Science Communications, Outreach, and Public Engagement

Government Science and Innovation in the New Normal Discussion Paper

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ABOUT GSINN – CANADA NEEDS A NEW RELATIONSHIP WITH SCIENCE AND INNOVATION THAT REFLECTS OUR TIME

In December 2020, the Institute on Governance launched Government Science and Innovation in the New Normal (GSINN), a multi-year, collaborative research initiative designed to explore the impact of the pandemic on federally-performed science and innovation, to support medium-term planning for federal science and innovation departments and agencies, and to provide insights to help rebuild the relationship between science and society.

Throughout the pandemic, anti-vaxxers – joined by anti-maskers – have challenged scientific evidence and public health officials with a mandate to keep us safe and stop the spread of the disease. This is just one example that demonstrates society's relationship with science is under strain.

But society's relationship with science and innovation did not decline overnight. The governance model that underpins Canada's relationship with science is based on a report called Science: The Endless Frontier (1945). This report outlined a basic compact in which society supports science with public funds and assures the scientific community a great deal of autonomy in exchange for the considerable but unpredictable benefits that can flow from the scientific enterprise.

Today, many of the underlying social, economic, and political assumptions in the postwar compact are outdated. This project examines the relationship between science and society and begins to imagine a new relationship, through nine specific themes:

- Equity, Diversity, and Inclusion;
- Global Research Collaboration and Infrastructure;
- Inclusive Innovation;
- Interdisciplinary Collaboration;
- Indigenous and Other Ways of Knowing;
- Mission-Driven Research and Innovation;
- Science Communications, Outreach, and Public Engagement;
- Skills and Knowledge; and,
- Trust, Integrity, and Science Ethics.

Taken together, these themes suggest elements of a new governance framework for science and innovation in Canada that embraces our current social, cultural and political realities, that recognizes the opportunities and limits of science. Perhaps most importantly, the project reinforces the role of science as part of society, and a tool ready to serve the needs of society.

Findings of the GSINN initiative were developed as a result of extensive research and engagement that included: a hindsight exercise, multiple foresight workshops, eight multisectoral roundtable discussions, and expert consultations that fed into this collection of 10 papers (one for each of the themes above and one capstone paper). Each discussion paper has been peer reviewed and explores a facet of how the relationship between government science, innovation, and society needs to be repaired in order to ensure science remains relevant in the new reality.

IOG extends its heartiest thanks to the eight federal departments and agencies that supported this work: Agriculture and Agri-Food Canada, Health Canada, Innovation, Science and Economic Development Canada, National Research Council, Natural Resources Canada, Public Health Agency of Canada, Public Services and Procurement Canada, and Transport Canada. We also wish to thank all of the individuals who participated in the workshops and roundtables whose input helped clarify and develop the project themes and findings. Finally, we want to acknowledge the following reviewers whose thoughtful feedback improved this paper: Ines Akué, Perry Boldt, Deanna Chan, Thomas Davis, Michelle Goldenberg, Aliza Rudner, Crofton Steers, Colleen Sutton, and Claire Zhou.

INTRODUCTION

The dawn and mass expansion of the internet has transformed society globally.

The creation of an online world has impacted every aspect of our lives; it has upended traditional power structures governing our countries, our business practices, how we socialize, and even how we enter romantic relationships. The internet has created a parallel universe – an alternate reality – in which many people have re-created themselves.

In the early days of the internet, there was much hope for the ways in which a digital world could democratize access to knowledge. Anyone would be able to create a web site and share their knowledge and perspective. Minority, non-conformist voices would have a say.

Fast forward to 2022 and our society is grappling with tensions between our real and digital world: the rise of a few private companies has formed a digital oligarchy that is larger and more powerful than many nation states; the increasing spread of mis- and dis-information is challenging people of all ages, races, and an online world comprised of a patchwork of legal authorities and regulation.

The scientific community is impacted by these tensions, like any other community; perhaps even more so because its relationship with society was already tenuous before the creation of the internet.

This paper will discuss why and how we communicate science, and how science communication has changed in the transition from Mode 1 to Mode 2 knowledge production. The paper will explore the parallel rise and function of public engagement and the implications for trust in science generally, and in government science specifically.

SCIENCE: A KNOWLEDGE SYSTEM HIDDEN FROM PLAIN VIEW

What is science? The term is often used interchangeably to refer to a systematic approach to producing new knowledge, a classification system for different types of knowledge (which can be further subclassified into disciplines such as chemistry, psychology, sociology, and physics), and a dominant element in the Western knowledge system. It is in this context which the paper discusses and uses the term science.

