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Policy learning, motivated scepticism, and the politics of shale gas development in British Columbia and Quebec

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ABSTRACT
What is policy learning and how do we know when we observe it? This article develops an original way of operationalizing policy learning at the individual and subsystem level. First, it juxtaposes four types of opinion change at the individual level – opinion shifting; opinion softening; position-taking and opinion hardening. This last change, we argue is indicative of motivated scepticism, a non-learning process that we borrow from public opinion studies. Second, we identify factors associated with opinion change and argue that some of them indicate policy learning, while others point to motivated scepticism. Lastly, we examine learning and motivated scepticism against patterns of opinion convergence (the expected outcome of learning) and polarization (the expected outcome of motivated scepticism) at the subsystem level. We illustrate the use of this approach to study policy learning with the case of shale gas development in two Canadian provinces, British Columbia and Quebec. While, we find clear signs of individual learning and motivated scepticism in both provinces, we find that policy learning is more prevalent in Quebec than in British Columbia at the subsystem level.

KEYWORDS
Policy learning; opinion change; opinion convergence; opinion polarization; policy change; hydraulic fracturing

Introduction
Take a fictional policy subsystem of four actors in which a decision must be made to ban, to regulate or to encourage hydraulic fracturing, a technology used by industry to extract natural gas trapped in shale formations. Say that two of the actors fear environmental risks and advocate a ban, while the other two want government to encourage the gas industry. In all likelihood, the two actors preoccupied with risk will collaborate with each other to better oppose the two shale gas proponents, citing particular arguments or evidence, while ignoring or discrediting anything that undermines their position. The two proponents will act similarly. Under such circumstances, the subsystem will rapidly become polarized and policy decisions will be difficult to make, that is, the status quo will be difficult to change. Actors with formal authority might impose a decision, but will be unable to count on the
collaboration of the disagreeing actors during implementation. In polarized subsystems, decisions to change or to maintain the status quo often suffer deficits of legitimacy.

Imagine now that in this subsystem one of the four actors on either of the two sides displays some willingness to seriously engage with the knowledge coming from the other side, examining carefully the evidence and allowing her position to evolve accordingly. Regardless of which side this actor might be on, its initial coalition partner might decide to adopt a similar attitude to avoid being left behind. Viewing the goodwill displayed by adversaries, one or both of the actors on the other side might likewise decide to relax their initial preferences, suddenly taking all of the evidence seriously rather than automatically discarding those that initially appeared inconvenient. Overtime, all four actors might come to agree on specific shale gas restrictions or promotional measures in a form of compromise. In contrast to the previous example, opinions in this scenario are likely to converge rather than polarize, facilitating decision-making and policy implementation, as well as preserving legitimacy.

Some policy scholars might argue that both examples exemplify policy learning, albeit different forms. Dunlop and Radaelli (2013, p. 606), for example, might suggest that the first scenario corresponds to “self-directed learning” in which learners refuse to acknowledge the possibility that “any expertise is superior to their own.” In this scenario, learning occurs within the boundary of the learner’s prior thoughts. The second scenario, they might further suggest, comes closer to “deliberative learning” since actors “reflexively modify preferences without exogenous constraints” (Dunlop & Radaelli, 2013, p. 608). Learning here occurs free of any other prior motivation than learning for the sake of learning. Other scholars would take issue with such a conception of learning, arguing that only the second scenario exemplifies learning, the first one illustrating a non-learning process. In fact, speaking of learning in the case of a scenario in which actors refuse to think outside of their prior thoughts does not make much intuitive sense. More importantly, the policy learning literature emerged to highlight that along well-known policy-making processes featuring the exercise of power also exist processes in which actors puzzle (Van Nispen & Scholten, 2015). Early learning scholars, notably Heclo (1974), pointed to policy actors whose policy preferences were not solidly cemented and who therefore spent time collectively puzzling over solutions to problems rather than always using coercion to make other actors do what they would otherwise not do. Heclo’s work brought to light a policy process largely absent from previous scholarship – one that might be regarded as less cynical than most power-centred processes – but he never denied the possibility that powering might also occur. In keeping with this perspective, we find it more useful to treat policy learning as a distinctive process that coexists with non-learning processes rather than as an all-encompassing heuristic in which all forms of policy-making can be categorized.

Learning, however, is not so easily distinguishable from non-learning processes. In fact, much of policy learning occurs in the minds of policy actors and therefore cannot be directly observed. But four decades of policy learning literature leave us with a host of indicators enabling indirect observation. The objective of this article is to identify a series of indicators of policy learning, which together can provide valid evidence of learning in policy processes. To sort out learning from non-learning aspects of policy-making – and measure the relative importance of each – we also identify indicators of a non-learning process, motivated scepticism, which closely matches the first scenario described above. To illustrate the usefulness of our measures, we apply them to the cases of shale gas development in Quebec and British
Columbia. While, we find some evidence of learning at the actor level, we also find that motivated scepticism is quite prevalent. While learning produced convergence in Quebec’s shale gas subsystem, it was insufficient to prevent polarization in the subsystem of British Columbia. Motivated scepticism bolstered opponents’ resistance to shale gas development in British Columbia, as well as proponents’ enthusiasm for this energy source.

