

6-3-2020

## Predicting Support for Oil Industry Regulatory Policy Alternatives During the North Dakota Oil Boom

Curtis W. Stofferahn

*University of North Dakota*, [curtis.stofferahn@und.edu](mailto:curtis.stofferahn@und.edu)

Jessica Schad

*Utah State University*, [jessica.schad@usu.edu](mailto:jessica.schad@usu.edu)

Follow this and additional works at: <https://egrove.olemiss.edu/jrss>



Part of the [Place and Environment Commons](#), and the [Rural Sociology Commons](#)

---

### Recommended Citation

Stofferahn, Curtis, and Jessica Schad. 2020. "Predicting Support for Oil Industry Regulatory Policy Alternatives During the North Dakota Oil Boom." *Journal of Rural Social Sciences*, 35(2): Article 1. Available At: <https://egrove.olemiss.edu/jrss/vol35/iss2/1>

This Article is brought to you for free and open access by the Center for Population Studies at eGrove. It has been accepted for inclusion in *Journal of Rural Social Sciences* by an authorized editor of eGrove. For more information, please contact [egrove@olemiss.edu](mailto:egrove@olemiss.edu).

---

## Predicting Support for Oil Industry Regulatory Policy Alternatives During the North Dakota Oil Boom

### Cover Page Footnote

Please address all correspondence to Dr. Curtis Stofferahn ([curtis.stofferahn@und.edu](mailto:curtis.stofferahn@und.edu)).

# Predicting Support for Oil Industry Regulatory Policy Alternatives During the North Dakota Oil Boom

Curtis W. Stofferahn  
University of North Dakota

Jessica D. Ulrich-Schad  
Utah State University

## ABSTRACT

Given the lax regulatory response of the North Dakota state government during the most recent oil boom in the Bakken Shale, a better understanding of how to frame alternative regulation policies for the general public is needed. A survey of North Dakota residents in 2015 indicates that attitudes towards the oil industry, regulation, property rights, and messaging are associated with policy receptivity. Thus, in framing policy messages, focus should be on confirming what the public already knows about oil industry conduct and its opposition to regulation. Individuals who are more favorable to regulation and have an unfavorable attitude towards the oil industry are more likely to be favorable to pro-regulatory policy alternatives. The results of these findings help us to better understand how the public views the regulation of natural resources and can be used by groups seeking to develop messaging to promote policy receptivity.

## KEYWORDS

Bakken Shale, framing, policy, regulation, unconventional oil and gas development

## INTRODUCTION

The North Dakota Oil Boom refers to the rapid expansion of unconventional oil and gas development (UOGD) which began in 2006 in the Bakken Formation (Nicas 2012a). Although oil companies have been drilling in the Bakken formation since the 1950s, new technologies, namely hydraulic fracking and horizontal drilling, have made it possible to

extract the oil from shale (Cournoyer 2011). In May 2012, North Dakota became the No. 2 oil-producing state in the U.S. Its daily production of oil increased to more than 575,000 barrels by 2012, which was slightly above Alaska's daily production of oil but still far below Texas's (Nicas 2012b). By June 2014, North Dakota was producing 1 million barrels of oil per day, the most the state had ever produced (Starbuck 2014). This rapid expansion strained the ability of state agencies to monitor and regulate oil production and resulted in numerous instances of wasteful flaring of natural gas, wastewater spills, radiation leakages, and improper disposal of radioactive drilling socks (Starbuck 2014).

While production began to slow in 2014, Jacquet and Kay (2014) argue that, given volatile energy prices, places rich in hydrocarbon like the Bakken Shale will experience waves of mini-booms and mini-busts as opposed to complete busts in the oil and gas industry. This means it is important to continue to examine how residents are impacted by UOGD and their views of policies aimed at regulating oil and gas companies in the context of UOGD. Thus, we explore how demographic characteristics and attitudes predict support for varying regulatory policy alternatives regarding UOGD in the context described below.

In 2014, the *New York Times* (NYT) ran a series of articles detailing the oil industry's poor environmental record and the state's lax approach to managing the North Dakota Oil Boom (Sontag and Gebeloff 2014). The state response to these articles was to defend their regulatory approach. The governor called the depiction of the state's regulatory approach inaccurate, unfair, misleading, and unrepresentative of how state agencies operate and regulate the oil industry. He said that the state had adopted some of the most restrictive regulations designed to protect the environment (Chaussee 2014). Others criticized the *Times'* focus on only the negative without acknowledging that regulatory work was underway.

As the *Times* article noted, North Dakotans are unlikely to protest the consequences of the lax regulatory environment, and the few individuals or organizations who dared to speak out against the relative leniency of state agency regulation were often marginalized (Sontag and Gebeloff 2014). Starting in 2013, however, several high-profile incidents drew public attention to the problems of relatively unregulated UOGD, which increased advocacy for greater regulation. These incidents included the largest on-land oil spill (MacPherson 2018; Sontag and Gebeloff 2014), the largest waste water spill in North Dakota (Dalrymple 2015; Hirji 2015; Jerome 2015), publication of a satellite photo showing flaring in the oil patch (Kusnetz 2014; Salmon and Logan 2013), the discovery of an

illegal radioactive drilling socks dump site (Atkin 2014a; Dalrymple 2014; Donovan 2014; Keller 2014), and the explosion of tanker cars on a train carrying Bakken crude oil (Atkin 2014b; Nunez 2014). Environmental activists, citing the *NYT* articles, called for the formation of a legislative committee to study state agencies' failure to enforce state rules and regulations of the industry (Nowatzki 2014).

Because of this increased press coverage, public attention was heightened about high profile oil industry accidents and the state's minimal enforcement of existing regulations. Prior to the 2015 legislative session, there was speculation in the media about the extent to which the public would welcome new regulations of the oil and gas industry, as well as more rigorous enforcement of existing regulations. It was in this context that the Dakota Resource Council (DRC) and the Dakotah Chapter of the Sierra Club commissioned a survey to assess public attitudes towards UOGD. Both organizations were predominantly interested in how such attitudes would affect the public's views of regulatory policy messaging. Considering there has been little focus in the literature on framing and perceptions of UOGD regulations, we explore how demographic characteristics and attitudes predict support for varying regulatory policy alternatives regarding UOGD using the survey data collected in 2015.