According to Miller and Munoz-Erickson (2018) knowledge systems are the organizational practices and routines that make, validate, communicate, and apply knowledge. Building on that definition, Mthembu (2020) explains that a knowledge system comprises many aspects within a sphere of influence, including social and cultural norms, ethical values, beliefs, and even technology. This implies that societies have differing and various ways of knowing.

Canadians live in a science-based society; our structures of government, our education systems, and our medical system are based on science. We privilege this type of knowledge above others. Science is differentiated by other types of knowledge in that anyone may become a scientist, provided they have access to and complete the necessary training, learn the normative behaviours (e.g., principles of research integrity), and model those behaviours in their own conduct.

As a body of knowledge, science is characterized by a process, a systematic series of steps which scientists take to produce and validate new knowledge. Science is not a static body of knowledge, but rather something that is constantly evolving. Thomas Kuhn (1996) described science as periods of normal science punctuated by periods of revolution. Normal science refers to times of consensus among members of a discipline or paradigm as to the validity of a body of knowledge. The revolutions occur as anomalies accumulate and knowledge, previously understood as valid, comes into question. In the context of new, emerging information, members of the scientific community will debate the validity of the knowledge in order to determine where a boundary may be drawn or redrawn to delineate the new knowledge, and create a new paradigm.

Kuhn's discussion does not consider the role of society in these periods of scientific revolution, nor the idea that a revolution can call into question the validity of the scientific process itself. But decades later, contemporary society finds itself in exactly this place. How did we get here? According to Thorpe (2020), the science-society relationship was at "a highwater mark" immediately after the Second World War. Since that time, science and society have drifted apart, or "become divorced" from each other (Douglas, 2021).

COVID19 PANDEMIC: A PERFECT COMMUNICATIONS STORM

The COVID19 pandemic has brought to the surface many of the underlying tensions between science and society that have existed for decades. Or, to extend Douglas' (2021) metaphor, the pandemic has brought the divorce to a watershed moment. For two years a new, aggressive, rapidly mutating virus has held the world captive while scientists have struggled to understand it and its origins, help citizens take steps to mitigate its spread, and then, agree to receive a vaccine created in record time. All the while trust in science and in government has fluctuated.

A human desire to help in a time of crisis has compelled many scientists to spring to action, to create Twitter accounts to share information, join committees, and to volunteer their time. It is a reasonable assumption that prior to the pandemic, many of those scientists had not received training in media relations or plain language communications. Early communications about the virus lacked clarity, plain language, and often did not put the critical information in context for the many publics that make up Canada. In addition, misaligned/varying interpretations of messaging across local, national and international jurisdictions created confusion for citizens and perpetuated the challenges of building/maintaining trust in science. Perhaps most importantly, many scientists who stepped up to help or onto social media applied their own social and ethical values to the scientific information they had to share. In doing so, they moved into offering science advice, and embedding their own risk assessment into their messages without understanding the impact of their own perceptions of risk for that of their audience(s).

Effective science communication requires the speaker to be aware of their own biases, skills, and limitations. Pielke Jr.(2007) describes the various approaches that scientists take when entering policy or politics in the form of the following four idealized roles (which for this discussion we are extending to public engagement and science communication).

- The pure scientist has no interest in the decision-making process of the other person and just wants to share facts.
- The science arbiter acts as a resource for the decision-maker, ready to answer their questions.
- The issue advocate works to convince the decision-maker to make a specific choice and ventures into telling the decision-maker what they ought to do, by making a case for that outcome.

- The honest broker provides a broad array of information and lets the decision-maker reduce his/her scope. The honest broker can be limited or comprehensive in their approach.

A fifth role that Pielke discusses is the stealth advocate, who presents themselves as either a pure scientist or honest broker, yet intentionally withholds certain types of information in order to steer the direction of the decision maker/audience.

In the early days of the pandemic, the voice of science was diverse, opinionated and often conflicting. With so many "experts" presenting evidence, or worse advice masked as evidence, how could regular citizens sift through mountains of information to make an informed decision. How could one deduce the intention of the communication, or the bias, to ensure the accuracy and applicability of the message provided? Add to this a crowded social media landscape in which people may or may not realize they are subject to algorithms, operating inside echo chambers, sorted into "online traps" (Dornan, 2021), and not protected from unlawful actors who actively seek to spread mis- and disinformation.

Has the COVID19 pandemic turned the science-society divorce into a Mexican standoff, where neither government, society nor science can walk away unscathed? Will we recover? Are scientists up to the task of earning the public's trust and affirming the legitimacy of their role? What role if any can communication and public engagement play in rebuilding trust in science? As any athlete knows, one cannot win a race and remain a champion without challenge. Science has held a privileged place in Canadian society since the end of the Second World War (almost 80 years). Achieving a place of privilege requires work both to win that race, and to maintain that place of privilege.

WHY SCIENCE COMMUNICATIONS?

