Objectives

Faced with growing complexity, policy-makers increasingly rely on scientific research to inform public policy in such complex, technical domains as energy, the environment, transportation, agriculture, food safety, fisheries, communication and health. In such policy domains, characterized by risk and uncertainty, citizens and policy-makers rarely possess the qualifications to inform their policy preferences with direct knowledge. Instead, they must rely on research and risk assessments developed by scientists who possess advanced qualifications in disciplines of the natural sciences. In some areas, scientific knowledge is consensual, thus having the potential to inform policy debate straightforwardly. In others, however, scientific disagreement can increase uncertainty in the policy-making process. Perceptions of risk, of scientific consensus, and of scientific debate, are thus important elements in the development of public policy. Under what conditions do lay individuals perceive consensual rather than controversial scientific knowledge claims? Do perceptions of consensus and controversy reflect the actual state of scientific knowledge? How do non-scientists judge the credibility of scientific expertise? Are the factors shaping citizen perceptions the same as those shaping the views of policy-makers? How might these processes affect scientists themselves?

By providing answers to these questions, this research project pursues three primary objectives: 1) to shed light on the way scientific knowledge in key policy areas is interpreted by government decision-makers and members of the general public; 2) to contribute to a growing body of scholarly work on the role of science in policy, and; 3) to raise awareness of the processes through which certain scientific knowledge claims are taken as true, with a view to improving the quality of Canadian governance. As scientific knowledge plays a growing role in policy decisions, answers to these questions are fundamental. In a healthy democracy, the opinions of citizens are expected to play a role in policy-making, even in technical domains. Therefore, the way in which citizens interpret scientific knowledge and judge expert credibility are crucial to understanding how democracy works. Similarly, the process by which policy-makers choose among competing scientific knowledge claims will have significant implications for policy agendas, political programmes, and their efficacy. In fact, policy-makers who accord too much or too little credibility to given scientists may under- or over-estimate risks.

Context

The questions asked in this project are inspired by work in social psychology, as are several important hypotheses to be tested. Social psychologists have developed an important literature on opinion formation and building on this have produced a significant amount of research on risk perception. In particular, three key insights from this literature are important for the proposed research.

1) This literature provides explanations of the gap between real risks and the lay public's perception of risk. It has addressed a large number of factors, emancipating itself from the simple notion that lay individuals lack a proper understanding of science. The factors shaping risk perception include novelty and dread (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978), feelings (Slovic et al., 2004), images (Slovic et al., 1991), trust (Brossard & Nisbet, 2006), the media (Combs & Slovic, 1979), the proximity of risks (Graham et al., 1999), the types of risks (de Zwart et al. 2009), worldviews (Seigrist et al., 2000) and the social context (Frewer et al., 1998). Regardless of the factor invoked, each seeks to explain biases in risk perception.

2) This literature assumes that scientists form their opinions in ways that are fundamentally different than the public (Bickerstaff, 2004). Scientists rely on analysis while affect (intuition and emotion) is thought to play a more prominent role among lay individuals. To be sure, some have questioned the assumption that analysis produces more accurate assessments of risk than the lay public's intuition (Epstein, 1994). Slovic et al. (2004), for example, reject the dichotomy between analysis and affect as two opposed ways of approaching risk. Not only do they argue that affect and analysis interact in any approach toward risk assessment, they also claim that it is misleading to consider analysis as a rational approach and affect as an irrational one: rationality is present in both (for example, it may be

rational to rely on affect to "navigate quickly and efficiently through a complex, uncertain, and sometimes dangerous world" (Slovic et al., 2004: 213)). This body of research nevertheless assumes some differences between scientists and the lay public in the way they form perceptions of risk, if only because analysis requires qualifications in a scientific discipline.

3) This literature originally focused on individual-based psychological factors, but has increasingly acknowledged the importance of social context (Frewer et al., 1998; Bickerstaff, 2004). It is now widely accepted that biased perception of risk among the lay public varies according to the social context in which they are embedded. Victims of social injustices, for example, are found to be more sensitive than non-victims to risk (Satterfield et al., 2004). Socially constructed worldviews have also been credited with creating distinctive biases in risk perception (Siegrist, 1999). In short, this body of research increasingly emphasizes the larger social context in the perception of risk.