## THEORETICAL ORIENTATION

Framing, as used in sociology, refers to "frames in communication" (Chong and Druckman 2007:106), and focuses on "words, images, phrases and presentation styles" (Druckman 2001:227) that are used to structure how we communicate. Goffman (1974) was among the first sociologists to develop the framing concept, arguing that frames help people organize what they see in everyday life. Gitlin (1980) defines frames as devices that facilitate how journalists organize vast amounts of information and package that information for audiences. He views frames as the means by which information is recognized, interpreted, presented, and organized for audiences. Hannigan (1995) uses a social constructionist perspective to argue that "claims makers" seek to frame environmental problems in ways that meet their own interests and understandings.

Several psychological processes have been employed to explain the cause of framing effects. Framing has been explained by processes such as the accessibility explanation (Iyengar 1991), the priority explanation (Nelson, Clawson, and Oxley 1997), the applicability explanation (Price and Tewksbury 1997), the readjusting explanation

(Simon 2001), the usability explanation (Pan and Kosicki 2005), and metaphorical reasoning (Lau and Schlesinger 2005). Of importance to this research is Lau and Schlesinger's (2005) model of public opinion, which relies on the use of metaphorical reasoning for understanding policy alternatives (Lakoff and Johnson 1980; Lakoff and Johnson 1999). They refer to their model as a model of "policy metaphors" (Schlesinger and Lau 2000), a borrowed term sometimes used in the literature on policy analysis (Schön and Rein 1994; Stone 1988). According to their model, societies have commonly understood ways of arranging social institutions and judging the effectiveness of their performance. They define social institutions as a set of social norms and practices -- such as "rights," "markets," "communities," or "families" -- representing commonly understood ways of allocating responsibility and distributing scarce collective resources. Individuals' understanding of these institutions is based on a combination of their personal experience (e.g., with one's own family) and culturally transmitted "stories" or frames (Gamson 1992; Lakoff 1996; Nimmo and Coombs 1980). Each of these institutions is a sort of "archetype," or an ideal, from which individuals may deduce the outcomes of actual policies or predict the anticipated outcomes of proposed policy reforms. It is the process of inference across domains that makes these archetypes function as metaphors. According to this model, when new social problems appear, existing institutional arrangements provide "templates" for understanding and judging different proposed solutions. When individuals rely on these shared social institutions as the basis for making comparative judgments, policy metaphors become accessible to a public that may not be very knowledgeable or interested in the political process.

Lau and Schlesinger (2005) extended their analysis of metaphorical reasoning to explore the usefulness of this approach for understanding the American public's choices among policy alternatives, doing so using data from a representative 1995 survey of public opinion toward reform of the U.S. health care system. After controlling for factors that past research has shown as important for understanding public opinion, including general partisan and ideological attitudes, self-interest, political values, and emotions, the health care cognitive frames specified by the general theory of policy metaphors strongly predicted public support for hypothetical solutions to three different health care policy problems. These frames also predicted support for President Clinton's 1993-94 health care reforms after controlling for those same conventional predictors. Most importantly, they demonstrated that these cognitive frames helped

constrain the beliefs of even the least politically aware members of the public.

## LITERATURE REVIEW

A large and growing interdisciplinary body of literature is focused on the socioeconomic impacts of UOGD. Previous sociological studies have focused on topics such as how place of residence affects individuals' perceptions of the oil and gas industry (Theodori 2009); how UOGD booms impact residents' perceptions of crime and daily behavior (Ulrich-Schad, Fedder, and Yingling 2019); how perceptions of the oil and gas industry affect individuals' actions in response to oil and gas development (Theodori and Jackson-Smith 2010); how public opinion about the U.S. energy situation affects policy changes concerning energy efficiency, conservation, and alternative energy sources (Bolsen and Cook 2008); how alternative framing of UOGD is affected by political ideology (Clarke et al. 2015); and how perceptions of energy impacts vary by population density and levels of development (Brasier et al. 2011). None of the research, however, has focused on how individuals' understanding of institutional arrangements provide "templates" for understanding and judging different proposed regulatory policy solutions related to UOGD.

Theodori (2009) found moderate support for his hypotheses that residents residing in places with various levels of energy development exhibit disparate perceptions of problems associated with natural gas development. In the county where natural gas development was more mature, residents were significantly more likely to perceive the social and/or environmental issues more negatively and five economic and/or service problems more positively than residents in counties where natural gas development was less mature. Residents in the county with less mature natural gas development also thought environmental and social problems would become worse.

Ulrich-Schad et al. (2019) surveyed residents in the Bakken Shale region finding that many perceived high levels of crime resulting from the boom and that their daily behaviors were changed as well. As further evidence of social disruption, they also found that residents felt less trust among neighbors and community helping occurred in the boomtown context. In addition, these perceptions mattered in terms of how residents felt about UOGD in general, their plans to migrate, and their involvement in community affairs.

Theodori and Jackson-Smith (2010) found that residents of a metropolitan county in the core area of shale gas production were

suspicious of the incursion of the shale gas industry and detested some possible challenging social and/or environmental issues that they perceived as associated with shale gas development. Contrarily, they valued the economic and/or service-related benefits that resulted from such development. Furthermore, they found that perception of the industry was a primary explanation of why residents became politically engaged and involved in attending a public meeting, contacting local elected officials or government agencies, and voting for or against a candidate based upon their position on drilling for natural gas.

Bolsen and Cook (2008) reported on trends in public opinion between 1974-2006 regarding conventional and alternative energy sources, support for various energy alternatives, and conservation strategies. Polling data at the national level indicated that concern about the energy situation was as high in the 2000s as it was in the 1970s. Although attitudes about traditional sources of energy were strongly influenced by current economic conditions, respondents were becoming more receptive to alternative sources of energy. There were high levels of support for policy changes that involved government promotion of energy conservation.