Communication is the act of transmitting information from one person or group to another. Communication can be achieved through actions, language, sounds, and in writing. Science communication refers to the specific act of communicating scientific evidence or information from one group to another.

Effective communication is the ability to customize the transmission of information for the intended audience by using language, gestures, analogies, images, and sounds that are relevant to them. In two-way communication, effective communication also requires a response to the information provided. For example, communication to a group of new or expectant mothers about healthy diet and sleeping practices will require an approach very different than that of an automotive engineer explaining the internal workings of a combustion engine to a group of engineering students. Yet in both cases, a person with scientific information is transmitting information to a group that may or may not share the same level of scientific training. The individuals sharing the information may also have to take culture (e.g., language, ethnicity, religion, educational background) into consideration, depending on their context and biases as compared to those of the people with whom they are communicating. This adds an additional level of consideration. In his work, Berkowitz (2013) explores the power of narrative (story telling) as a means to traverse the cultural divide from those who have a science message to the rest of society; stories help present scientific information in a manner that is engaging and culturally meaningful.

Plain language science communications can bridge a cultural divide between scientists and non-scientists – whether policy makers or members of society – by creating a place of common understanding. For the purpose of this paper, the discussion will focus on two relationships: a) the relationship between science and policy which exists inside the federal government, and b) the relationship that science informs, between the public service and the people it serves.

PRINCIPLES OF SCIENCE COMMUNICATION

According to the U.S. National Academies (2017), there are five goals for science communication, namely to:

- Share recent findings,
- Increase public appreciation of science,
- Increase knowledge and understanding of science,
- Influence the opinions, policy preferences or behaviours of people, and

- Ensure that a diversity of perspectives about science held by different groups are considered when solutions to societal problems are pursued

Keohane et al (2014) present five principles for effective communication by scientists to policy makers. Considering GSINN's broader audience, the authors have adapted these by adding a sixth principle to consider discussion with a non-scientific audience, though the authors recognize that it is policy makers with whom government scientists are most often engaged, on behalf of society.

The six principles of effective science communication.

- **Honesty**: not lying or intentionally deceiving one's audience, as well as avoiding deliberately misleading incompleteness or manipulation of information to deceive.
- **Precision**: providing as precise as feasible or reasonable a description of scientific findings.
- **Audience relevance**: communicating clearly about issues that have implications for public policy in such a way that members of the intended audience can draw valid inferences for policy, programs, services, and advocacy.
- **Declaration of bias**: clearly declaring the context under which the knowledge was created, and by whom, in order to provide any additional, necessary situational information for the audience.
- **Process transparency**: providing a clear description of the scientific process of inference, and the process of peer review, in such a way that scientifically qualified members of the audience could check the validity of the conclusion for themselves.
- **Specification of uncertainty about conclusions**: providing a clear description of the scientific evidence available, the limitations of that evidence, and discussing the inferences that may be drawn from the information at hand. Discussing uncertainty can also be framed in the context of when new information may be available.

According to Keohane et al (2014), there are also an ethical imperative – respect – and an instrumental imperative – reciprocity – that underpin effective and ethical science communications. The ethical imperative requires that any member of any audience be treated with respect equal to that accorded to the set of people who are communicating the information, regardless of the level of scientific training of any party. The instrumental imperative is reciprocity, or the idea that any message delivered may be improved by the audience's reactions to that message in order to improve its clarity.

The limitation of Keohane et al.'s principles is that scientists are only able to employ all six – underpinned by both the ethical and instrumental imperatives – when they engage audiences using communications vehicles that permit two-way communication between parties. By design, one-way communication (such as a documentary or a poster) does not provide a means by which an audience member may provide feedback and have that feedback addressed by the party disseminating the message.

THE SCIENCE – POLICY RELATIONSHIP

For this paper, the term policy is used in the broadest context, to refer to the many tools that the public service has at its disposal – policies, programs, services, regulations and statutes – in order to deliver its mandate. Similarly, science is also used in a broad sense and may refer to any type of knowledge generated in disciplines that fall under the medical, social and natural scientific disciplines and engineering.

As Kinder (2013) discusses in his adaptation of C.P. Snow's famous lecture, science and policy are two very distinct cultures. In the Canadian government, they operate in different parts of the country, on different time horizons, they use very different language, and they serve different purposes. Yet, in the federal government science exists both to develop new knowledge meant to inform the work of the government and as a methodology of quality control to ensure the safety and health of Canadians.

Navigating these cultural differences, however, requires clear, effective, and principled science communications.

THE SCIENCE – SOCIETY RELATIONSHIP

The social contract between science and society, broadly speaking, requires mutual engagement and communication between those who conduct science and the rest of society. This is a critical aspect of the contract where both parties have struggled.

