that provided research funding at Canadian universities: the Canadian Institute of Health Research (CIHR), the Social Sciences and Humanities Research Council (SSHRC) and NSERC (Canadian Association of University Teachers, 2013). Critics of the Harper government's "anti-science" approach also pointed out that Mark Mullins, a climate change critic and former executive director of the Fraser Institute was appointed to the NSERC governing board in 2009 while John Weissenberger, a global warming skeptic was appointed to the board of the Canada Foundation for Innovation – an agency that provides funding for Canadian science research and technology development (Curry, 2009).

The Harper government announced the closure of the national Library and Archives Canada sites in 2012 as it moved towards digitization. The scientific community, however, raised concerns that the dismantling of these libraries was haphazard and resulted in the loss of fishery, ocean and environmental libraries. The accusation came

from scientists that much library material was destroyed without being digitized. The political move has been tied to the Harper government's perception that environmental science threatens the exploitation of natural resources (Nikiforuk, 2013; Amend and Barney, 2016). Soon after its election into power in 2006, the Conservative government made it clear that they opposed Canada's Kyoto Protocol pledges, which aimed at a 6% reduction in greenhouse gas emissions by 2012. In December 2011, the Harper government announced that Canada would be the first nation to officially withdraw from its Kyoto pledges (Holmes, 2013; *Toronto Star*, 2011).

In 2012, Canadian scientists looking to provide a briefing to the media on the state of sea ice in the Arctic failed to achieve the "nine levels of approval" required by their department (Munro, 2014). Agents from the science and science journalism fields alike began to make a concerted effort to raise public awareness on the issue. In 2013, the union representing public service employees in Canada, the Professional Institute of the Public Service of Canada surveyed thousands of Canadian government scientists and found that 90% "do not feel that they can speak freely to the media about the work they do" (PIPSC, 2013). Despite the government's claim that many scientists provide interviews (CBC News, 2013), a decline in interviews on topics such as climate change were notable (De Souza, 2010). In addition to the information policy, other new policies served to reduce environmental scrutiny that could hamper projects aimed to boost economic growth. For instance, the *Canadian Environmental Assessment Act* (CEAA), which came into effect in July 2012, mandated that any project that did not fit the federal government's definition of "major" would undergo assessment according to provincial criteria and where provincial criteria did not exist, projects would not undergo any environmental assessment (Davidson, 2012). The CEAA sparked a drastic drop in the number of departments and agencies that could perform environmental assessments – from 40 to 3. The government explained the cuts as an attempt to accelerate the processing of reviews on projects that would benefit the Canadian economy (Davidson, 2012).

The information flow was further stymied in 2013. Despite Conservative MP Kellie Leitch's assurance that government scientists were always free to publish their results (CBC News, 2013), the story broke that Fisheries and Oceans Canada was requiring pre-approval by ministry officials before submitting their work for peer review and

publication (Birchard and Lewington, 2013). The government explained that this new policy was a tool to protect its intellectual property rights.

In tandem with new communication policies for government scientists and access restrictions for the media, the federal government began closing down scientific institutions and facilities, such as scientific libraries where records going back decades were discarded (Wells, 2013). Other organizations and offices that ended up on the chopping block include the Office of the National Science Advisor, the National Round Table on the Environment and the Economy (NRTEE) and the Canadian Foundation for Climate and Atmospheric Sciences. The Office of the National Science Advisor, which was created in 2004 to channel science advice to the prime minister, was reassigned to the industry minister in 2006 then closed in 2008 (Hoag, 2008). The NRTEE that worked to develop policies to encourage sustainable development in Canada and reported on Canada's greenhouse gas emissions to meet specified goals was closed in 2013. The Canadian Foundation for Climate Atmospheric Sciences was the primary source for climate research in Canada. Its' closing eliminated funding for many environmental monitoring and research programs and facilities (Voices-Voix, 2014). Other closures include the Ocean Contaminants and Marine Toxicology Program (Harnett, 2012), the Canadian Policy Research Networks (CPRN, 2009; Voices-Voix, 2011), and the Mersey Biodiversity Centre (Moase, 2014).