Clarke et al. (2015) explored how alternative framing of UOGD is affected by political ideology. Their research indicated that people are more supportive of UOGD when it is referred to as shale oil or gas development rather than when it is referred to as fracking. They found that this relationship is mediated by greater perceptions of benefit versus risk. Political ideology did not moderate these effects. These findings are partly explained by the tendency to associate fracking with more negative impacts and shale oil or gas development with more positive impacts.

Brasier et al. (2011) researched how perceptions of energy impacts vary by population density and levels of development. Their case study research in Pennsylvania and New York documented preliminary impacts of natural gas development occurring there. The communities chosen for study varied by level of development and previous extractive history. They found that participants from areas with low population density and higher levels of development had a broader awareness of both positive and negative impacts of natural gas development. They drew upon the regional history of extraction to voice their environmental concern despite direct, local experience.

The purpose of this research is to determine which message frames and oil industry, regulatory, and property rights attitudes are associated with support for policy alternatives. Attitudes serve as an



"archetype," or an ideal from which individuals deduce the outcomes of oil development policy, develop perceptions of oil industry regulation, and determine favorable policy message framing. As mentioned previously, Bolsen and Cook (2008) found support for how perceptions of gas and oil development affected respondents' acceptance of policy changes that included energy conservation and alternative energy sources, and Clarke et al. (2015) found that respondents were more supportive of UOGD when it was framed as shale oil development rather than fracking. However, this review of the literature found no research that examined how individuals' understanding of institutional arrangements provide "templates" for understanding and judging proposed policy solutions or perceptions about regulations.

## METHODS

This analysis is based on telephone interviews of 901 randomly selected adults age 18 or older in North Dakota. The interviews were conducted from February 18 through March 6, 2015. To provide a probability-based sample representative of all such individuals, a dual-frame random digit dial (RDD) sampling methodology was used, whereby both landline and cellular telephone numbers were included, which yielded an error margin<sup>1</sup> of +/- 5.2 percent. The response rate was calculated using the American Association of Public Opinion Research (AAPOR 2020) calculator and estimates the fraction of all eligible respondents in the sample that were ultimately interviewed. It measures all the sampled telephone numbers ever dialed from the original telephone number samples. This is calculated by taking the product of the three component rates: the contact rate, which is the proportion of working numbers where a request for an interview was made (55.2 percent landline, 32.7 percent cellular); the cooperation rate, which is the proportion of contacted numbers where a consent for interview was at least initially obtained versus those refused (35.6 percent landline, 46.0 percent cellular); and the completion rate, which is the proportion of initially cooperating and eligible interviews that were completed (16.6 percent landline, 9.6 percent cellular). The overall response rate for the landline sample was 16.9 percent and for cellular sample was 9.6 percent. Most recent studies using surveys to examine shale oil and gas development use mail or electronic and mail surveys (Fernando, Ulrich-Schad, and Larson forthcoming), and have achieved response rates ranging from 17 to 39 percent. Phone surveys tend to achieve lower response rates than mail or mixed mode surveys (Dillman, Smyth, and Christian 2014), as is true for phone surveys focused on oil

and gas development. A study by Lachapelle and Montpetit (2014), for instance, achieved a response rate of 14 percent in the U.S. portion of their study using RDD, and McGranahan et al. (2017) achieved 17 percent.<sup>2</sup>

In order to assess the representativeness of our data, we compared some of the demographic data from the survey to demographic data from the estimates in the 2015 American Community Survey (ACS) for North Dakota (see Table 1).

Table 1: Comparison of Survey and American Community Survey Data for North Dakota (2015)

	2015 ND Survey	American Community Survey 2015	Difference: ACS-Survey
<i>Education</i>			
Less than high school	6.0	8.3	2.3
High school diploma	21.0	27.4	6.4
Voc. school or some college	21.6	23.4	1.8
Associate or equivalent	24.0	13.2	-10.8
Bachelors or equivalent	18.1	20.1	2.0
Master's degree or higher	9.2	7.6	-1.6
<i>Race and Ethnicity</i>			
Hispanic	3.5	2.9	-0.6
White	87.2	90.8	3.6
Black/African American	5.1	2.3	-2.8
Asian	0.5	1.6	1.1
Native American/Alaskan Native	2.7	6.6	3.9
Native Hawaiian/Pacific Islander	0.3	0.2	-0.1
Other	3.0	1.0	-2.0
<i>Household Income</i>			
\$25,000 or less	15.4	20.4	5.0
\$25,001 to \$50,000	30.9	23.8	-7.1
\$50,001 to \$100,00	31.1	32.4	1.3
\$100,001 +	22.6	23.6	1.0
<i>Age</i>			
18-24 (20-24 in ACS)	13.0	9.4	-3.6
25-34	19.2	14.3	-4.9
35-44	13.8	11.1	-2.7
45-54	15.9	12.7	-3.20
55-64	19.4	12.5	-6.90
65+	18.7	14.2	-4.50

The difference between our survey data and that from the ACS is only greater than 7 percent in two comparisons. Our survey data had nearly 11 percent more with an associate's degree or equivalent and about 7 percent more in the \$25,001 to \$50,000 income group.

The survey questions were developed by staff at the DRC and the Dakota Chapter of Sierra Club in conjunction with the Social Science Research Institute at the University of North Dakota. The survey questions can be found in the final report (Stofferahn, Fontaine, and Morrison 2015). All of the attitudinal items are measured with Likert level responses: strongly support or strongly agree scored as four; somewhat support or somewhat agree scored as three; somewhat oppose or somewhat disagree scored as two; and strongly oppose or strongly disagree scored as one.

The purpose of this research is to determine which message frames and oil industry, regulatory, and property rights attitudes (independent variables) are associated with support for policy alternatives (dependent variable). We hypothesize that each message frame will influence support for policy alternatives, but that oil industry, regulatory policy, and property rights attitudes reflect individuals' understanding of institutional arrangements and provide "templates" for understanding and judging different proposed policy solutions. Because we are interested in classifying individuals on the basis of their support (high or low) for policy alternatives (dependent variable) based upon their support for message frames and oil industry, regulatory, and property rights attitudes (independent variables), we used discriminant analysis. We are interested in predicting whether respondents' support for the independent variables would enable us to classify them into the high support for the dependent variable. The ability to predict which independent variables were more useful in predicting membership in the high support category can be useful in crafting message frames to advance such policy alternatives.