According to the terms of the social contract, society provides resources for the scientific enterprise (through public funding) in exchange for knowledge produced by the scientific enterprise that benefits society. Therein lies an ethical obligation for scientists to listen to democratic publics in order to address the challenges that society determines are important and relevant to the betterment of society. The social value of science depends on the ability of science to address challenges such as climate change and the United Nations Sustainable Development Goals that acknowledge those widely shared social values.

WHEN DOES SCIENCE ADVANCE PUBLIC POLICY AND DECISION MAKING?

In The Honest Broker, Roger Pielke, Jr. (2007) illustrates when science can and can't advance public policy and decision making. He has labelled the former Tornado Politics and the latter Abortion Politics. Instances of Tornado Politics are situations characterized by a) demand for a decision, b) when parties to the debate share a common goal and a common value system, and c) when including scientific information can help differentiate between viable solutions to a policy challenge or question.

According to Pielke, science does not have a role to play in what he calls Abortion Politics where there is a) demand for a decision, but b) parties to the decision do not share values. In such cases the parties must seek an approach to mediating the topic in question that will enable them to reconcile values and biases that underpin the decision at hand. For example, science can play a role in designing the optimal production, collection, and storage processes of grains and pulses but has little or no role to play to determine the number of silos a country builds in order to store a desired amount of food in reserve. Determining the right amount of grain to store in reserve is a political decision informed by the values of the community or country.

A PARADIGM SHIFT: FROM KNOWLEDGE TRANSMISSION TO ENGAGEMENT AND CO-CREATION

The push for greater outreach and engagement between science and society is part of a paradigm shift from one-way to two-way communication. Under one-way communication (as we see in Mode 1 knowledge production), Gibbons (CBC, 2010b) suggests that "science is on transmit and society (and industry) [are] expected to take from it…and use as appropriate." In such circumstances, there is no requirement on the part of scientists to ensure their messages are clear, relevant, or appropriate. There is no requirement on the part of the scientist to consider the intended audience, and the type of message that will be most appropriate. The assumption is that the appropriate audiences will receive the message and apply it accordingly.

With two-way communication (as demanded in Mode 2 knowledge production), society can engage with and challenge the scientific enterprise. Michael Gibbons suggests this democratic revolution from Mode 1 to Mode 2 has been taking place since the middle of the 20th century. In an ideal conceptualization of Mode 2 knowledge, society engages with science to discuss the challenges society faces, and science and society work collaboratively on those challenges. In reality, the transition from Mode 1 to Mode 2 knowledge production has not been smooth.

During this transition (which Gibbons suggests has been taking place since the second half of the twentieth century), there has not been a consistent change in the manner in which scientists are trained to prepare them for non-technical audiences that engage with or challenge their work. Nor has there been a broad shift in the culture of science to acknowledge the biases that exist in the scientific enterprise in order to encourage scientists to think about and prepare for how they will work with policy makers or society, per Pielke's idealized roles. (For more on these tensions, see GSINN Skills and Knowledge.)

Canada's first national science and technology policy, Innovaction, introduced in 1988, was the first political platform designed to actively "harness the power of science and technology" for economic and industrial benefits. The message of this policy was clear, Canadian scientists would no longer exclusively pursue knowledge "wherever it leads" (CBC, 2010a) with applications to follow (or not). Instead, objectives would be tied to government funding for research and development. This shift included the announcement of the creation of the Networks of Centres of Excellence and paved the way for encouraging active participation in the conduct of research and the lobbying for specific objectives on the part of civil society, the non-profit sector, the private sector, and academia.

As science was being "harnessed" for economic benefit, science was, increasingly, becoming the focus of social crises such as the tainted blood scandal and the collapse of the cod fisheries. Scientists in Canada were not alone; negative societal reactions in the UK to bovine spongiform encephalopathy (BSE or Mad Cow Disease), the cloning of Dolly the sheep, and the introduction of genetically modified foods had perpetuated a crisis of confidence in science.

In response, the House of Lords (2000) undertook a study to examine the relationship between science and society. The report called for a shift of emphasis from public awareness of science to public understanding of science. Looking back, this report become one of the early calls for science to (re)engage society in its work, and initiated a trend towards outreach and public engagement in policy making, including in science policy.

In practice, this involved reconceptualizing science outreach from the deficit model to one of engagement and co-creation. The deficit model conceptualizes a lay person's mind as "an empty bucket into which…science can be poured" (Gregory and Miller, 1998, p.89). The deficit model also assumes that the public is a uniform group that "passively awaits information", rather than a variety of nuanced groups – or publics – who may have active and differing relations with science. (Marks, 2009, p.2) Many studies have shown the deficit model approach has not led to greater support of science Indeed, countries that have greater scientific knowledge are not necessarily more positive about science. (Marks, 2009).