These three insights motivate the questions in this project. If risk perceptions are biased, perceptions of scientific knowledge claims and expert credibility are also likely to be biased. If scientists form their opinion of risk in a manner that is different from the lay public, the same might also be true of the way scientists judge the credibility of their peers. And if context matters, the political context in which policy-makers are immersed must also affect the manner in which they judge and use science.

To be sure, social psychology is increasingly influential in political science. Insight into the factors biasing perception has been incorporated into models of policy-making (Leach et al., 2005; Sabatier et al., 1993; 1999). In turn, political science has made a significant contribution to social psychology by refining the understanding of socio-political factors that bias perceptions of science and its policy role. Researchers interested in socio-political factors have notably drawn on the work of Douglas & Wildavsky (1982) who argued a long time ago that risk perception depends on idealized ways of life. Following this perspective, it is believed that individuals who idealize individual freedom, for example, are likely to discard risks whose acceptance by government might encourage the adoption of constraining regulations. In contrast, individuals who believe that government must protect the community worry more about risks. Douglas & Wildavsky's argument fits nicely into a social psychology that has become more accepting of the importance of the socio-political context (Kahan & Braman, 2006).

The proposed research project will test the hypothesis that political beliefs influence public perceptions of the level of scientific debate on a range of carefully selected Canadian policy issues. It will also examine the influence of these political beliefs on the assessment of particular scientific knowledge claims, which are used by non-scientists to inform their policy preferences on highly complex, technical issues. Unlike previous research conducted outside Canada (e.g. Kahan et al. 2010), this research will examine whether the effect of political beliefs extend to decision-makers. Policy-makers are no more likely than ordinary citizens to possess scientific qualifications that would enable them to form their policy preferences directly, without the mediation of scientific expertise. Moreover, policy-makers are likely to hold political beliefs with even greater conviction than ordinary citizens, suggesting that the influence of such views on the perception of scientific consensus and credibility will be larger. While previous studies have shown that particular policy processes are selective in their use of scientific research (Jenkins-Smith, 1990; Jasanoff, 1990; Harrison, 2002; Montpetit, 2005; Renn, 1995; Sabatier & Zafonte, 2001; Weible, 2008), this research goes further, and explores the cognitive, individual level factors that contribute to the biased use of science in public policy.

As the primary research questions guiding this project suggest, this research will also examine the impact of political beliefs on scientists. Few political scientists have ventured into such an investigation, although several assume that scientists form their opinions in a manner that is not entirely distinctive. As Guston (2006: 381) writes, "Scientific views are thus compelled by many of the same elements as are political opinions". The only empirical tests (of which we are aware) looking at the role of political beliefs among scientists were conducted by Carol Silva et al. (2007). In a recent study of radiation risks,

they show that, consistent with the precautionary principle, scientists recommend a level of regulation that is often more stringent than what the accepted state of scientific knowledge would suggest is appropriate. This gap between scientific knowledge and scientific policy advice is explained by extra scientific factors, including scientists' beliefs in the primacy of social equality (henceforth egalitarian) over beliefs in the importance of individual responsibility (henceforth individualist). The proposed project extends this kind of analysis to a series of other salient issues on the Canadian policy agenda.