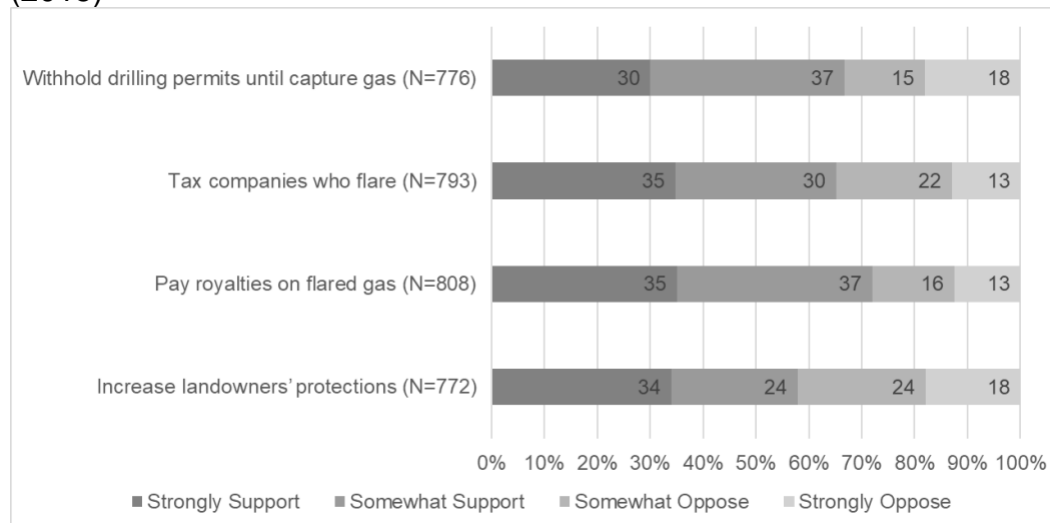
#### *Dependent Variable*

##### *Support for regulatory policy alternatives*

Four questions measure support for regulatory policies (see Figure 1). For all variables described below, we include the question wording used in the survey followed by a shorter label in parentheses. Questions include levels of support (4 point Likert scale) for: "withholding oil drilling permits until oil companies develop the technology to capture and market the natural gas which is now flared" (withhold drilling permits until capture

gas); “taxing oil companies who flare unnecessarily” (tax companies who flare); “requiring oil companies to pay mineral owners’ royalties on the natural gas being wasted” (pay royalties on flared gas); and “increasing landowner protections against oil companies land acquisition tactics” (increase landowners’ protections).

**Figure 1: Support for Regulatory Policy Alternatives in North Dakota (2015)**



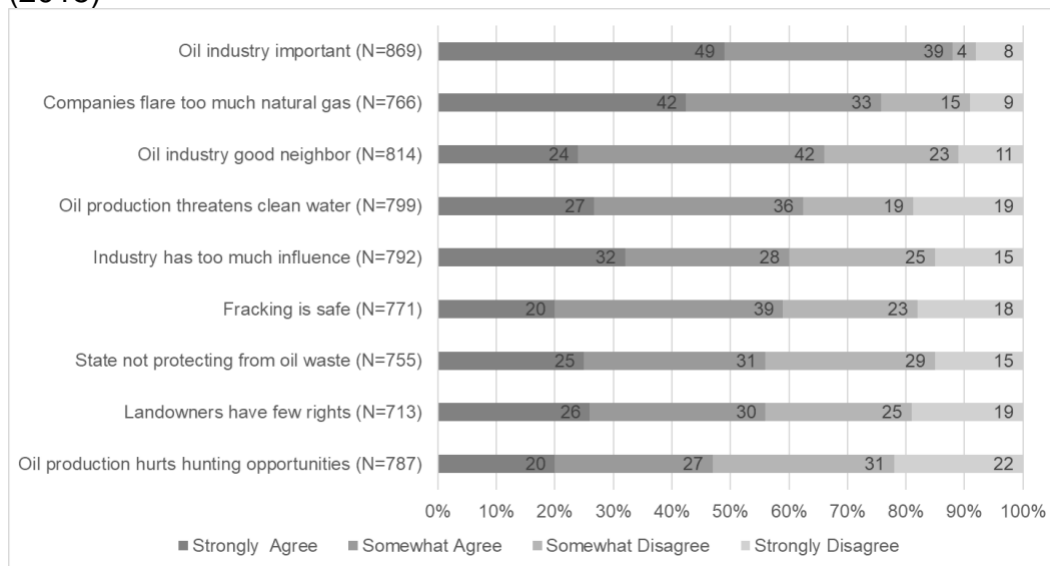
The four questions were combined into a support for regulatory policy alternatives scale (policy alternatives). The scale mean was 11, the variance was 10, the range was 12, the minimum was 4, and the maximum was 16. The higher the score, the greater the support for new policies to regulate the oil industry. The overall Alpha was .75. Dropping “increase landowners’ protections” would have raised the Alpha to .79, but we kept it in the scale because the Alpha was satisfactory with it included. Based upon the frequencies for the newly created scale, we created two separate classification groups -- high support and low support for additional regulations -- by dividing the frequencies for the scale at the midpoint with 49 percent of the cases in the low group and 51 percent in the high group (policy alternatives groups). Those classified in the high support for policy alternatives group would be more likely to support withholding drilling permits until companies can capture gas, taxing companies who flare, requiring companies to pay royalties on flared gas, and increasing landowners’ protections. Those classified in the low support group are less likely to support all four regulatory policy alternatives.

*Independent Variables*

*Attitudes towards the oil and gas industry*

Nine items measure attitudes towards the oil and gas industry (see Figure 2). The highest percentage of respondents (88 percent) agree (strongly and somewhat) that “oil production is important to jobs and North Dakota’s economic prosperity” (oil industry important). At the same time, a high percentage of respondents (75 percent) believe the “oil industry flares off more natural gas than it should” (companies flare too much natural gas). The fewest percentage of respondents (47 percent) agreed that “oil production hurts hunting opportunities in North Dakota” (oil production hurts hunting opportunities). Notably, respondents were more likely to agree (either strongly or somewhat) than disagree with all statements that reflect environmental concerns and the influence of the industry.