In 1964, Marshall McLuhan famously declared the medium is the message, arguing that a message and the manner in which it is delivered are equally powerful. Modern day communication provides us with many more communications vehicles than were available in 1964, and a greater onus on the part of the communicator to consider not just the words we use, but the manner in which we share the message. We also now live in a perpetual state that includes both Mode 1 and Mode 2 knowledge production. As such, communicators must be clear in their intentions: are they engaging their audience in the creation of a message or are they disseminating a final product? An effective communicator must ask themselves all of these questions in the creation of a message, and act according to their intended impact.

MULTIPLE APPROACHES TO PUBLIC ENGAGEMENT AND OUTREACH

Public or stakeholder engagement is a process of working collaboratively with and through groups to address issues that affect a community. For the purpose of this discussion a community may be one united by a common purpose (e.g. people who fish for cod professionally) or refer to a distinct geographic area (the community that lives around the nuclear power plant on Bruce Peninsula). In a public sector context, public engagement is generally used to inform or improve policies, programs, practices, products and services.

Engagement, appropriately timed and designed enables decision makers to explore a challenge and co-create solutions with the impacted audience. Engagement can also lead to greater support for decisions, save time and money, create a sense of ownership among groups consulted, and improve trust between the group consulted and the group leading the consultation. (Armstrong and Patey, 2019)

The following figure presents engagement mapped on two axes: stages of engagement refer to the stage in the policy or product cycle in which the engagement takes place (see Figure 1). The spectrum of engagement refers to the degree of transparency introduced in the engagement process. Transparency can be measured by the degree to which participants in the engagement practice are aware of their collaborators, and their role in informing a path forward. There are legitimate reasons for a lack of transparency in an engagement activity: to protect the identity of participants, or to discretely manage sensitive information. But, increasingly, a lack of transparency is perceived as a need for control on the part of the party leading the engagement, and a lack of trust between parties and or in the process whereby those who administer the tool may control the outcome. Other factors to consider in selecting a mechanism for engagement is: preferred method of communication for the audience being engaged, access to technology, digital literacy, document use, time, and impact on the long-term relationship with this stakeholder group.

Figure 1: Stages of the policy / product cycle

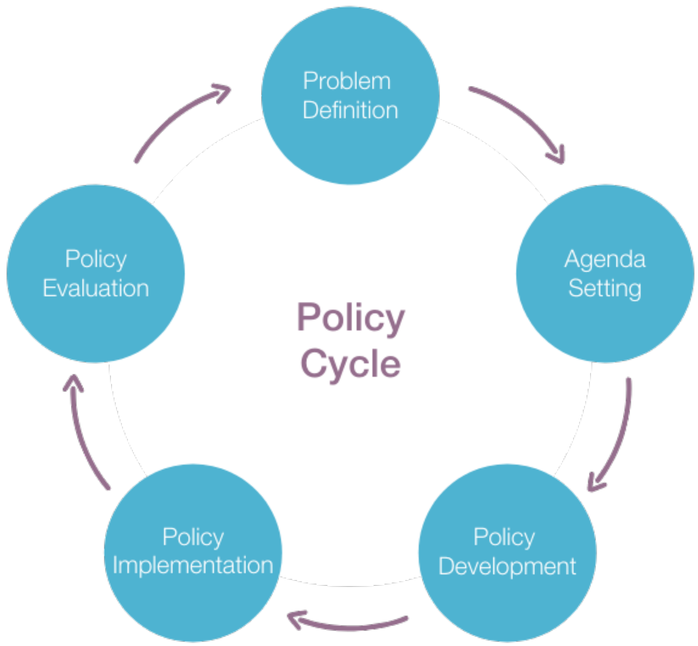
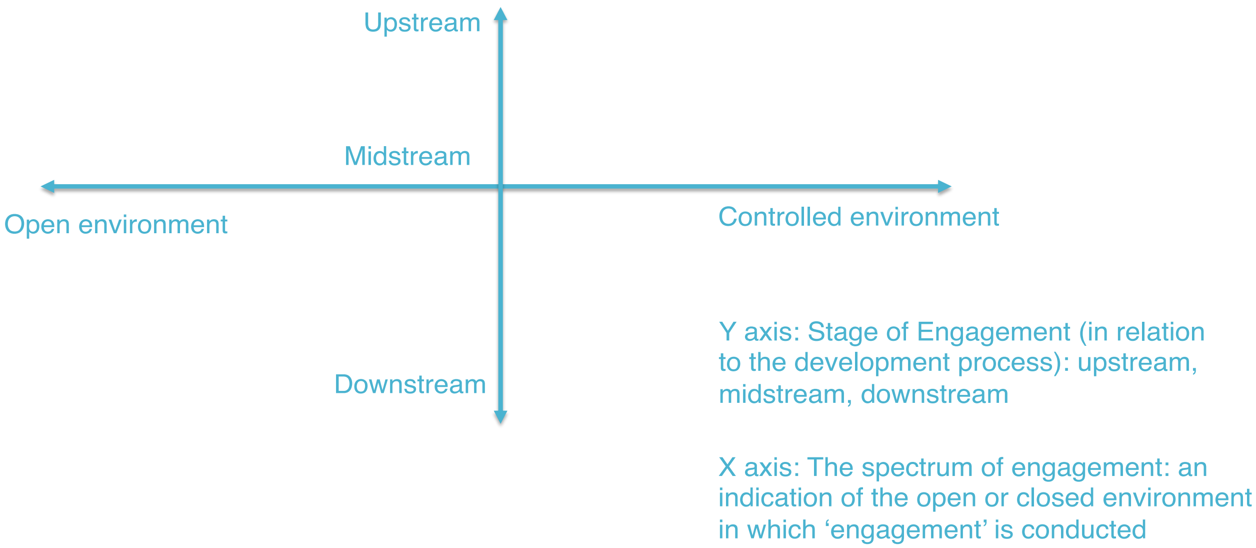