Several facilities that were targeted for closure but saved in reduced form include the Polar Environment Atmospheric Research Laboratory, which takes Arctic measurements of the atmosphere, ozone layer and impacts of climate change (Mancini, 2013b); the Experimental Lakes Area, an ecological research station that conducts large-scale studies of freshwater lakes and assesses the impact of contaminants (Raj, 2013); and the Kluane Lake Research Station, which conducts research on the largest non-polar icefield in the world (Zada, 2012). The trend appears to be closures of research centres that dealt with levels of pollution and the impacts of climate change. The trend also highlights the controversy over the development of the Arctic that was prevalent between agents in the science and political fields in the 1970s, which was a hot button environmental policy issue at the time.

Along with the alleged communication sanctions and cuts to research facilities was the redirection of funds. Prior to the Harper government, the NRC supported basic research

in government labs and the commercialization of that research. Since the Harper government came into power, the NRC claims to have been relegated to acting as a "concierge service" for industry (NRC, 2013; 2014). In May 2013, the Harper government revealed its rebranding plan for the NRC that would focus the agency away from basic research in the pursuit of knowledge gathering and discovery and towards applied research instead that would support Canadian industry (Amend and Barney, 2016). Instead of supporting basic research, its purpose now is to provide support to scientists working in the private sector. The restructured NRC would be a "business-driven, industry-relevant research and technology organization" (NRC, 2013). Another funder of basic research in universities, NSERC has experienced budget cuts as well as the majority of funds redirected towards "target areas…that are in the national interest from a social and economic perspective" (Mancini, 2013c). Many NSERC grants now require matching funds from the private sector. Thus, research in government and university labs now require industry interest to gain funding. These changes were made according to NSERC to "streamline operations and ensure maximum efficiencies" (Mancini, 2013c) – a reasoning that echoes the sentiment behind the 1970s Trudeau government's "rationalized management" approach.

According to material released to justify the information release policy, prior to these restrictions, media coverage of scientist without these sanctions led to interviews that resulted in "surprises to Ministers and Senior Management" and "limited coordination of messages across the country" (Greenwood and Sandborn, 2013).

In 2013, Democracy Watch filed a complaint with the federal information commissioner concerning the government's interference with the freedom of federal scientists to speak publicly about their research and findings (Democracy Watch, 2013a). The accompanying report (Democracy Watch, 2013b) condemned the government's actions as "a threat to democracy," a charge that would later be echoed by prominent Canadian scientist and environmental activist David Suzuki (2013).

At the end of 2014, the editorial board of the *Toronto Star*, Canada's largest daily newspaper, commented on Canadian science policy, noting that science policy had taken a "catastrophic course" under the Harper government. They reflected that the turn away from basic science to application-driven research and the commercial public-private partnerships that had been built under the Conservative government had

"essentially transformed much of Canada's research budget into a business subsidy" (*Toronto Star*, 2014). At this time, a number of editorials and opinion pieces in mainstream media and scientific publications both in Canada and internationally since 2006 had served to label the Harper government as "anti-science" (e.g., *Globe and Mail*, 2013; *Toronto Star*, 2013; Klinkenborg, 2013; Bell, 2012; Nature 2012a; 2012b; Douglas, 2013; Holmes, 2013). A report by the Canadian Journalists for Free Expression (2015) described the Harper government as having an "insatiable appetite for controlling the flow of information and the substance of political debate" (Amber, 2015).

The current Trudeau Liberals presented their victory in the 2015 federal election as a restoration – "Canada is back!" Among the pledges made by the current government is one to restore science to its "rightful place" in the Government of Canada (Duncan, 2015). Since then, the Liberal government has instated a decision to withdraw restrictive media and communication policies for federal scientists, to reinstate the long-form census, and create a chief science officer position.