We begin the article with a discussion of the policy learning literature, as well as of the public opinion literature from which the concept of motivated scepticism originates. The goal is to define learning and motivated scepticism and to identify indicators allowing the empirical observation of these two processes. We follow with a presentation of a survey of actors involved in the making of hydraulic fracturing policy in British Columbia and Quebec. The survey measures a number of attitudes indicative of both learning and motivated scepticism. We conclude with a discussion on the implications of these findings for policy-making.

**Indicators of policy learning**

Policy learning is a process, not a single variable waiting to be measured. Our definition of learning is inspired by studies in education and therefore involves a teacher transmitting knowledge to learners (Montpetit & Lachapelle, 2015). We define learning (at the individual level) as the use of new knowledge to inform actors’ policy preferences. In theory, this process happens relatively free from bias; it represents openness to integrating new knowledge with one’s priors in a way that is consistent with that new knowledge. Over time, this process is likely to change the attitudes of the learners in ways that facilitate future interactions among them. As this definition of learning suggests, we may identify at least some of the variables that are involved in learning processes (e.g. knowledge), as well as the nature of their causal relationship (i.e. cause a convergence in attitudes). However, our knowledge of learning goes far beyond this simple definition. Owing to four decades of scholarship on policy learning, we know which teachers encourage learning most, under what conditions learners assimilate knowledge and under what conditions knowledge will
alter their attitudes. We also know which type of subsystem change is most likely to result from learning (Bennett & Howlett, 1992; Dunlop & Radaelli, 2013; Freeman, 2006; Hall, 1993; Heikkila & Gerlak, 2013; Knoepfel & Kissling-Näf, 1998; May, 1992; Zito & Schout, 2009). Here we use this knowledge to build indicators of policy learning, from the very beginning of the process (at the individual level) to its end product (at the subsystem level).

In addition to learning, we introduce the concept of motivated scepticism to the policy learning literature to help clarify thinking around non-learning processes. Borrowed from the public opinion literature, the concept of motivated scepticism refers to instances where, confronted with information that contradicts one’s priors, actors discredit, pick apart, or actively seek countervailing information, encouraging them to harden their position (Taber & Lodge, 2006). This cognitive bias implies that one’s predispositions and priors interfere with the processing of new knowledge, making learning, as described above, more difficult. In its ideal-typical form, learning is disinterested. Actors engage in learning processes to seek the “truth” or to better their community; they engage without any prior expectation about where the acquired knowledge will take their opinion. In contrast, actors engaged in motivated scepticism substantiate an existing opinion with new knowledge. In this process, any discordant knowledge and its promoters are quickly discredited (Sabatier, Hunter, & McLaughlin, 1987). Motivated scepticism is thus more likely to produce opinion hardening. The process simply fails to encourage any shift or softening of opinions. Motivated scepticism is important in the public opinion literature, providing a theory behind the common observation that shifts in opinion is infrequent among the politically aware public and that polarization is frequent (Farrar, Green, Green, Nickerson, & Shewfelt, 2009; Zaller, 1992).

Our model of learning and non-learning is designed to apply mostly to substantive policy issues in technical policy subsystems. Learning about political strategies, for example, is thus excluded from our analysis (Bennett & Howlett, 1992). Likewise, learning from any form of experience, including foreign experiences – as opposed to learning from knowledge – is not within the scope of this article (Carpenter, 2004; Dolowitz & Marsh, 2000; Shipan & Volden, 2008). The type of learning covered here mostly occurs from the transmission of scientific or technical knowledge. Teachers, in such cases, are thus often experts with scientific credentials and with a university affiliation. The limits around the scope of this article stem partly from our empirical cases: hydraulic fracturing for shale gas in British Columbia and Quebec. Hydraulic fracturing is a technical issue that offers an opportunity to study policy learning from scientific evidence, a topic of great interest in the social sciences (Haas, 1992; Jasanoff, 1990; Jenkins-Smith, Silva, & Murray, 2009). While the scope of our analysis is limited, it nevertheless covers learning from its individual to its collective manifestation. We argue that learning is first an individual level process, involving stimuli (knowledge) that enter the minds and causes a change in the cognition of policy actors. For policy scholars, however, limiting the analysis to this individual level is unsatisfactory. Policy-making is a collective process, and therefore the interest of studying learning rests on the consequences of changes in cognition for this collective process (Heikkila & Gerlak, 2013; Leach, Weible, Vince, Siddiki, & Calanni, 2014). Our model predicts that learning at the individual level increases the probability of convergence at the subsystem level. Our

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2To be sure, conventional approaches to policy learning adopt a different epistemological approach to learning than that adopted by scholars of public opinion. In our view, the relative success of measuring learning in the public opinion literature merits a consideration of how it might be applied to the study of public policy.

3The measurement tools developed here however might be easily adapted to other types of learning.
approach thus integrates both, learning at the level of the actors (individual level), which is expected to precipitate learning at the level of the subsystem (collective level).