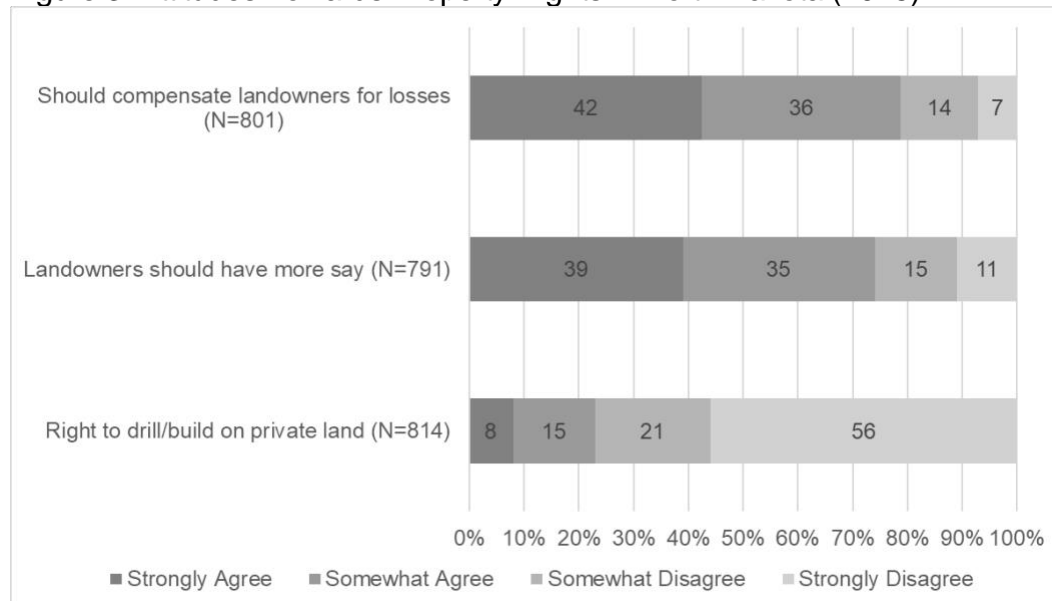
Figure 2: Attitudes Towards the Oil and Gas Industry in North Dakota (2015)



*Attitudes towards property rights*

Three questions comprise respondents’ attitudes towards property rights (see Figure 3). Nearly four out of five respondents (78 percent) believe that “when home/land values are harmed by oil production the industry should do more to compensate owners for their losses” (should compensate owners for losses). A high percentage also agree (74 percent) that “balance needs to be restored and landowners given more say against oil companies” (landowners should have more say). On the other hand, only 23 percent agree that “oil companies should have the right to drill and build pipelines across private lands” (right to drill/build on private lands).

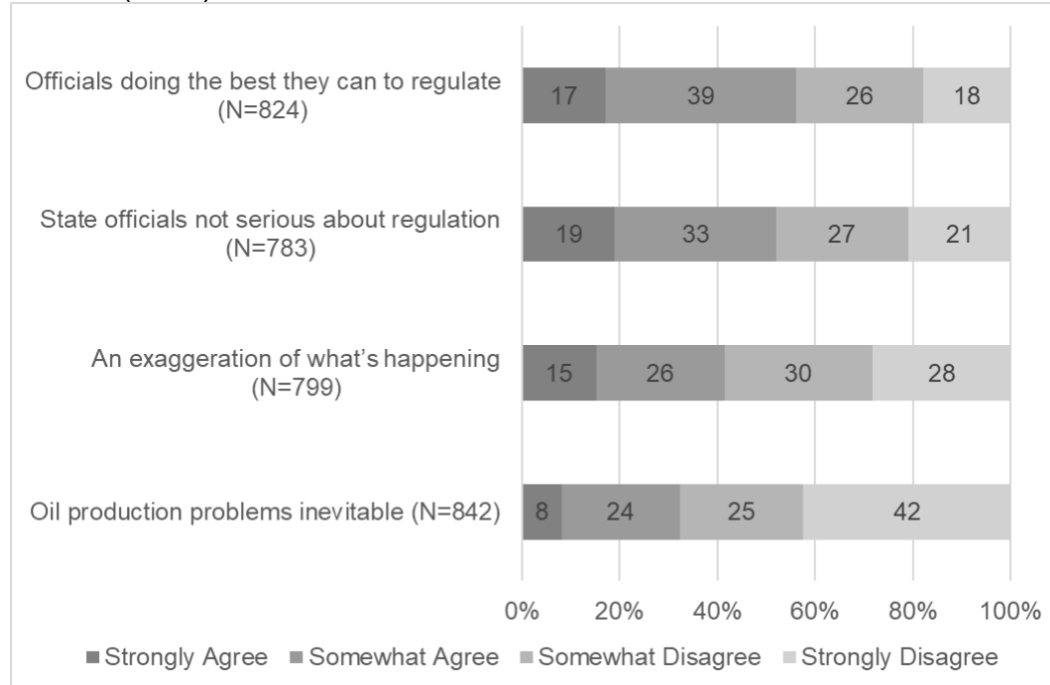
Figure 3: Attitudes Towards Property Rights in North Dakota (2015)



*Attitudes towards oil and gas industry regulation*

Five questions concern attitudes towards oil and gas industry regulation (see Figure 4 for four). Most respondents see the regulations on the oil and gas industry as too lax (49 percent), 41 percent see them as appropriate, and only 10 percent say they are too restrictive (not shown in figure). Most respondents (56 percent) agree that “North Dakota officials are doing the best they can to regulate the oil industry” (officials doing best they can to regulate). About half of respondents (52 percent) also agree that “state officials are doing what the oil companies want” (state officials not serious about regulation). Forty-one percent agree with the statement “this (perceptions of problems associated with lightly-regulated oil development based upon other survey items) is an exaggeration of what is happening in western ND” (an exaggeration of what’s happening). Finally, just one-third (32 percent) agree that “these types of oil production issues/problems can’t be helped” (oil production problems inevitable).