The proposed research follows from the past and current research interests of both the applicant and co-applicant. More than 10 years ago, the applicant undertook considerable research on the difficulties of democratic legitimacy in a domain, biotechnology, in which technical expertise is required for policy-making (Montpetit, 2003b; 2003c; 2005; Montpetit et al., 2004; Montpetit & Rouillard, 2008; Montpetit et al., 2005; Montpetit et al., 2007; Paré & Montpetit, 2009). Over the years, this research has begun to focus more on policy-making roles among actors, notably scientists (Montpetit 2008; 2009; 2011; forthcoming; Montpetit & Sheingate 2008). This latter research on policy actors increased the applicant's familiarity with the literature on the relationship between science and policy, with the work of Hank Jenkins-Smith, Dan Kahan & Carol Silva becoming particularly influential on his thinking. This research also builds nicely on the co-applicant's work on climate change (Lachapelle, 2010) and public opinion on climate related issues (Borick, Lachapelle et al. 2011), which examines the cleavage between expert policy advice, on the one hand, and responses from politicians and the public, on the other. One year ago, the applicant suggested to the co-applicant that they adapt a survey experiment on political beliefs and scientific consensus, originally designed by Kahan et al. (2010), and administer a similar instrument to political science students in their respective classes. A small institutional SSHRC grant supported this experiment, allowing the researchers to bring substantial modifications to the issues examined in the survey as well as to the measurement items used. The final results were presented at academic and public conferences and drew substantial interest from Canadian policy-makers and the media (see the knowledge mobilization plan). The logical next step is for the researchers to extend their project to a broader, more representative sample of the Canadian public, decision-makers, and scientific experts, and to include a wider range of issues. In addition to building on and refining conclusions gained from an important body of literature, the project will extend insights to a new population and issue domains, and test several original hypotheses, thus promising to contribute considerable knowledge and experience on measurement instruments, public perception of science, policy-makers' use of science, and on the translation by scientists of scientific knowledge into policy advice.

Methodology

The proposed research will analyze new data to be collected from three surveys: an Internet survey experiment of lay Canadians, an Internet survey of scientists, and a face-to-face survey of Canadian legislators. All three surveys will deal with identical policy issues, each requiring information inputs from the natural sciences. The issues selected are primarily environmental (corresponding to one of SSHRC's priority areas of research) and were chosen based on their strategic importance for Canada, as well as for their distinctive traits. In fact, the robustness of the findings will depend on the diversity of issues included in the surveys, as consistent results across a set of clearly distinctive issues will allow the research to more accurately ascertain the role of political beliefs on individual perceptions of science.

The preliminary investigation conducted among students examined six issues: climate change, shale gas, wind turbines, cell phones, tobacco use and genetically modified cultivars. In this project, we add two other issue domains: pesticide use and oil sands. The survey material for the first six issues is already prepared and was successfully pretested with student respondents in the academic year 2010-2011. Each issue is either high on the public agenda or is economically important for Canada. Each is also associated with a number of risks, including extreme weather, water contamination, nausea and migraines, cancer and threats to biodiversity. Moreover, knowledge of the risks associated with each issue varies. The risks of lung cancer associated with the use of tobacco, for example, are better known

than the risks of brain cancer associated with the use of cellular technology. In addition, disagreements over the risks associated with some of these issues follow well-known cleavages, while disagreements on other issues do not. For instance, opponents of genetically modified organisms frequently have left-leaning political beliefs while proponents frequently belong to the right. As smoking and cell phone use are just as prevalent on the right as on the left, disagreements about risk do not so obviously follow this left/right cleavage. Meanwhile, wind turbines are frequently supported by individuals holding left-leaning political beliefs, and therefore it will be important to see whether concerns over risk posed by this technology are also held by egalitarians.

In order to test the primary hypotheses, each of the three surveys will measure the political beliefs of respondents. In the American literature, political beliefs are measured using levels of agreement with two sets of statements, one that positions respondents on a disparity/equality belief scale and one on an individual/community belief scale (Silva et al., 2007). Examples of statements relevant for each scale are presented in Box 1 (not all reproduced here to conserve space). The statements used in the American literature were pretested with Canadian political science students and worked well. In fact, they performed in a manner similar to questions for left/right positioning used in the Canadian Elections Study. In light of some controversy over traditional measures (Schuman & Presser 1996), however, we plan to add original forced-choice questions in addition to the others, in order to test the reliability of various measures, and to publish a paper on the measurement of both egalitarian/individualist and left/right cleavages in cross-national (and cross-cultural) perspectives.

Box 1: Statements on beliefs about disparity, equality, individuals and community

Disparity: We have gone too far in pushing equal rights in this country.
Equality: Our society would be better off if the distribution of wealth was more equal.
Individuals: The government interferes far too much in our everyday lives.
Community: The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals.

