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Title: Perception of hydraulic fracturing in western Canada: Public survey results

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Summary

Hydraulic fracturing, colloquially known as fracking, is an extremely divisive topic. One of its associated risks is the potential for induced seismicity (IS). Although hydraulic fracturing (HF) has been around since the 1950s in Alberta (Alberta Environment and Parks, 2018), factors affecting public perception of the risks of IS are not fully understood. Public perception can influence social license to operate. Thus, understanding the factors that influence public perception can lead to smoother interactions between industry and the public and improve the reputation of industry. A better understanding may also ensure safe and economic energy production can continue. Last spring, we distributed a survey to the public to explore the opinions and perceptions of HF and the oil and gas industry in western Canada. This allows us to evaluate public preferences for, and acceptability of, HF operations and related public perceptions of risk. While some outcomes are not surprising, such as the concept of NIMBY (not in my back yard), many of the conclusions will be able to provide new insights to inform policy and best practice reviews within the industry and regulatory bodies. Support not only for oil and gas, but also for specific HF scenarios that include different levels of anticipated seismicity was explored, along with the influence of things like prior earthquake experience, energy industry work experience, and knowledge. The main concerns the public have in relation to the oil and gas industry are shown to be related to water quality, water usage, and surface spills. Overall, the results of these surveys will enable us to make policy recommendations, which will bring local industry, integral to the Alberta economy, more in line with the perceptions and preferences of the Alberta public.

Theory / Method / Workflow

In recent years, there has been an increase in fluid injections associated with hydraulic fracturing (Atkinson et al., 2016; Vengosh et al., 2014). This comes with an increase in the risk of IS as well as increasing scrutiny from both the public and regulators (Atkinson et al., 2016). Outside of Canada, there have been studies examining information-seeking behaviour related to IS risks (Kahlor et al., 2019) and public perception of the energy industry and oil and gas extraction (Rassenfoss, 2019). Within Canada, there have been only a few studies related to the oil and gas industry, and specifically HF and IS (Boroumand, 2015; Truong et al., 2019). Aside from these studies, research into public perceptions of HF, IS, and the oil and gas industry in energy-rich western Canada is minimal and needs expanding, making the results of this survey a timely addition to the field.

This study uses a survey questionnaire and embedded factorial survey experiment (FSE) to elicit participants' preferences for HF project scenarios in the context of IS. The FSE approach forces participants to make trade offs between different HF scenario attributes, including distance, truck traffic intensity, time of day of operation, level of community control, level of community financial benefit, and anticipated risks of seismicity. Scenario attributes were randomized, presenting participants with a variety of scenarios to respond to that allows the researchers to measure preferences and perceived risk factors of HF activities. There was an additional focus on the role of self-rated, or subjective, knowledge in perceptions of acceptability of HF.

The accompanying survey was divided into 8 sections, with approximately 35 questions being presented to each respondent. Some responses were removed due to non-completion of the FSE section, and persons under the age of 18 were not permitted to take the survey. All responses from participants over the age of 18 who completed at least part of the FSE section were included in the analysis.

In the FSE section of this survey, respondents were presented with six FSE scenarios, chosen at random out of a total of 144 scenarios, and asked to indicate their level of support for the scenario on an 11-point scale from 0 (do not support at all) to 10 (fully support). The attributes in each scenario were randomized so that every scenario was different. Each of the 144 scenarios was rated 50 times on average.

The results of the FSE responses were analyzed using three different regression models – ordinary least squares (OLS), OLS with cluster-robust standard error, and random intercept. The OLS model is a linear regression that estimates the relationship between the independent variables (the attribute levels) and dependent variable (the respondent's rating of the scenario). Because responses may vary not only from scenario to scenario (within respondents) but also from person to person (between respondents), the error terms become multilevel. The cluster-robust standard error model attempts to deal with this in the simplest manner, but another approach is the random intercept model. This type of model aims to estimate and account for the amount of variation in responses that can be attributed to differences between respondents, giving a result that is assumed to show only the difference in attribute levels (Auspurg & Hinz, 2015).

We obtained approval for the survey from the University of Alberta Research Ethics Board in February 2019 (Pro00088384) before data collection began. We then administered the survey to the public online and shared the link via word of mouth and email. Additionally, it was featured as a news story online and on the radio (Antoneshyn, 2019; Craddock, 2019; Willis, 2019). The survey was active and available from March 11 to June 24, 2019, and received 1,311 valid responses. A total of 305 surveys were begun but not completed beyond the first section, disqualifying them from the analysis which required at least partial completion of the FSE scenarios in section 2. Of the 1,311 valid surveys, only 179 did not fully complete the survey (i.e. click "submit" on the final page after being presented with all questions). This gives us a full completion rate of 70% and a partial completion rate (completed at least part of the FSE section but did not click "submit") of 81%. Due to the nature of distribution, it is impossible to know how many potential participants were reached and thus we cannot estimate the percentage of the population that our 1,311 responses represent, making a response rate unknown.

Results, Observations, Conclusions

Overall, acceptability of HF in western Canada appears to be tied to: responsible exploration practices, with mitigation measures in place to safeguard fresh water resources; distance from habitations; community consultation; economic and financial community benefits; anticipated seismicity levels; and subjective knowledge of the energy industry.