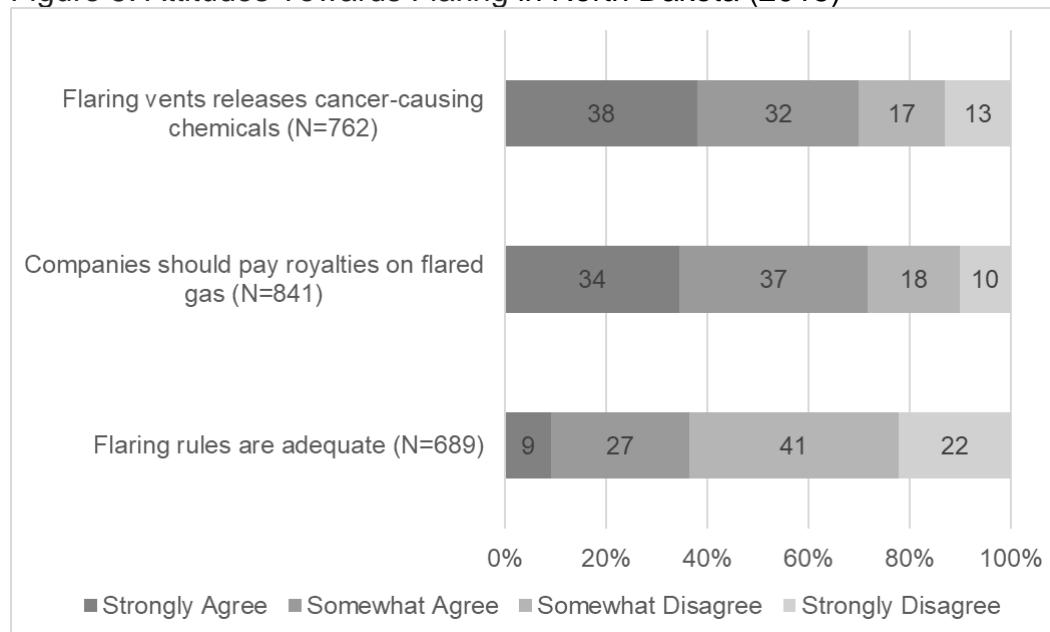
Figure 4: Attitudes Towards Oil and Gas Industry Regulations in North Dakota (2015)



#### *Attitudes towards flaring*

Two-thirds of respondents (65 percent) indicated they were knowledgeable of the “definition of flaring.” Three questions concern respondents’ attitudes towards flaring (see Figure 5). About seven out of ten respondents believe that “oil companies who flare should be required to pay royalties to mineral owners for the wasted gas” (companies should pay royalties on flared gas) and that “flaring vents cancer-causing chemicals into the air and water ways” (flaring vents releasing cancer-causing chemicals). At the same time, very few (36 percent) agree that “current flaring rules are adequate” (flaring rules are adequate).

Figure 5: Attitudes Towards Flaring in North Dakota (2015)

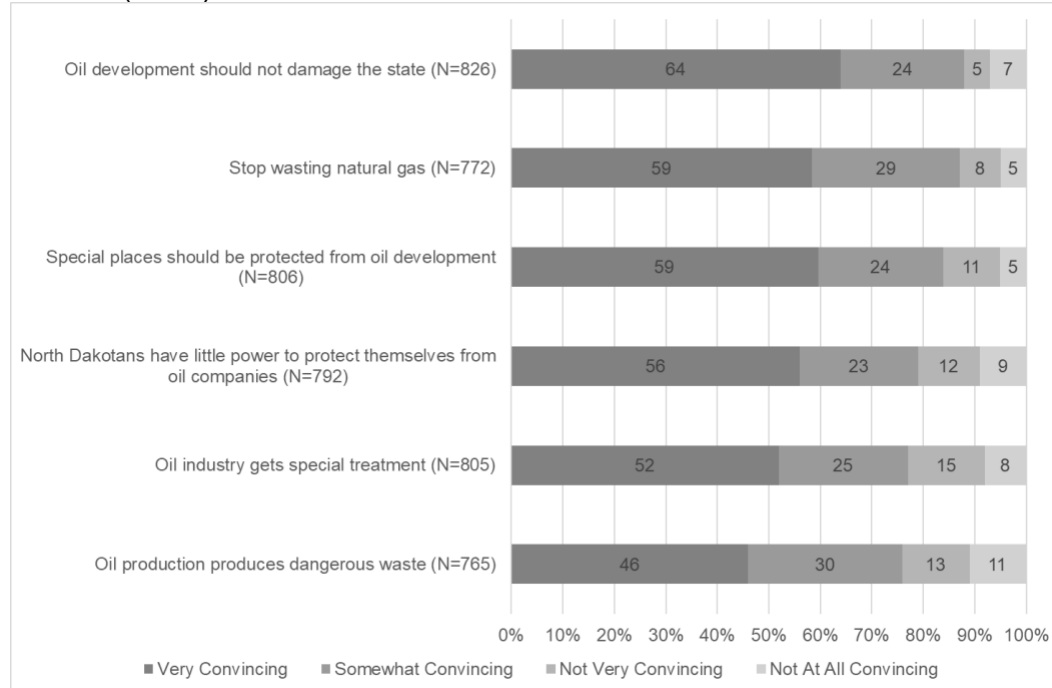


*Attitudes towards policy statements and messages*

Respondents were also asked how convincing six oil and gas development policy statements and messages were (see Table 6). There were generally high levels of agreement that these were convincing messages (e.g., all above 75 percent). The highest percentage of respondents (88 percent) found the messages that “we should slow down the pace of development and make sure we have the capacity to handle the traffic, safety, transportation, housing and other infrastructure” (oil development should not damage the state) and “North Dakota officials should stop giving drilling permits to oil companies if they cannot figure out how to capture natural gas” (stop wasting natural gas) somewhat or very convincing. The fewest percentage of respondents (76 percent) were convinced that “oil production generates radioactive water and oil waste that is dangerous to people who live and work in North Dakota” (oil production produces dangerous waste).



Figure 6: Attitudes Towards Policy Statements and Messages in North Dakota (2015)



### *Demographic Variables*

Demographic variables education, age, residence, income, and political party affiliation were included in the discriminant analysis (see Table 2).