Figure 2: Stages and spectrum of engagement



- **Upstream engagement** is "an opportunity for social values to be disclosed, debated and consciously incorporated into technological development before particular trajectories and attitudes become set" (Delgado et al. 2011, p.835). It is a chance – at the problem definition or agenda setting stage in policy making – to have a different kind of conversation (e.g., rather than engaging about accepting or rejecting GM crops, one can ask about the best way of ensuring food security). Sometimes referred to as anticipatory engagement, it can offer an opportunity to engage publics on the acceptability of a new and emerging type of science. (Delgado et al, 2011)
- **Midstream engagement** is engagement at the stage of laboratory research, or during policy development or implementation
- **Downstream engagement** occurs at the stage of application development, products and commercialisation, and in a policy context, at the stage of policy evaluation.

Two other types of engagement not listed in the table are: **reactionary engagement**, which happens in real time, as a controversy is unfolding (during the policy implementation stage); and, **reflective engagement**, which occurs after a controversy has subsided, or after a period of time (during the evaluation stage of the public policy cycle). This may be intentional as new scientific methods become available.

In the context of engaging society in the future direction of science, Brian Wynne (2006, p.19) argues that public engagement should actually be about the "interests, purposes and expectations" driving research. Engagement should enable "constructive negotiation of possible alternatives, multiple trajectories, and different technologies, including of different social ends" (p.218).

Wynne (2006) – among others – draw parallels between engagement in science and transparency and authority in knowledge production. Authentic engagement, especially in the early stages, can have the greatest influence on future research trajectories, yet this is the least common type of engagement activity, for exactly the reasons that Wynne illustrates. The scientific enterprise has developed an elaborate process for creating and establishing knowledge in specific places, such as laboratories. These places are imbued with culture, process, and hierarchy away from public scrutiny (Knorr Cetina, 1995). This elitist process is reinforced by an education system where only those with access to highly specialized education and training may become a scientist and further this knowledge system and the type of knowledge it produces. Wholly embracing upstream engagement – with non-technical individuals – opens the black box of scientific knowledge production in the name of trust, transparency, and accountability and risks taking part of this process out of the hands of scientists to co-create the questions that science must pursue and the manner in which science pursues those questions, with society.

Yet, Egan (2012) argues scientists have a social responsibility to the public. Egan (2012) quoting Barry Commoner says "science policy is a social conversation, not a scientific one" that seeks to understand scientific implications and find a level of social acceptance of those findings in order to advance society. This is the moral imperative for co-creation, that is implicit in upholding the postwar social contract between science and society.

CITIZEN SCIENCE AND OPEN SCIENCE

Within the broader transformation of the public policy enterprise to embrace engagement, scientists have found unique ways to engage society in their work. Citizen science involves engaging lay people in the collection of scientific information and conduct of scientific research. Open science is a move to make data, publications, and other scientific artefacts available to anyone.

Are citizen science and open science forms of engagement? In the strictest sense, both practices offer a means for society to become more involved in science by, for example, counting butterflies, making meteorological observations or reading articles. However, these mechanisms still require scientists to think strategically[1] about their approach to collaboration with non-scientists and to

[1] Open science and citizen science initiatives that seek to engage society in science must also be cognizant of unlawful actors who seek to commit espionage through these avenues. The Government of Canada has recently introduced measures to counter this trend.

modify their behaviour according to their ideal role, and disclose their biases. In order for both practices to be authentic engagement, both citizen science and open science must provide means for society to be active in the ideation stages of the scientific process and contributing to data collection. Ideally, mechanisms would also provide for society to be involved in a discussion of the findings and their application. Without careful consideration for ways that society can be involved, citizen science and open science may present the appearance of outreach or engagement activities that seek to involve society, but in reality, maintain a careful division of tasks where the authority to determine what questions to ask and how to answer them, rests with the scientist, reinforcing a hierarchy in the pursuit of knowledge.