Figure 1 provides a visual representation of a policy learning process. The left of the figure represents a moderately divided subsystem at $T_0$. The subsystem comprises four learners, possibly a mix of industry representatives, advocacy groups and civil servants, although the precise identity of the learners is of little importance here. What matters more is the initial distribution of preferences among these learners at the outset of the learning process. Paying attention to the various shades of blue and red, Figure 1 suggests a weakly divided subsystem: two learners have weak preferences, one in favour of the status quo (learner b), one in favour of policy change (learner d); only one is strongly committed to policy change (learner a) and one has no clear preference (learner c). Situated at the centre of the subsystem is a teacher who is independent from all of the learners. Examples of such teachers include respected university scientists or independent commissions whose knowledge cannot be suspected of being tainted by a close collaboration with some of the learners (Ingold & Gschwend, 2014; Leach et al., 2014; Marier, 2009). The credibility of teachers often rests with their recognized willingness to speak an inconvenient truth equally to all learners, whenever such truth arises. However, at any point in time, knowledge is not equally inconvenient to all learners and Figure 1 illustrates a case in which the teacher’s knowledge offers support to the status quo, matching the position of learner b more than that of any of the other learners. In any case, the invisible learning process begins at the individual level once the teacher’s knowledge is transmitted. The knowledge acts as stimuli that will encourage the learners to reflect upon their respective priors.

The next directly observable event manifests itself at $T_1$, on the right side of Figure 1, and corresponds to a change in each learner’s policy preference. In Figure 1, we distinguish between 4 opinion change possibilities: shifting, softening, position-taking and hardening.

Figure 2. Motivated scepticism.

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4A good example of such a teacher is Robert B. Jackson, who has produced inconvenient evidence about hydraulic fracturing for both, industry and environmentalists. See (Voosen, 2015).
5To be sure, teachers may also learn, but for the sake of parsimony we excluded this possibility here.
Although learning might produce all four opinion changes, the literature suggests that the former three are more likely than the latter to be indicative of learning. Opinion shifting involves movement in an actor’s position from supporting a given outcome (status quo or policy change) to opposing it or vice versa. Opinion shifting is the opinion movement often assumed to occur in major learning processes (e.g. Hall, 1993; Lertzman, Rayner, & Wilson, 1996). Softening refers to a movement from strong support or opposition towards weaker support or opposition, without changing sides in the debate (e.g. Weiss, 1977). Position-taking refers to opinion formation, that is, a movement from indifference or uncertainty to a supporting or opposing position. The public opinion literature makes the useful distinction between opinion change and opinion formation, position-taking referring to the latter (Druckman & Bolsen, 2011; Zaller, 1992). The literature on policy learning rarely if ever addresses position-taking. The public opinion and communication literatures would however suggest that it is indicative of learning, as knowledge and information often make individuals realize that they should have a position on a given policy issue (Feldman, Maibach, Roser-Renouf, & Leiserowitz, 2012). Lastly, hardening implies actors staying on the same side in a debate, but becoming more committed to their initial position. This last type of opinion change, as well as no opinion change, is more likely to be a form of motivated scepticism. In such instances, policy actors facing new information that challenges their initial preferences refuse to change their position, and may actually harden their views in response.

As is clear from Figure 1, knowledge will have different effects on learners, some of which are associated with non-learning processes. Despite the variety of effects illustrated on the right side of Figure 1, two characteristics suggest that the observed changes between $T_0$ and $T_1$ indicate learning: (1) most of the observed opinion change types are associated with learning in the literature (the hardening of learner b is the only exception); (2) the cumulative effect of these types of changes suggest a convergence of opinions, that is, policy preferences divide the subsystem less at $T_1$ than they did at $T_0$. Note that Figure 1 illustrates a learning process that would unlikely produce policy change given the teacher’s weak preference for the status quo. We did this purposefully to underline that policy change per se might be a poor indicator of learning. A teacher might be said to have successfully produced learning even after having reinforced support for the status quo and reducing the probability of a policy change. In fact, more important than policy change in learning processes is the facilitation of collective action, which is independent of the teacher’s substantive preference. In Figure 1, even if the teaching encourages the status quo, the result is improved collaboration over policy implementation. It is in fact likely that the interactions among the actors are easier at $T_1$ than they were at $T_0$. As a result, learning likely improves the legitimacy of the subsystem displayed in Figure 1.

In contrast, Figure 2 provides an illustration of motivated scepticism in its most obvious form – when information is not entirely neutral. To illustrate, the situation at $T_0$ in Figure 2 is identical to the $T_0$ situation in Figure 1, with one significant exception: the teacher is closer to learner b than to any of the other learners in the former figure. To help imagine the teacher in Figure 2, one might think about a think tank or research centre receiving significant funding from learner b. As a consequence of this proximity, learners a, d and c might view the teacher as unwilling to speak inconvenient truths to learner b, while unhesitant to press such knowledge on them. Suspicious of any challenging knowledge transmitted by this teacher, learners a and d are likely to harden their respective position (at best, refuse
to change it). Learner c, who does not have any prior preference, might be more easily moved towards the teacher. And learner b, who finds confirmation of her prior position in the process, might end up hardening her position (further encouraging learner d to do the same). In theory, opinion hardening can occur with a neutral teacher, as with learner b in Figure 1, but the literature tells us that this form of opinion change is particularly likely when the teacher is closer to a given learner or a coalition of learners (Weible, 2008). The end result at $T_1$ is a subsystem that is more polarized than at $T_0$. Collective action in such a subsystem is difficult and legitimacy suffers, as predicted by the motivated scepticism literature (Taber & Lodge, 2006).