### ANALYSIS AND RESULTS

Discriminant function is a statistical analysis used to predict a categorical dependent variable (called a grouping variable) by one or more continuous or binary independent variables (called predictor variables). Discriminant function analysis is useful in determining whether a set of variables is effective in predicting category membership. Discriminant function analysis is used when groups are known beforehand. Each case must have a score on one or more quantitative predictor measures and a score on a group measure. In simple terms, discriminant function analysis is classification: the act of distributing things into groups, classes, or categories of the same type.

**Table 2: Summary of Descriptive Statistics of the Study Independent Variables, Survey of North Dakota Residents (2015)**

Variable Name	Question wording/variable creation	Variable measurement/coding	Mean	Standard deviation
Age (N=901)	Is your age 18-24, 25-34, 35-44, 45-54, 55-64 or 65 or older?	1 (18-24) 2 (25-34) 3 (35-44) 4 (45-54) 5 (55-64) 6 (65+)	3.7	1.7
Education (N=901)	What is the highest level of education you have completed?	1 (Less than high school) 2 (High school diploma) 3 (Vocational or some college) 4 (Associates or equivalent) 5 (Bachelor's or equivalent) 6 (Master's degree or higher)	2.8	1.1
Residence (N=863)	Would you say you live in a rural area, a small town, or a city?	1 (Rural area) 2 (Small town) 3 (City)	2.2	.8
Income (N=643)	Thinking about members of your family living in this household, what is your combined annual income (pause) please remember we don't have to know exactly, but I will read some broad income categories - please tell me which one best reflects the total pre-tax income from all sources earned in the past year?	1 (\$25,000 or <) 2 (\$25,001-\$50,000) 3 (\$50,001-\$100,000) 4 (\$100,000 & >)	2.6	1.0
Political Party (N=760)	And do you consider yourself to be a Republican, a Democrat Independent, or a Libertarian?	1 (Libertarian) 2 (Republican) 3 (Independent) 4 (Democrat)	2.0	1.0

As is typical in much sociological research, our survey data included ordinal level attitudinal and demographic variables. The survey data included ordinal demographic variable which were used in the discriminant analysis. Ordinal variables with five or more categories can often be used as continuous without any harm to the analysis (Johnson and Creech, 1983; Norman, 2010; Sullivan and Artino, 2013; Zumbo and Zimmerman, 1993). In cases like this, researchers refer to the variable as an “ordinal approximation of a continuous variable,” and they cite the five or more categories rule. Of the five demographic variables, three did not

meet the five or more categories rule: residence (3 categories), income (4 categories), and political party (4 categories). We assume that the deviation from the five categories rule is not significant enough to affect analysis because the demographic variables reflect an underlying continuous variable. We summed the attitudinal ordinal level attitudinal variables to create approximately continuous variables which is commonly done based on the logic of using ordinal variables previously mentioned.

One of the assumptions of discriminant analysis is that the data represent a sample from a multivariate normal distribution which can be examined by histograms of frequency distributions. The concern is that ordinal data might not be normally distributed, however, violations of the normality assumption are not "fatal" and the resultant significance test are still reliable as long as non-normality is caused by skewness and not outliers (Tabachnick and Fidell 1996).

The discriminant model was developed based upon Schlesinger and Lau's (2000) model of public opinion relying on the use of metaphorical reasoning for understanding policy alternatives. In the discriminant model, the independent variables include individuals' attitudes towards the oil industry (which represent individuals' frames about how the oil industry has operated in the state); their attitudes towards property rights (which represent their frames about the sanctity of private property); and policy statements and messages (because of their importance in affecting policy alternatives, the dependent variable).

The results of the last step of the discriminant analysis are reported in Table 3. Of the variables that the procedure entered in the last step, included were: four from the clusters comprising attitudes towards the industry and policy statements/messaging; three from the cluster comprising attitudes towards regulation; and only one variable that represented attitudes towards property rights. The demographic variables of political party affiliation and residence were entered in the last step.

The eigenvalue for the discriminant function is 1.9, which indicates a strong function. The canonical correlation is a correlation between the discriminant scores and the level of the dependent variable. The canonical correlation for the discriminant function is .8, indicating a moderately strong correlation. The Wilk's Lambda is the proportion of the total variance in the discriminant scores not explained by differences among groups. A lambda of 1.00 occurs when observed group means are equal (all variance is explained by factors other than difference between those means), while a small lambda occurs when within-groups variability is insignificant compared to the total variability. A small lambda indicates that

the group means appear to differ. The associated significance value indicates whether the difference is significant. In this case, the significance level indicates that the group means for each of the variables that the procedure entered on the last step are significantly different (not shown in table). The Wilks' Lambda was .4 with a Chi-square of 274.3 and 14 degrees of freedom which was significant at <.001.

Table 3: Variables in the Last Step of the Discriminant Function Analysis, Survey of North Dakota Residents (2015)

	Tolerance	F to Remove	Wilks' Lambda
Oil industry important	.3	9.5	.4
Landowners should have more say	.6	16.6	.4
Fracking is safe	.7	14.3	.4
Companies flare too much natural gas	.5	29.3	.4
Oil production produces dangerous waste	.5	18.0	.4
Special places should be protected from oil development	.7	11.8	.4
Withhold drilling permits until capture gas	.6	20.3	.4
Oil development should not damage the state	.4	64.6	.4
An exaggeration of what's happening	.8	11.3	.4
Companies should pay royalties on flared gas	.7	23.1	.4
Flaring vents releasing cancer-causing chemicals	.6	14.9	.4
Should compensate landowners for losses	.7	5.2	.4
Political party	.7	8.8	.4
Residence	.7	6.4	.4

Table 4 presents the standardized canonical discriminant function coefficients. These coefficients work just like beta weights in regression and could be used to write out the equation for the discriminant function. They indicate the direction of the effect (positive or negative) with the dependent variable "policy alternatives group." The score is calculated in the same manner as a predicted value from a linear regression, using the standardized coefficients and the standardized variables.