SCIENCE IS NOT A MONOLITH AND NEITHER IS COMMUNICATIONS

A common criticism from among the scientific community is the expectation that they must do it all, referring to growing demands for scientists to be many things: to conduct research, to teach, to provide science advice, to be excellent communicators, etc. Gluckman (2018) begins to unpack the many hats of scientists by identifying four types of scientists that are emerging along the science-policy spectrum. If we consider public engagement – distinct of science communications – as a means to open the black box of science and rebuild the relationship between (government) science and society, we find that three of these roles can contribute in a unique way. They are presented here for further consideration.

- **Knowledge generator**: scientists and researchers who generate new knowledge. These individuals work in the lab or the field and do not engage with policy analysts. These individuals are well suited for citizen science activities as their skill set requires the ability to posit questions, and collect data to create collections. Working with society through citizen science initiatives would require workplace training in cross-cultural communications and plain language communication when working with different publics.
- **Knowledge synthesizer:** individuals or teams who aggregate knowledge in order to determine the significance of the knowledge or what it means. This role is instrumental in the translation of science and evidence for policy (including evidence from public engagement activities). This role does not work directly with society or policy.
- **Knowledge broker**: individuals who translate scientific findings for the benefit of policy makers, political officials, and members of society. These individuals regularly interface with

policy analysts. These individuals are well suited for science communication activities for both Mode 1 and Mode 2 knowledge transmission as they have a highly developed sense of appropriate communication in different contexts, strong plain language skills, and an ability to broker knowledge in different contexts.

- **Policy evaluation**: individuals or teams performing this role review the outputs or results of programs, services or policy decisions to measure the extent to which they achieved their intended purpose. In the context of the Government of Canada, these individuals are often found in RSA (related science activity) functions, regulatory roles, or embedded in evaluation teams. These individuals could we be well suited for reflexive or downstream engagement activities, if provided with the necessary social and emotional skills training to integrate findings from engagement alongside other types of evaluation material when reviewing whether policy decisions achieved their intended purpose.

As discussed in Skills and Knowledge, normalizing these four types of scientists – acknowledging their different functions, skill and knowledge requirements – requires a new reward structure (or structures). The default 'publish or perish' environment in which scientist are currently enculturated does not normalize social and emotional skills development, nor reward communication, public engagement, and outreach activities

FINDINGS FROM THE IOG ROUNDTABLE DISCUSSIONS

In April 2021, the Institute on Governance hosted a half-day workshop on Science Communications, Outreach and Public Engagement. Subject matter experts from eight federal departments—Agriculture and Agri-Food, Health, Innovation, Science and Economic Development, National Research Council, Natural Resources, Public Health Agency, Public Services and Procurement, and Transport— participated in the discussion. The workshop employed the seven-question foresight methodology to explore this topic. In March 2022, the IOG hosted a multisectoral roundtable with partners of the above listed departments to discuss this topic in the context of relationships with federal departments. What follows are themes and ideas that resulted from those conversations.

What we can learn from risk communications. Scientific methodologies, engagement and outreach can be immensely powerful tools. We could look to the area of risk communication in public engagement as a prime example for improving transparency in science communications. The risk communications 'playbook' is tried and true, has been field tested many times, and the methodology has been honed over many years. The principles are established and effective:

- Communicate early and often.
- Stick to what you know and don't speculate.
- Be honest about what you're saying and what you don't know.
- Don't try to calm people down by giving them false hope.

In a crisis situation, the natural reaction from a communication perspective tends to be to try to mollify that audience to calm them down. Instead, science communicators should aim to engage their audiences frequently over an extended period. Rather than mollifying negative reactions, engage them to fuel dialogue to create understanding.

Risk communication also teaches us that if we prime people in particular ways – based on the information we provide to them – communications can unknowingly contribute to a kind of false anchoring. During the pandemic, reputable web sites devoted resources to dispelling myths with strong declarative statements, rather than presenting facts and sources. In those instances, it was difficult to see the corrective information. The risk in these practices is that people will form memories based on the myths. Moments such as these require quick course corrections, especially during a highly evolving situation such as COVID-19.