Based on these insights from the literature, we propose the following model that can be used to observe policy learning and motivated scepticism processes:

1. At the individual level, policy learning is indicated by the presence of several actors in a subsystem who move away from indifference, shift existing positions or soften them.

2. Policy learning is further indicated when an actor takes, shifts or softens her position as a result of knowledge produced by independent sources (for example, university scientists).

3. At the subsystem level, policy learning increases the probability of an overall convergence of opinion that facilitates collective action among actors (but not necessarily policy change).

4. At the individual level, non-learning, in the form of motivated scepticism, is indicated by the presence of several actors in a subsystem whose positions are difficult to change or harden over time.

5. Motivated scepticism is further indicated when opinion hardening results from knowledge produced by coalition partners.

6. A clear relationship between opinion hardening and actors’ prior motives further indicates motivated scepticism.

7. At the subsystem level, motivated scepticism increases the probability of a polarization of opinions, making collective action more difficult.

Before applying these indicators to shale gas development in Canada, it is important to highlight three caveats. First, unlike Figures 1 and 2, most subsystems will comprise more than a single teacher and each teacher’s knowledge will not necessarily carry the same lessons to learners. Therefore, evidence of learning at the individual level will not necessarily translate into collective learning (i.e. position convergence). Second, learning and motivated scepticism will both be present simultaneously in most subsystems. Therefore, the indicators are not intended to categorize subsystems as either learning or motivated scepticism, but to measure the relative importance of the two processes.6 Third, on its own, any single indicator listed above might be misleading. Hardening, for example, is treated as an indicator of motivated scepticism, but in some instances it may also result in learning.7 Therefore, it is the accumulation of indicators that is important; not the presence or absence of any single

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6 Measuring the relative importance of the two processes however is difficult, owing to the causal nature of several of our indicators.

7 Take for instance the example of a policy actor who is initially opposed to fracking for fear that this activity can contaminate local aquifers. They may learn that fracking also poses substantial risk for climate change, and as a result of this learning, harden their position.
one of them. The probability of convergence/polarization increases with the accumulation of indicators of learning/scepticism.

**Shale gas development in two Canadian provinces**

Up until the early 2000s, technologies to release the natural gas trapped in shale rock formations were insufficiently efficient to justify the drilling of wells on such sites for the purpose of commercial development. In fact, horizontal drilling and hydraulic fracturing, the technology enabling the extraction of natural gas from shale, became profitable only in the early 2000s. This sudden profitability created an appetite for shale gas development in several American states and Canadian provinces (Rivard et al., 2014). British Columbia, already a producer of conventional gas, quickly became a leader in shale gas development with the drilling of a first commercial well in 2005. Ever since, almost 2000 shale gas wells have been drilled in the province, with the authorization of the provincial government

More surprising is the appetite found in Quebec around 2007 for natural gas, a resource that the province has historically lacked (at least in terms of conventional reserves). Yet, an important shale formation expands from the south-west of the province all the way to Quebec-city. By 2007, it had become clear that some of the gas trapped in this formation was recoverable through horizontal drilling and hydraulic fracturing (Comité de l'évaluation environnementale stratégique, 2014). Between 2007 and 2009, about 30 exploration wells were drilled in Quebec and by 2010 the gas industry was ready to begin extraction on a commercial scale. However, out of fear of a strong public backlash, the provincial government has not authorized the drilling of a single well since 2010.

In light of the divergent approaches to shale gas development in British Columbia and Quebec, and given the fact that the shale gas issue first emerged on political agendas in these two jurisdictions, we focus our empirical analysis on these two cases. We also build on past comparative research comparing the shale gas issue in these two provinces, which has demonstrated important differences in media coverage (Montpetit, Lachapelle, & Harvey, 2016), as well as different levels of mobilization across Quebec and British Columbia (Bherer, Dufour, & Rothmayr, 2013). Both provinces also undertook major consultation processes, though the British Columbia case was limited to consultation around health assessment, while consultation in Quebec addressed broader environmental, health, social and economic risks and benefits (Bureau d'audiences publiques sur l'environnement, 2011; Fraser Basin Council, 2012). In light of this past research, it is reasonable to expect that the Quebec shale gas subsystem quickly became far more adversarial than the one in British Columbia. The two subsystems provide good cases for the study of policy learning and motivated scepticism. In fact, differences in the level of antagonism should make policy learning more likely in British Columbia and motivated scepticism more likely in Quebec (Leach et al., 2014; Weible & Sabatier, 2009), although we find the opposite.