Each of the three surveys will also question respondents on the level of agreement among scientists on the risks associated with the selected issues. Respondents will be presented with a statement, that using cell phones increases the risk of developing brain cancer for example, and will be asked whether they think that most scientists agree, most scientists disagree or scientists are divided in their views. We hypothesize that relative to individualists, egalitarians are more likely to answer that most scientists agree when the statement suggests that risks are high (e.g. cell phone use causes brain cancer). Conversely, relative to egalitarians, individualists are more likely to answer that most scientists agree when the statement suggests that risks are low (e.g. genetically modified organisms are safe for human consumption). We hypothesize further that the same pattern will be found among our sample of policy-makers. Responses from scientists on these questions will be helpful in determining actual levels of scientific consensus and debate.

Each of the three surveys will also include questions to control for respondents' views of science and scientific progress, level of scientific literacy, aversion to risk, emotion, level of social trust, relationship to each of the issues, in addition to standard socio-demographic characteristics.

The opinion surveys, as well as the survey of scientists, will include an additional experimental component inspired by Kahan et al. (2010), which has already been pretested with students at the University of Montreal in 2010/2011. The experiment involves presenting respondents with identical scientific profiles (top section of Box 2), accompanied with a low risk opinion for half of the sample and a high risk opinion for the other half (bottom section of Box 2). The two groups of respondents will then be asked to assess the credibility of the scientist. If political beliefs are unrelated to judging credibility, only the scientific qualifications highlighted in the profiles will influence perceptions that a particular author is a trustworthy expert on the issue. Conversely, if political beliefs matter, perceptions of scientific credibility among respondents will vary depending on one's political predispositions, and whether they are exposed to the high or the low risk opinion. We hypothesize that egalitarians, for

example, are more likely than individualists to judge an expert as being highly credible when the expert offers a high risk opinion on the issue. The analytical component will then test this hypothesis using correlation and ordered logit regression, among other techniques, to measure gaps and biases in perceptions of science among scientists and the public. The survey will be conducted by a commercial polling firm, selected following a competitive bidding process, in accordance with the highest standards of the profession. To enable comparisons between the five main regions of Canada, we estimate that a sample of 2000 Canadians will be required.

Box 2: Example of a Scientific Profile with an Opinion for Each Side of the Split Sample

Scientific Profile

Louis Atkinson
Title: Professor of Geology, University of Colorado
Education: Ph.D. from Princeton University
Member:

- American Association of Geologists
- National Academy of Sciences

Low Risk Opinion

"Shale gas extraction poses no risk to the environment and drinking water. To release the gas from the shale, water mixed with sand and chemical additives (less than 1%) is injected at high pressure into the ground at depths of several hundred metres below the water tables. There are safe methods to retrieve and treat the water from hydraulic fracturing. The water and gas come to the surface through high strength steel tubing, cased in cement throughout the freshwater aquifer zone until the surface. This is a proven method and recognized for lowering the risks of groundwater contamination to nearly zero. In other words, existing technologies allow for the safe extraction of shale gas."

High Risk Opinion

"Shale gas extraction poses a risk to the environment and drinking water. Shale gas is a form of natural gas that is particularly difficult to extract. To release the gas from the shale, water mixed with sand and chemical solvents are injected at high pressure into the ground below the water tables. These chemicals and gas bubbles risk contaminating the water, as well as the land near the well. In fact, treatment of contaminated water has provided questionable results. Finally, leaks of methane and hydrogen sulphide, a toxic gas potentially harmful to human health, have been observed in many existing wells. In other words, the extraction of shale gas is still too risky."