Chapter 6: Discussion

The interactions between the three fields during the controversies in question were explored in this thesis to identify patterns of opposition and alliance between these fields. This was done using 'Bourdieu's conceptual triad' of practice, habitus and social fields.

Bourdieu's conceptual triad (practice, habitus and field) and the pursuit of capital

Bourdieu's conceptual triad can be used to provide a deeper analysis of how these fields relate to each other in times of controversy that centers around science policy. The triad of practice, habitus and field helps us gain a better understanding of why certain alliances and oppositions came about using the logic inherent in each specific field examined.

Bourdieu portrays 'practice' as a concept that encompasses activities that possess a social character and bears meaning. In the case of this thesis, the practice under examination is the participation in media discourse on science policy controversies. According to Bourdieu, 'practice' can be theorized through the concept of 'habitus, which is a concept that dictates that agents have a socially developed capacity to act a certain way depending on a system of predispositions that guide them to do so.

To provide context and explain the stimulus behind the practice of agents who decide to act one way versus another, Bourdieu introduced the concept of 'field.' It is a space where a power struggle is waged and agents are located. Each social field provides a means of accumulating 'capital' and converting 'capital' between fields (Bourdieu, 1985). Four types of 'capital' are considered here: economic, social, cultural and symbolic (see Chapter 3 for definitions). All four forms of 'capital' can be used to acquire or "buy" better positioning.

Journalism is considered part of the broader field of cultural production. Bourdieu understands the field of cultural production as high in cultural and symbolic capital but low in economic capital. This is in direct contrast to the field of power, which is high in economic capital and low in cultural capital. Agents in the journalism field vie for cultural, symbolic, economic and social capital. Cultural capital for journalists come in the form of their know-how and skills, the articles and news pieces that they produce as well as their educational credentials. Symbolic capital is the resources made available as a result of

prestige or recognition (Calhoun, 2002). The journalism field reproduces or publicizes knowledge produced elsewhere. It is considered heteronomous as it seeks to appeal to those outside the field (i.e. audiences or readers) rather than to its peers. This is how journalism generates economic capital, which is why it imposes its heteronomous values on other fields (Siapera and Syridou, 2012). The specific idiosyncrasy of the journalistic field is that the market weighs more heavily on it than on many other fields, according to Bourdieu (1998). Social capital in this field represents their networks of peers, sources and readers, which captures both the production and reception sides of journalism (Siapera and Spyridou, 2012). Journalists reporting on science and on science policy must acquire and maintain access to a network of agents in the political and science fields to function and gain a better standing within their field.

In the scientific field, power is equivalent to scientific authority or the accumulation of scientific capital (peer-reviewed publications, grants) (Albert, 2011). This can be seen as the capacity to define what is legitimate or 'good' science. Thus, agents in the science field compete to gain access to the resources available in the science field (laboratory space, professorships, research funding, etc.) and control their distribution according to what is deemed 'good' science. Characterized by its own logic and shared assumptions, the scientific field should be viewed as a social arena that is relatively independent from the broader social environment, according to Bourdieu (Albert, 2011). The Haldane principle that sparked the ideal in scientific practice that the best scientific results are achieved when scientists are left to allocate their resources internally (see Chapter 5) ultimately serves to preserve the autonomy of the science field. The autonomy of this field is the result of a socio-historical process (see Chapter 5) and insulates the science field from domination by other fields. It also helps the science field maintain its internal rules where scientific capital is a highly valued commodity. According to Bourdieu, the volume of capital one possesses depends on the symbolic value attributed to the properties or resources one holds. Agents who possess more of a valued form of capital bring more weight to bear on defining what counts as legitimate power. The stock of capital that an agent possesses can rise or fall in value if the rules or logic of the field change.