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8In Canada, natural resources are of provincial jurisdiction. Therefore, the federal government plays a limited role in shale gas development.
The actor survey and descriptive statistics

Building on actor surveys conducted in the state of New York (Heikkila et al., 2014), we administered a web questionnaire in early 2015 to all actors who participated in two open public inquiries on shale gas development in Quebec and British Columbia (Bureau d'audiences publiques sur l'environnement, 2011; Fraser Basin Council, 2012). Industry, environmentalists, local citizen groups, municipalities, provincial civil servants, think tanks and various experts participated in these inquiries. To our knowledge, no shale gas subsystem actors in the two provinces were excluded from participating in the inquiries or decided to boycott it. We are therefore confident that the list of participants to the inquiries comprises all of the actors who play substantial policy roles in the two subsystems. Every single actor participating in an individual capacity received the questionnaire, as well as one person per organization among the individuals representing organizations. In other words, we made sure that one respondent corresponds to one actor. The total subsystem population in Quebec thus comprised 141 actors, compared to 59 in British Columbia. The difference in numbers between the two provinces might reflect differences in the mobilization of opponents, which past research has shown to be smaller in British Columbia (Bherer et al., 2013). The response rate in each of the two provinces is 60%, with all of the actor categories being proportionally represented.

We measure opinion movement by computing the difference between actors’ opinion when they first became aware of shale gas development (between 2009 and 2010 for most people) and their current opinion on seven salient issues. Specifically, we asked respondents to indicate their indifference or the extent of their agreement/disagreement at the outset of their involvement as well as their position at the time of the survey, on a 1–5 Likert scale. We thus rely on self-reported measures of opinion change from a survey conducted in 2015, which represents for most respondents a potential for learning over a six-year period. Our questions cover a broad range of issues, including risk, regulation and governance of shale gas development. Including questions on such a broad range of issues allows us to capture potential learning processes in a variety of crucial areas that were debated over this period:

1. Potential economic benefits are high.
2. The potential environmental risks are significant.
3. The potential health risks are significant.
4. The government should ban hydraulic fracturing across the province.
5. The province should strengthen its regulations to make hydraulic fracturing safer.
6. The province should increase royalties on gas extraction.
7. Local governments should be able to ban hydraulic fracturing.

As shown in Figure 3, the overall pattern of opinion change is similar between the two provinces, with most respondents displaying a stable opinion, followed by respondents who display changes of small magnitude. However, the range in the magnitude of change between when actors first became aware of the issue, and their opinions at the time of the survey, is higher in Quebec than in BC, just like the proportion of respondents who have not changed their mind at all. In British Columbia, opinions are most stable on the

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9We argue these consultations are comparable, though as mentioned, the British Columbia case was limited to consultation around health assessment, while consultation in Quebec addressed broader environmental, health, social and economic risks and benefits.
importance of strengthening regulations, while in Quebec opinion is particularly stable on
the need to increase royalties. In Quebec, more respondents moved towards disagreement
than towards agreement that shale gas development carries important benefits, while in
British Columbia, the opinion movement on this issue is equally split between agreement
and disagreement. Thus, we observe some important differences in terms of the substance
of opinion change in the two jurisdictions.

The observed opinion changes on the seven statements were used to construct six differ-
ent variables, each measuring the importance of different types of opinion change, which
we conceptualize as indicators of learning and non-learning. The mean values for each
variable are shown in Figure 4. Consistent with the definition given above, ‘opinion shift-
ing’ provides the number of times, out of the seven issues, that a respondent moved from
agreement to disagreement and vice versa. Likewise, ‘softening’ is the frequency of move-
ment from strong agreement or disagreement to a weaker stance, while staying on the same
side. ‘Position taking’ indicates how frequently a respondent moved from uncertainty to
either of agreeing or disagreeing. ‘Opinion hardening’ is the number of times a respondent
moved from agreeing to strongly agreeing or from disagreeing to strongly disagreeing. ‘No
change’ is the number of issues on which respondents’ opinion did not move. Thus, each
respondent can potentially have events in each of these variables, for an overall maximum
of seven. We also computed a variable called ‘max,’ which corresponds to the proportion of
‘no change’ when the initial position was either of strongly agree or strongly disagree. This
variable was computed for the analyses that we present below to account for the fact that
these respondents did not have the option to indicate a further hardening of their position,
which is a limitation of our survey design.

On average, respondents indicate not having changed their opinion on 4.4 of the seven
issues presented above. The mean is slightly higher in Quebec than in British Columbia,
but the difference is not statistically significant in a t-test. In fact, differences between the two provinces on each of the indicators are statistically insignificant. As shown in Figure 4, movement of opinion is strikingly similar between the two provinces. Interestingly, in the two provinces, about half of the respondents who did not change their opinion did not have the possibility to indicate a hardening of their position (max). In other words, the ‘no change’ variable might exaggerate the importance of opinion stability; hardening might, in reality, be more common than suggested by Figure 4. Position-taking occurred on an average of 1.1 of the seven issues, followed by hardening which averages at .8 and softening at .5. Opinion shifting occurs least frequently with an average of .2. We argued above that position-taking, opinion shifts and softening are indications of policy learning, while hardening and no change indicates motivated scepticism. Figure 4 thus provides the first evidence that learning and motivated scepticism occur simultaneously in the two subsystems. Moreover, the two subsystems are not as different in this regard.