The mean rating of all FSE scenarios together is 4.9, with a relatively large standard deviation of 3.8. Together, these indicate a broad, balanced range of responses.

An expected finding from the FSE scenarios is that there are higher levels of support for scenarios which place an HF operation farther from the respondent's home, involve community consultation, provide economic or financial benefits to the community, and involve lower levels of anticipated seismicity.

From the regression models, we find that the largest positive effect on scenario responses is due to benefits. This implies that perception of HF operations may be linked to how those operations benefit local communities. There was also a positive impact on responses due to consultation – communities want to be involved in the planning and placement of operations where possible. Unsurprisingly, placing operations more than 15 km from a respondent's home had a significant positive effect on responses. The last main point to be taken from the initial regression models was the significantly negative effect increasing levels of anticipated seismicity had on support for any given operation.

Subjective knowledge was measured by asking 'How would your friends and family rate your knowledge of the energy industry in western Canada?' with four available responses: not at all knowledgeable, somewhat knowledgeable, knowledgeable, and very knowledgeable.

Having subjective knowledge of the energy industry in western Canada appears to have a noticeable influence on FSE scenario ratings, as shown in Figure 1. Respondents with subjective knowledge are less likely to be negatively influenced by the possibility of IS events (provided they cause no damage) and by closer proximity of HF operations to their homes.

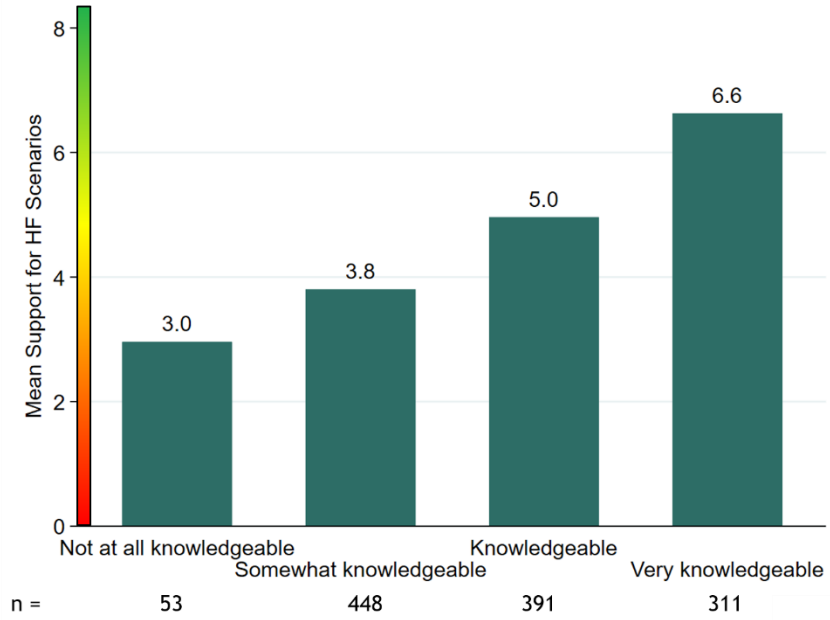

Figure 1: Mean FSE scenario ratings on a scale from 0 (do not support at all) to 10 (fully support) for the different subjective knowledge ratings. Number of respondents for each knowledge category are (L-R): 53, 448, 391, 311.

From the rest of the questionnaire, we found that nearly 40% of respondents had attended an informational meeting related to oil and gas activity at some point.

Approximately 80% of respondents are within their prime working years (ages 25-64), and approximately 86% have some amount of post-secondary education. There was a nearly even distribution of male and female respondents (54% and 42%, respectively).

Over 90% of respondents responded correctly to three or more of the five true/false questions related to HF used to approximate objective knowledge. In comparison, just over 95% of respondents described themselves as being at minimum "somewhat knowledgeable" about the oil and gas industry in western Canada. This indicates a minimal gap between subjective and objective knowledge.

49% of respondents had never experienced an earthquake in their lives, while 51% had.

Over 60% of respondents had some form of experience with the energy industry through either personal related work experience or through work experience of a family member.

Respondents were also asked to rate their level of trust for specific oil and gas industry stakeholder parties, in addition to the perceived transparency of those parties. The top three most trustworthy parties are felt to be local oil and gas companies, government regulators, and local municipalities, with all three having a primary mode response of “somewhat trustworthy”. The least trusted party is indicated to be local politicians, with a primary mode response of “somewhat untrustworthy”. Similarly, the top three most transparent parties are felt to be local oil and gas companies, government regulators, and local municipalities, all with a primary mode response of “somewhat transparent”. The least transparent were local politicians and environmental organizations, with primary mode responses of “somewhat non-transparent” and “not at all transparent” respectively. From this analysis, it appears that trust is correlated with transparency. This could indicate a need for strong, transparent communication with the public in order to improve public trust of stakeholder parties associated with the oil and gas industry.

Recommendations for improved communication with the public include the creation of an interactive website containing HF operations with dates and locations, contact information for the owner and regulator and links to relevant websites, and incident logs.

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