Agents in the political field require economic, social and cultural capital to gain entry to this field. For agents in the political field, gaining a favourable media presence in the public eye and greater social capital with journalists is a key element in building symbolic

capital. Symbolic capital (honour, prestige, power) is a reflection of other capital forms in aggregate. Thus, attaining certain recognized positions in a profession (scientific, political or journalistic) automatically bestows symbolic capital onto agents. Although symbolic capital can be attained on various levels and among various audiences, it is increasingly facilitated by forms of mass communication through the media (Davis, 2010). Agents from both the science and political fields recognize that the media plays a key role in the accumulation of symbolic capital.

The production of policy is a heavily mediated process as 'public attention is steered by the attention of the media' (Sontag, 2003). Journalists are not only operant in the journalistic field in the media but increasingly in the offices of politicians and policymakers, which can affect the very process of policy production (Lingard and Rawolle, 2004). The effectiveness of many policies, including science policy, is dependent on the portrayal of these policies in the media. The science journalism field also depends on the science and political fields as a source of reportage on science and science policies. Similarly, the science field has a dependence on the government and the science journalism field for positive media coverage and hence favourable funding and policy directions.

Bourdieu's field theory suggests that fields evolve through the on-going clash between those who want to conserve a single dominant logic and those who advance a single alternative logic. In the controversies examined here, the policies imposed on the science field by the political field would change the rules that dominated for so long in the science field. The greater the control scientists can exert over the conditions under which agents can enter and participate in the field, the greater the autonomy the field can maintain from external powers. The science policies examined in this thesis ultimately provide the political field with a means to dominate the science field. By requiring the science field to collaborate more closely with industry to obtain funding and by making economic gain its ultimate mission, these policies erode scientific capital and elevate economic capital instead. An increased role for socio-economic stakeholders, such as agents from the political and economic fields, through participation in the establishment of research priorities and the evaluation of research proposals also implies a shift in the field's inclusion criteria and facilitates the entry of players whose primary goal is not the acquisition of scientific authority but instead the use of scientific knowledge for economic or political gains. Essentially, a capitalistic market logic was

imposed onto the scientific field. This changes the rules of the game in the science field that is part of the habitus of its agents and naturally sparked resistance from scientists.

Agents in the science field possess close ties with agents in the science journalism field and vice versa as the agents from these fields share a mutual dependence. This form of social capital or network of people that the science field had access to was tapped as a resource that could be mobilized to oppose political authority over scientific autonomy and conserve the existing rules and autonomy of the science field. This could have been the reason behind the creation of the *Science Forum*, which was a collaborative effort between prominent science journalist David Spurgeon who was the editor of the journal and various university scientists who sat on the editorial board. Agents from the science journalism field were perhaps compelled to align with agents in the science field in opposition to these policies as a means to preserve this social capital of networks formed with the agents of the science field on whom they relied on as a source of their reportage. In the contemporary controversy over an information release policy that allegedly prevented science journalists from accessing scientists and vice versa, the alignment of agents in the science journalism field with those from the science field could likely be attributed to the perception of a direct block imposed on their access to their sources. In the historical example contained in the *Science Forum*, agents from the science journalism field referred to secrecy surrounding science policy decisions as well as alleged that an information release policy was in effect even in the 1970s that prevented science journalists from accessing scientists. This could have given science journalists all the more reason to oppose the policies and the political field in the historical controversies examined here.

Science journalism, science and policymaking interactions

The practice of engaging in science controversies (national science policy and environmental policy in the *Science Forum* and the “muzzling” of scientists on the CSWA website) show an alignment between agents from the science and science journalism fields when the autonomy of the science field is threatened by political authority (see Table 4 in Chapter 4: Results). Agents from both the science and science journalism fields showed opposition to political authority over science. The strongest alignment between the fields of science and science journalism appears in the contemporary controversy. Among the controversies examined, the contemporary controversy on the

‘muzzling’ of scientists also appears to be the most polarizing as there were no neutral opinion statements captured in the instance of this practice. This may be due to the fact that the ‘muzzling’ of scientists represents an obstacle to both fields by the political field (see Chapter 5) as the science information release policy of the Harper government directly obstructed science journalists from functioning as agents in their field to inform the public on events that bear an impact on said public. An “anti-science” trope appears to be leveled against the political field by agents in the science and science journalism fields in both the historical and contemporary example of science policy controversies.