The survey of scientists will be administered by the applicant, co-applicant and research assistants. Both applicants have considerable experience conducting public opinion and elite surveys, whose results were published in excellent journals and policy reports (see Montpetit, 2009; 2011; forthcoming; Borick, Lachapelle et al., 2011). The expert survey will be sent to university scientists from those disciplines in the natural sciences that are deemed most relevant to at least one of the selected issues. The identification of the scientists will require establishing the relevance of the various scientific disciplines through a scan of the web sites of the science faculties, the agricultural schools, environmental schools, public health schools and medical schools of all Canadian universities. The scan will involve looking into summaries of research conducted in all of these institutions for evidence of relevant research conducted in one (or more) of the eight issues. Examples of disciplines whose relevance is known include toxicology, biology, geology, climatology, oceanography, molecular biology, physics, oncology, and epidemiology. After the identification of all relevant disciplines, a comprehensive list of all Canadian professors working within these disciplines will be compiled, whether their research deals directly with one of the issues or not. In fact, we prefer surveying scientists for whom expertise on the issues is low rather than missing scientists with high qualifications. To control for expertise, information on the research conducted will be collected while building this inventory. We estimate that the list will contain between 1500 and 2000 individual scientists.

The survey administered to the sample of scientists will include most of the questions asked in the survey administered to lay Canadians, including the experiment just presented. Therefore, scientists will be asked to assess the credibility of their peers in disciplines other than their own. In addition to the

information collected on the respondents' research, a question will ask them to weigh the degree of relevance of their research for each of the eight issues. This information will be useful to measure whether scientists, in general, form their opinion in a manner that differs from the lay public or whether they do so only when they have legitimate qualifications in a particular scientific area.

Some of the controls included in the survey of lay Canadians will not be necessary for the survey of scientists (e.g. questions on scientific literacy). These questions will be replaced by questions on policy recommendations for scientists whose research pertains to one of the eight issues (these respondents will be directed toward questions specific to their respective discipline). The goal here is to measure a potential gap between scientist's perception of risk (measured with the questions on scientific agreement) and the advice they would offer to policy-makers. Scientists whose research is relevant to the shale gas issue, for example, will be asked to rate the degree of permissiveness and restrictiveness of the regulations that they would recommend to governments for the exploration and the extraction of this energy resource.

The third survey of Canadian legislators will differ slightly from the other two. First, it will be conducted in person as legislators are unlikely to fill out an Internet survey themselves. While time consuming, the in-person method will enable the inclusion of open questions to collect qualitative information, in addition to the quantitative data collected from the closed survey questionnaire. The closed questions will be drawn from the surveys of scientists and lay Canadians (notably those measuring the perception of scientific consensus and political beliefs), but will exclude the experiment, because the group of respondents will be too small to split. We target a sample of at least 100 legislators from the federal House of Commons and the legislative assemblies of Quebec and Ontario, although all elected officials from these chambers will be invited to participate. The survey of legislators will comprise a number of questions on the involvement of legislators over the eight issues and the sources of scientific advice upon which they rely, providing rich qualitative information

The three surveys will begin simultaneously in the first year of the program. Again, the applicants began preparing the material for the survey of lay Canadians last year (2010-2011) and expect fielding the survey in the first few months of the program. The survey of scientists will take longer as it requires compiling a comprehensive list of scientists in the disciplines relevant to the eight issues. Research assistants will work on this list in the first year of the program and the survey will be administered early in the second year. The survey of legislators will begin early in the first year and will likely take as long as three years to complete. Appointments with legislators are difficult to obtain, and will require travel to Quebec City, Ottawa and Toronto. As a result, the interview schedule will occur over a longer period. We aim for 100 completed interviews at the end of the third year. Analysis and diffusion of results from the survey of lay Canadians will begin in the first year of the program and those from the survey of scientists toward the end of the second. The applicants will prepare several articles for conferences and eventual publications during the four years of the program. Once results from all three surveys are compiled in the fourth year of the project, the applicants will begin writing a book accessible to the general public to discuss the implications of project findings for Canadian policy-making and for democracy in Canada.

The questions motivating this research are key to understanding democracy and policy-making, and have been the object of relatively few empirical investigations, all of which have been conducted outside Canada. Not only does this proposal promise to challenge extant explanations and refine existing measures, it will push scholarship further (notably through the administration of surveys to policy-makers and scientists). Moreover, it proposes an investigation adapted to the Canadian context and focused on issues important to Canada. Lastly, the survey methods upon which the project rests meet the highest standards for quality research in political science and social psychology. Research results relying on such methods have been published in the most rigorous scholarly journals, and the applicants plan to follow suit.