Long-term engagement, managing in periods of high uncertainty. At various times during the pandemic, public opinion polls confirmed that Canadians had a high degree of trust in federal and provincial science-based institutions. But as the pandemic continues with no end in sight, Canadians' engagement levels in information about the pandemic is waning and personal preferences are overtaking a desire to follow public health directives. Many people are now operating as if the pandemic is over. And it now seems that governments aren't actively managing their pandemic communications any longer. Are we losing public communications on the pandemic? For those individuals who are still engaged and understand the pandemic is not over, the question remains: where are they getting reputable information? Since March 2020, all levels of government in Canada have been telling citizens to follow the scientific evidence that governments are providing to them. But now, the scientific evidence is hard to find, and sometimes harder to understand. Who is taking ownership and responsibility for communication to Canadians?

A call for reasoned transparency. When we think about the current noisy communications and information environment, when governments put information out for public consumption there needs to be a lot more done around how the information is made accessible and digestible. It can be difficult to find information within specific agency websites. Additionally, the information provided is not particularly useful to help people answer specific questions. Some information should be readily available and easy to access to respond to the public's general questions. Some stakeholders remarked that Evidence for Democracy has produced interesting and insightful research on the topic of transparency. Transparency is not just this monolith, there are many different channels for transparency: open science and open data are specific examples. But these should not be intended to be for the broader public. Typically, open science and open data should be for the research community. Data dumping – simply making information available without tools or context – does not provide value to the public. Information that is available but not accessible contributes to the erosion of trust between government scientists and the society they are meant to serve. Stakeholders called for reasoned transparency, defined as synthesizing key ideas in a clear way) vs 'fishbowl' transparency (akin to the data dump of look for the needle in that proverbial haystack).

There is no such thing as a 'scoop' anymore. Seasoned journalists and communicators whose career predate the internet and social media recall the rush of a scoop, defined in journalistic terms as the desire to be the first person to receive and produce a news article on a particular topic. Being the first was known as "getting the scoop". The advent of the internet has created a massive database for us all to search, anytime. It has blown open the gatekeeping role of traditional media outlets which curated a body of news based on a defined set of social values. Now, anyone can publish anything they like. In addition to the problems of misinformation and disinformation, the internet is changing how we share, store, and access information. And as such, we might consider that all our communications are chapters in a story that will continue throughout our career. We are no longer seeking scoops, we are writing chapters.

DISCUSSION AND QUESTIONS FOR FURTHER RESEARCH

- How do we encourage science communication activities that move beyond the scientific community and its supporters talking to each other towards activities that engage those who are science hesitant?
- What is the role of science communications to demonstrate uncertainty, humility and the limits of our knowledge and understanding?
- Are scientists up to the task of earning the public's trust and affirming the legitimacy of their role? What role if any can communication and public engagement play in rebuilding trust in science?
- Should all scientists share a responsibility for communicating science or should it be left to what Gluckman calls knowledge brokers?
- How should science communication practices evolve in times of crises, like the COVID19 pandemic?
- How can citizen science, open science, community-based research, inclusive innovation and other participatory approaches change public engagement and the co-production of knowledge?
- Could engagement and outreach – as scientific methodologies rather than communications tools – offer a means to improve the science-society relationship?

GLOSSARY

Mode 1 knowledge production is discipline-based, validated by a community of specialists; Mode 1 distinguishes between what is fundamental and what is applied. (Gibbons et al, 1994)

Mode 2 knowledge production is transdisciplinary, not monodisciplinary. It is carried out in non-hierarchical, heterogeneously organized, transient forms. Mode 2 knowledge production involves close interaction of many actors through the process of knowledge production, making it more socially accountable. In mode 2 knowledge production, the process becomes more reflexive. (Gibbons et al, 1994)

Science: Systematized knowledge derived from observation, analysis, and experimentation carried on to determine the nature or principles of what is being studied; a branch of knowledge or study, especially one concerned with establishing and systematizing facts, principles, and methods, as by experiments and hypotheses. Sometimes "Science" is used to denote natural sciences, to the exclusion of the social sciences and humanities (SSH); however, in its broadest interpretation it encompasses all disciplines of academic knowledge and both quantitative and qualitative methods. (OECD, 2021)

Western knowledge: This term includes countries or regions where the administrative powers are operated by "settler governments" (Blue et al, 2013), established by European settler colonial societies which attempted to gain control over Indigenous lands. These countries – such as Australia, Canada, New Zealand and the United States – share "common **Western knowledge** histories and […] contemporary issues among Indigenous populations and settler colonialists" (Paul, 2014), that continue to inform much of their operations. These countries are linked by philosophies, epistemologies, capital, migration, governmental alliances, and accommodation by Indigenous People(s) (Blue et al., 2013). Their people, economies, and historical processes are intertwined. It is through this lens that we define science (as a practice and a way of knowing), and the Canadian context which refers to the definitions, methodologies, and constructions of science as established by the settler-colonial society of Canada.

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