Aside from the “opposition to government policy,” the theme that was strongest among all three controversies was the observation of “government misinformation or lack of information to the public” by agents of the science and science journalism fields (see Table 5 in Chapter 4). There is evidence of information release restrictions on government scientists from the historical example found in the *Science Forum*. This is particularly interesting as the ‘muzzling’ of scientists is an action that has thus far only been applied to the Harper government in the contemporary controversy. Yet, opinion statements captured in the *Science Forum* during the 1970s when the Trudeau (senior) government was in power alludes to an earlier attempt by the government to control the release of government scientific information to the press. This appears to have a historical genesis rooted in the move by the political field to shift funding and resources from public (basic) science to private (industrial) science (Chapter 5). The shift from a public or open approach to scientific research to private or corporate secrecy appears to have had a hand in shaping the contemporary controversy of the ‘muzzling’ of scientists.

Other themes that did appear in the historical as well as contemporary controversies was the “political involvement of scientists” and the call for “more funding for science” (Table 5). The call for scientists to enter the political arena that emerge from this data analysis was mostly driven by scientists. Agents from the science journalism field appear to be mostly silent on the subject, with a minority supporting and a few standing in opposition of the view that scientists should be involved in politics. The call for more government funding for science or opposition to reduced government funding for science appears to be shared by scientists and science journalists as witnessed in the opinions examined in the historical example – with a majority of scientists championing this cause. This was not a strong theme in the contemporary example and is one that was only found among agents in the science field in the contemporary controversy.

The alignment of opinions between science journalists and scientists appear strong when collaborating to oppose the imposition of political authority over scientific autonomy. There are some clues captured that help explain why this alliance is valued by the science field. A commentary from David Spurgeon (editor of the *Science Forum* and science writer for the *Globe and Mail*) alludes to the benefits to the science field of having the press on their side: “Dr. Connell [University of Toronto’s vice-president for research and planning] said [at the CSWA’s fifth Annual Science Writing Seminar] that the science writers had played an important part in influencing the federal government to increase funds in this year’s estimates for the Medical Research Council, and the Canada Council” (Spurgeon, 1975. Somebody out here is listening). There are also statements from agents in the science field that show that scientists are aware of the benefits of the alliance with the science journalism field. J.G. Parr, dean of applied science at the University of Windsor (and editorial board member of the *Science Forum*) noted that at the Progressive Conservatives Policy Conference in Niagara Falls, science policy was included on the program and that the purpose of this was “to bring the subject to the attention of party members and politicians” (Parr, 1969. Getting together with Progressive Conservative thinkers). He goes on to note the failure of the party to do so but recognizes that “If this was achieved at all it was through the press rather than the ranks of the party." Taken together, the statements allude to benefits in social capital to the science field when alliances are formed with the science journalism field, which one may theorize is connected to the press’s ability to sway public opinion and potentially mobilize the public to pressure the political field to bend in their favour. Alliance with the science journalism field, which has access to the public and thus ability to sway the political field, also can and has (as seen by the statements presented) resulted in economic capital for the science field (e.g. by influencing an increase in government funding to science).

In a statement by J.A. Morrison, director of the Institute for Materials Research at McMaster University (and *Science Forum* founder and editorial board member), he suggests that agents from the science field should cultivate this alliance when he notes that scientists should “expend less of our effort on adversary politics and more on trying to develop mutual confidence and respect between scientists and those who support them” (Morrison, 1975. We can't restrict scientists and get unexpected finds). His statement also gives us a glimpse of how this alliance is valued on a more personal level

when he comments on the friendship between himself and the editor of the *Science Forum*: “In our small corner and through our friendly arguments, the editor and I are trying to help with that [developing mutual confidence and respect]."