Several of our indicators of policy learning and motivated scepticism are causal relations rather than descriptive statistics on isolated variables. One such indicator of learning associates the probability of position-taking, position softening and shifting with the value that actors place on independent sources of knowledge. One survey question thus asks respondents to indicate the frequency of their collaboration with university scientists. In Quebec, 74% of the respondents collaborate once a year or more with university scientists, compared to 71% in British Columbia. The difference between the two provinces is not significant in a t test.

We also argue that opinion hardening among actors who value coalition partners indicates motivated scepticism. These actors are likely to trust information coming from fellow coalition members, which is unlikely to challenge their pre-existing positions. One question asked respondents how important it is for them to form and maintain a coalition with allies. In Quebec, 47% of the respondents said that coalitions are very important to them against
32% in British Colombia. The difference between the two provinces is significant at \( t = .13^{10} \), a difference that makes sense given the suspected high level of adverseness in Quebec.

While, the survey did not include a specific question measuring the importance of information produced by members of their own coalition in comparison with more neutral informants, we did ask respondents to indicate how important it is for them to produce and diffuse their own research. Actors who practice motivated scepticism are likely to engage in such activities rather than collaborate with more neutral university scientists, who risk challenging their opinion. In British Columbia, 46% of the respondents indicated that producing their own research was very important to them, against 41% in Quebec. The difference is not statistically significant at conventional levels.

The main predictor of opinion hardening in processes of motivated scepticism is prior motives. It is common in studies of motivated scepticism to rely on the cultural values and biases to measure such motives (Druckman & Bolsen, 2011; Kahan, Jenkins-Smith, & Braman, 2011). Inspired by these studies, we included four cultural theory questions in our survey, two indicating a predisposition towards market values and two indicating a predisposition towards egalitarianism. Specifically, respondents were asked to indicate their level of agreement with the following questions:

1. Competition is good. It stimulates people to work hard and innovate.
2. Government programs – not free markets – are the best way to supply people with the things they need.
3. We need to dramatically reduce inequalities between the rich and the poor.
4. Government should provide a decent standard of living for everyone.

A factor analysis found that the four questions load onto a single factor (producing a negative sign for question (1); they also produce an alpha scale reliability coefficient of .8. This is consistent with other research in Canada that finds egalitarian and free-market cultural theory items tapping into the same latent predisposition (Kiss, Lachapelle, & Montpetit, 2015). After reversing the coding of question 1, we created a single scale measuring the extent to which respondents value equality and we treat this value as a single value predisposition, which we conceptualize as egalitarianism. Note that previous studies have shown clearly that valuing equality impacts attitudes (Kahan et al., 2011; Lachapelle, Montpetit, & Gauvin, 2014; Silva, Jenkins-Smith, & Barke, 2007). The scores on this measure range between 5 and 20. The mean score for British Columbia is 11.6, compared to 13.1 in Quebec. The difference between the two provinces is statistically significant at \( t = .03^{10} \).

In the regression analysis that follows, we also included control variables, which theory does not readily associate with learning or motivated scepticism, but which might nonetheless have an influence. These variables are the weekly time spent working on shale gas development, the gender of the respondent and organizational affiliation.

**Causal indicators**

As suggested in the above discussion, opinion shifting, opinion softening and position-taking are most indicative of learning when observed with the independent variables just presented.

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10 The small number of respondents explains the difficulty of getting statistically significant difference within narrower margin of errors.
We thus organized these opinion changes into a single dependent count variable, which indicates the number of events corresponding to shifts, softenings and position-takings for each respondent. We use the sum of the three types of opinion change, as opposed to three distinct variables, to maximize variation. Following the same logic, we summed hardening and max, as they most likely indicate motivated scepticism. As explained above, ‘max’ was generated to account for the fact that respondents with extreme positions on our Likert scale at the outset did not have the option to indicate any further strengthening of their position. We thus assume that respondents with extreme positions at the outset and who did not indicate any change in their position might also practice motivated scepticism. For the sake of simplicity, we speak only of shifting and hardening to designate these two count variables in the rest of this section. For the purpose of comparison, we also present a regression on no change, which includes max.