There is also recognition from science journalists in the *Science Forum* of a bias by agents from the science journalism field towards science, as can be seen in this comment from the editor: “…we must admit a bias in favour of science rather than against it” (Spurgeon, 1978. A new magazine for a new era). Spurgeon also explains why he values the alliance with the science field when he notes that “Despite its limitations, we see the scientific approach as among the most valuable man has ever adopted for achieving insights into the nature of the universe.” This echoes the minor theme “belief in the ability of science to find solutions” found in the opinion statements on government environmental policy debates (see Chapter 4, Theme 10).

There are also limits to the support that science journalists afford scientists in their aspirations. For instance, in the opinion statements calling for scientist involvement directly in the political field, science journalist Lydia Dotto, science writer for the *Globe and Mail* expressed her doubts in the ability of scientists to cope in the political sphere, noting that "…outside of their scientific disciplines, scientists appear to have no greater expertise than anyone else in manouevering through the quasi-parliamentary wrangles that inevitable befog such gatherings [SCITEC forum on science priorities in Canada]. Perhaps they have less, as the SCITEC meeting demonstrated" (Dotto, 1973. SCITEC: still groping in search of a role?).

Science and technology development are central elements of the Canadian economy and as such, play a defining role in Canada as a modern society, and are crucial instruments in the organization of power and prosperity in Canada. Past studies on the conflict between the science and political fields notes that the charge of “anti-science” recently leveled against the Harper government gained wide-spread dissemination in the 1990s when various strains of critical thought associated with postmodernism, the sociology of scientific knowledge, and social studies of science and technology were accused of hostility toward the scientific method and scientific knowledge, serving to undermine the validity of the scientific approach (Amend and Barney, 2016; Ashman and Baringer, 2001; Ross 1996; Segerstrale 2000; Sokal and Bricmont, 1998). However, as we see in the debate over science policy in the *Science Forum*, this accusation was

already present in the early 1970s when agents from the science field used the "anti-science" trope to oppose political authority in the controversy over the building of a national science policy in Canada.

A study by Kahan (2014) notes that the use of the "anti-science" trope to discredit another's beliefs serves to produce a polarization of views that may not otherwise exist. This trope appears to be a common thread among the past and present controversies on science policy. Agents from the science and science journalism fields have used the "anti-science" trope effectively as a means to mobilize opposition in both sets of controversies. Chris Turner, in his book the *War on Science*, observed that for the Harper government, "…the purpose of research – of science generally – is to create opportunities for industry, and the purpose of government is to assist in that process in whatever way it can" (Turner, 2013). I would argue the same perception appears during the 1970s when the Trudeau (senior's) government was in power.

Then, as now, scientific knowledge is presented by agents in the science and science journalism fields as somehow above and beyond politics. As well, its practitioners are lauded as a rational group of players who are free of political implication (Amend and Barney, 2016; Turner, 2013). This view of scientists today is one that has persisted from the 1970s as witnessed by the statements captured in the *Science Forum*.

The views of scientists and science journalists in the 1970s as seen through the opinion statements captured from the *Science Forum* show that the steps taken by the Harper government and the 'muzzling' of scientists is less than revolutionary and more the completion of a long-term political goal to refocus scientific research away from basic or public science towards more short-term practical applications for economic gain as we can see from the debates on the national science policies and environmental policies in the *Science Forum* (Gibbons et al., 1994; Nowotny et al., 2001). Concern over government restrictions on the flow of information and on scientists from speaking to science journalists was also an issue that was addressed in the *Science Forum* in the 1970s. There is even evidence of government information release policies that may have served to 'muzzle' scientists in the 1970s in the *Science Forum*. Science journalist Jeff Carruthers commenting on an alleged silencing of scientists in the health protection branch notes that "The situation has deteriorated so much that scientists throughout the HPB [health protection branch] refuse to talk to the press, out of fear that they might

reveal something the minister's office might decide is 'policy'" (Carruthers, 1973. Political interference in the health protection branch).

The overall theme of bringing science and technology into conformity with the priorities of market ideology and capitalist industry did not start with Harper but began in the 1970s as evidenced by the controversies discussed in the *Science Forum*. Then as now, the government's predisposition was encouraged by a series of high-level assessments of science and technology sectors in this country. The Lamontagne report (1968-1977) for instance echoes the sentiments of the 2011 report of the Expert Panel on Federal Support to Research and Development (known as the Jenkins Report). The 2011 report mandated by the minister of state for science and technology set the agenda to continue rather than reconceive the federal role in science and technology in terms of business innovation and commercialization. It continued a tradition to transform agencies such as the NRC into an agency for the support of business R&D rather than basic science (Expert panel on Federal Support to Research and Development, 2011). Likewise, restructuring of research granting bodies that tie scientific research ever more closely to the priorities of industry and commerce began in the 1970s.

In the contemporary controversy, labeling the Harper government as "anti-science" is misleading. Ultimately, using an "anti-science" label may come at the expense of a more precise positioning of the Harper governments continuation to more closely align science with industrial development and commerce that arguable started in the 1970s.

Limitations and Future Work

Before concluding, it is worth briefly discussing some of the limits of this thesis. First, there were not many political opinion statements captured in both the historical and contemporary examples. This is likely due to a disinclination of policymakers to comment on controversial policy issues as well as the culture of secrecy surrounding the creation of science policy alluded to in both the historical as well as the contemporary examples. This, however, means that the results provide a limited exploration of the political field as related to the science and science journalism fields. Future research that explores additional political opinions is thereby warranted. Second, the strict methodological focus on science, science journalism and political fields meant that other (perhaps important)

fields were not included in the analysis. For example, upon assessment of the results, it appears that future work could include agents from the industrial field, adding opinion statements from private sector scientists and industrialists who had much to gain from the political move to shift funding and support away from public science to help the growth of private or applied science instead. Third, distinctions between agents from each field was more clear cut in the past controversies, making it easier to assign a particular agent to a specific field. Today, with scientists who also blog or report on science, there could be blurring of these lines in some instances. This is also true in the instances where former scientists joined government, making it difficult to tell in certain cases which field they may be representing when they comment on a controversy. Fourth, the presented analysis is likely uniquely tied to the examples explored and generalization from the results should be made with caution. Whether other topics support the conclusions presented here will also need to await further study. Lastly, the CSWA webpage used in this thesis only presents one particular archive of the 'muzzling' of scientists' example, and one that was removed in 2015. This means that certain links may no longer be publically available. Future work to reconstruct a wider sample of this contemporary controversy may bear additional insights into how the science, science journalism and political fields interact.

Conclusion

The examination of the two historical controversies in the *Science Forum* on national science policy and environmental policy as well as the contemporary controversy on the 'muzzling' of scientists found that:

1. Science journalists appear to be in alignment with scientists to oppose political power when an attempt is made to impose political authority over scientific autonomy by agents in the political field through the use of controversial science policies.
2. The contemporary controversy over the 'muzzling' of scientists can be better situated historically using the controversies on national science policy and environmental policy examined in the *Science Forum* as there are earlier instances of an observation of an information release policy and accusations of the 'muzzling' of government scientists in the 1970s in the *Science Forum*.

3. Science journalists are not in alliance with scientists on certain endeavours to resist political power as can be seen in the call for more funding for science and the push for more political involvement of scientists, which are agendas that may be spearheaded by scientists but are not broadly supported by science journalists.

The historical controversies examined in this thesis provide a historical genesis and context to the contemporary controversy investigated. One of the great contributions of Bourdieu's conceptual triad is its ability to understand society and its constituent parts in relational terms. Thus, rather than seeking to understand the field of science journalism in isolation, the triad allows us to conceptualize it and the actions of its players in relation to other fields and players.

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