Table 1 thus shows three Poisson regressions, one on ‘shifting’, one on ‘hardening’, as well as one on ‘no change’. Unexpectedly, there is no difference between the propensity of Quebec and British Columbia’s respondents to shift, harden or maintain their opinion. Alleged differences in the level of antagonism between the two subsystems did not appear to impact actors’ inclination to learn or engage in motivated scepticism in any significant way. Collaborating with university scientists, however, encourages opinion shifts and discourages opinion hardening, an indication of policy learning. The perceived importance of forming and maintaining coalitions, as well as the perceived importance of producing in-house research, increases the number of times that hardening occurs, an indication of motivated scepticism. In addition, valuing equality is a predisposition that encourages opinion hardening in a manner consistent with motivated scepticism. Interactions between these variables and the respondent’s province of origin were tested and produced no significant results (not shown in table format). In other words, collaborating with university

Table 1. Poisson regressions.

| Position-taking, bias softening and shifting | Hardening, including max | No change, including max |
|---------------------------------------------|--------------------------|--------------------------|
| British Columbia                           | .230 (1.42)              | .011 (.08)               | −.122 (−.98)               |
| Coll. with scientists                      | .422** (2.37)            | −.299** (−2.28)          | −.170 (−1.52)              |
| Coalitions important                       | .005 (.03)               | .326*** (2.72)           | .017 (−.17)                |
| Produce research                           | −.433*** (−2.79)         | .287** (2.49)            | .171* (1.75)               |
| Egalitarian predisposition                 | −.036 (−1.39)            | .040* (1.87)             | .018 (1.04)                |
| Weekly time investment                     | −.179*** (−2.76)         | .077* (1.86)             | .054 (1.51)                |
| Female                                      | −.110 (−.72)             | .076 (62)                | .067 (64)                  |
| Actor category                              |                          |                          |                          |
| Industry                                   |                          |                          |                          |
| Governments                                | .626*** (2.90)           | −.167 (−.96)             | −.267** (−1.96)            |
| Local groups                                | .429 (1.38)              | .171 (.79)               | −.172 (−.90)               |
| Env. groups and labour                      | .599** (2.45)            | .034 (.19)               | −.187 (−1.26)              |
| Ind. experts                                | .186 (.68)               | .025 (.13)               | −.097 (−.63)               |
| Constant                                    | 1.241*** (3.25)          | .080 (.25)               | 1.148*** (4.49)            |
| Observations                                | 122                      | 122                      | 122                       |
| Pseudo $R^2$                                | .08                      | .08                      | .026                      |

$t$ statistics in parentheses. $^* p<.10; ^{**} p<.05; ^{***} p<.01.$

11 We tested regression models on each of the three types of change and obtained results that are similar to those obtained with the aggregation.
scientists, participating in a coalition and egalitarian values produce the same effect on opinion shifting and hardening in the two provinces. Of note among the control variables is the impact of the time invested by a respondent on hydraulic fracturing. The more time a respondent spends on this issue every week, the less likely she is to shift opinion and the more likely she is to harden her views.

While, we expected to find more evidence of policy learning in British Columbia and more evidence of motivated scepticism in Quebec, Table 1 indicates that the two processes are equally important in the two provinces. In fact, Table 1 provides evidence that, at the individual level, both policy learning and motivated scepticism are important processes in each subsystem. As expected, respondents who value independent expertise are more likely to take position, shift or soften their stance. Conversely, respondents who value their participation in a coalition and who prefer internal expertise over less predictable independent teachers, are more likely to harden their position. Lastly, when respondents value equality, they are more likely to harden their position over time. This might be expected. Indeed, horizontal well drilling for shale gas in Canada is driven by private industries and often comes across as detrimental to local communities, hence the unease of individuals and groups who value social equality. These individuals and groups substantiate their position selectively, hardening it over time.

To sum up, Table 1 provides indications that policy learning and motivated scepticism occur simultaneously in policy subsystems. The evidence presented remains inconclusive on the relative importance of each of these processes. So far, however, we have only examined policy learning and motivated scepticism at the individual level. Policy scholars interested in collective action would insist on the importance of also looking at the impact of opinion change between $T_0$ and $T_1$ on the overall subsystem. We now turn to this task.

### Opinion change at the subsystem level

The combined influence of individual learning and motivated scepticism can have a wide variety of impacts on a subsystem. In subsystems where several teachers transmit inconsistent knowledge, individual learning might not produce enough convergence to prevent motivated scepticism and a resulting polarization of groups. In subsystems with a single teacher, learning might be too weak to offset motivated scepticism. And of course a situation where learning is powerful enough to facilitate collective action against the force of motivated scepticism, a normatively appealing situation, is also a possibility. To examine the impact of individual learning and motivated scepticism at the subsystem level, we compare the overall opinion of respondents in each subsystem when they first became aware of shale gas development with their opinion at the time of administering the survey.

Specifically, we aggregated initial opinions on the seven issues presented above in such a way as to obtain a measure of the overall initial support/opposition given to shale gas development by each respondent. We created a similar measure for respondents’ current opinion at the time of the survey. In each case, the measure varies between 7, indicating strong support to shale gas development, and 35, indicating strong opposition. In Quebec, the average position became slightly less favourable, moving from 24.8 to 25.5, with standard deviations of 5.2 and 5.5, respectively. In British Columbia, respondents overall also became

\[12\text{The alphas for the four resulting scales are all above .8.}\]
less favourable, moving from 22.4 to 23.2, but with the larger standard deviations of 6.4 and 7.6 respectively. The difference between the two means in each province is statistically significant at $t < .1$. These means, however, provide little information on the convergence or the polarization of positions in the two subsystems over time, although standard deviations do. In fact, the large increase in the standard deviations in British Columbia hint at polarization, a movement confirmed by the visual representations of the distributions offered by Figure 5.

Figure 5. Opinion change at the subsystem level.

In contrast, the current opinion in the Quebec figure has a single mode that reaches higher than the single mode distribution of initial opinion. Over the period, most Quebec respondents became more opposed to shale gas development and few remained as supportive or became more supportive than they were initially (the tails showing strong supporters
initially and currently are similar). In contrast with British Columbia, individual learning in Quebec resulted in a convergence of views that likely facilitates collective action in the province today. Less disagreement and easier interactions among actors, however, will not make policy change in Quebec any easier than it was in the past. In fact, policy learning has increased opposition to shale gas development in a province whose policies already restrict such development.

**Conclusion**

Ever since the seminal work of Helco (1974), we know that policy-making is not always about powering, that learning also plays a role. With the exception of scholars working on policy diffusion (Shipan & Volden, 2008), few have ventured into studying policy learning with quantitative methods. Therefore, we know very little about the prevalence and influence of policy learning on collective action over non-learning processes that encourage powering. By putting forward measurable indicators, this article makes up for this shortcoming.\(^{13}\) To be sure, our actor survey relies on self-reported measures taken at one point in time in order for us to measure learning processes. While this approach has its limits, we argue it makes a substantive improvement in our capacity to observe learning and non-learning processes. Though the subsystem population sizes across our two cases are different, we argue that they are representative of the different levels of mobilization observed across British Columbia and Quebec. Moreover, we achieve a very good response rate (60%) in both provinces, with all actor categories being proportionally represented. We are confident that our samples allow us to draw valid inferences about learning and non-learning processes in the area of shale gas development in British Columbia and Quebec.

In this article, we define policy learning as a process that involve teachers capable of making learners shift, soften their policy preferences or take a clear position. At the subsystem level, these changes in opinion increase the probability of convergence and make collective action easier at \(T_1\) than it was at \(T_0\). To get a precise appreciation of policy learning, we contrasted it with motivated scepticism, a non-learning process that involves learners who seek knowledge only to strengthen their position over time. At the subsystem level, motivated scepticism encourages polarization, making collective action more difficult at \(T_1\) than it was at \(T_0\). The indicators that we propose in this article were applied to shale gas development subsystems in Quebec and British Columbia. We found significant evidence that both individual learning and motivated scepticism are occurring in the two subsystems. While, we expected clear signs of individual learning in British Columbia’s less adversarial subsystem and evidence of motivated scepticism in Quebec’s more adversarial subsystem, we in fact found signs of both individual learning and motivated scepticism in the two provinces. Our individual level indicators did not allow us to measure the relative weight of each process, but subsystem level analysis showed that policy learning is more prevalent in Quebec than in British Columbia. In fact, the debate over shale gas development in British Columbia has become increasingly polarized, while views have converged in Quebec. In other words, our collective level observations suggest that individual learning was able to offset the effect of motivated scepticism in Quebec, but not in British Columbia.

\(^{13}\)Note however that the method put forward here would also be appropriate in the context of qualitative studies.
The differences observed across the two cases are consistent with the idea that learning at the individual level can lead both to instances of collective learning (as in the case of Quebec) as well as collective non-learning (as in British Columbia). This is possible because knowledge itself is indeterminate. In the case of Quebec, consultations produced knowledge on the risks and uncertainties with shale gas development in the province, on which actors drew lessons in a way not seen in British Columbia. In fact, similar knowledge in British Columbia served to harden the positions of both shale gas opponents, as well as proponents.

Up until 2011, British Columbia has authorized the drilling of nearly 2000 shale gas wells. The demand for permits has since receded, with the fall of the price of natural gas. Were prices to go up again and demands for permits were to resume, provincial decisions to authorize drilling would likely face more opposition than they did before 2011, owing to motivated scepticism and a related greater polarization of the subsystem. The observed policy learning in Quebec, however, would not make drilling any easier in this province. Already in 2011, it was very difficult for the Quebec government to authorize the drilling of wells for shale gas. The views of actors might have converged since then, but only to strengthen the status quo. Owing to policy learning, there is less disagreement today than there was in 2011, that the government should prevent the drilling of shale gas wells. In other words, policy learning does not always go hand in hand with policy change. A focus on policy change is insufficient as an indicator of policy learning.

Though not the focus here, the approach outlined in this article has implications for examining policy change. As our model suggests, when more learning takes place among actors – i.e. relatively free from biased assimilation – then we might expect an increase in the probability of opinion convergence at the subsystem level. This facilitates collective action and, in cases where the implications of new knowledge contradict the status quo, may facilitate policy change. However, when learning at the individual level is marred by motivated scepticism – i.e. when actors actively seek to discredit new information, hardening their positions and creating a larger rift among actors with different priors and preferences – we expect opinion polarization at the subsystem level. This polarization, we would expect, makes policy change more difficult, thus favoring the status quo. Future work may wish to test these expectations in contexts of policy stability and change.

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