Table 4: Standardized Canonical Discriminant Function Coefficients for the Discriminant Function Analysis, Survey of North Dakota Residents (2015)

	Function 1
Oil industry important	-.4
Landowners should have more say	.4
Fracking is safe	-.3
Companies flare too much natural gas	.6
Oil production produces dangerous waste	.4
Special places should be protected from oil development	-.4
Withhold drilling permits until capture gas	.4
Oil development should not damage the state	-.9
An exaggeration of what's happening	-.3
Companies should pay royalties on flared gas	.4
Flaring vents releasing cancer-causing chemicals	.4
Should compensate landowners for losses	.2
Political party	.3
Residence	-.2

Table 5 presents the classification results. Overall, the discriminant function correctly classified 76 percent of all the original grouped cases, 72 percent of the low support for “policy alternatives group,” and 80 percent of the high support for “policy alternatives group.”

Table 5: Classification Results of the Discriminate Analysis, Survey of North Dakota Residents (2015)

		Predicted	Group	Membership
Original Count	Policy alternatives group	1	2	Total
	1	237	93	330
	2	71	278	349
	Ungrouped Cases	97	125	222
Percent	1	71.8	28.2	100.0
	2	20.4	79.6	100.0
	Ungrouped cases	43.8	56.2	100.0

The discriminant function analysis performed well in properly classifying most cases, and it helped to determine which messaging items and fostering which attitudes would be more effective in developing a campaign to increase receptivity to policy options. We find that attitudes towards the oil industry, regulation, property rights, and messaging influence policy receptivity. Table 6 presents the results of the discriminant classification by attitudes towards industry, messaging, regulation, property rights, and demographic variables.

Table 6: Interpretation of Results of the Discriminate Analysis, Survey of North Dakota Residents (2015)

	Variable	Standardized Canonical Function Coefficient
Attitudes Towards Industry	Oil industry important	-.4
	Landowners should have more say	.4
	Fracking is safe	-.3
	Companies flare too much natural gas	.6
Attitudes Towards Messaging	Oil production produces dangerous waste	.4
	Special places should be protected from oil development	-.4
	Withhold drilling permits until capture gas	.4
	Oil development should not damage the state	-.9
Attitudes Towards Regulation	An exaggeration of what's happening	-.3
	Companies should pay royalties on flared gas	.4
	Flaring vents releasing cancer-causing chemicals	.4
Attitudes Towards Property Rights	Should compensate landowners for losses	.2
Other	Political party	.3
	Residence	-.2

In regard to *attitudes towards industry*, the standardized coefficients for all items were in the expected direction, with those respondents who disagree about the importance of the oil industry, agree that landowners have few rights, disagree that fracking is safe, and agree that companies flare too much natural gas being more likely to be classified in the high support for policy alternatives group.

Concerning *attitudes towards messaging*, two of the standardized coefficients were in the expected direction, but two were not. As was expected, as agreement that oil production produces dangerous wastes increases, and as agreement that permits should be stopped until natural gas is captured increases, respondents were more likely to be classified in the high support for policy alternatives group. Unexpectedly, as agreement that some places are too important to be sacrificed to oil production increases, and as agreement that oil development should not damage the state increases, respondents were more likely to be classified in the low support for policy alternatives group. These two statements would seem to

indicate that respondents are not opposed to oil development, they just want more regulation of existing oil development.

The three questions concerning *attitudes towards regulation* had standardized coefficients going in the expected direction. As was expected, as agreement that what is happening in western North Dakota is an exaggeration increases, the more likely respondents would be classified in the low support for policy alternatives group. Furthermore, when agreement that companies should pay royalties on flared natural gas increases, and as agreement that flaring vents is releasing cancer-causing chemicals increases, respondents were more likely to be classified in the high support for policy alternatives group.

Regarding the one question concerning *attitudes towards property rights*, the standardized coefficient was in the expected direction. As was expected, as agreement that oil companies should compensate landowners for their losses increases, respondents were more likely to be categorized in the high support for policy alternatives group.

Finally, the direction of the standardized coefficients for the two demographic questions were as expected. Assuming a continuum of conservative to liberal (from Libertarian to Republican to Independent to Democrat), as political party affiliation became more liberal, respondents were more likely to be categorized in the high support for policy alternatives group. Further, as residence became more urban, respondents were more likely to be classified in the low support for policy alternatives group. The latter is somewhat incongruous, but rural residents are more likely to be exposed to the hazards of unregulated rural industrial development. Accordingly, they would be more likely to be classified in the higher policy attitude group.

## CONCLUSIONS

This research drew upon Lau and Schlesinger's (2005) model of public opinion that relies on the use of metaphorical reasoning for understanding policy alternatives. In this analysis, the oil industry is defined as the institution which is involved in allocating responsibility and distributing resources through the market or through the political process. Individuals, through their shared understandings, construct the oil industry as an archetype from which they have deduced the outcomes of proposed regulatory policies. Because of the existing and emerging problems associated with oil development, individuals have drawn upon this archetype of the oil industry to understand and judge proposed regulatory policies. By relying on these shared archetypes of the oil industry as the

basis for evaluating proposed regulatory policies, various messaging strategies can be employed to increase individuals' unfavorable perceptions of the oil industry, increase their favorable attitudes towards regulation, and thereby influence their receptivity of policies that increase regulation on the oil industry.

The results of this discriminant analysis would indicate that in framing favorable policy messages, environmental organizations seeking to increase public support for oil and gas regulations can focus on confirming what the public already knows about how the oil industry has conducted itself in the state as well as the industry's opposition to regulation. Individuals who are more favorable to regulation, are opposed to the lack of regulation on the oil industry, and have an unfavorable attitude towards the oil industry are more likely to be favorable to pro-regulatory policy messages. Such attitudes will continue to be important to examine as the oil and gas industry in the area continues cycles of mini-booms and mini-busts that impact residents differentially over time (Jacquet and Kay 2014).

## NOTES

<sup>1</sup> This means that one can be 95 percent confident that the mean response for any question in the statewide sample of adults will not vary more than 5.2 percent in either direction from the actual mean for the response if all adults age 18 or older in North Dakota were surveyed.

<sup>2</sup> The response rate has traditionally been fundamental to survey research based on the assumption that the larger the proportion of participating sample units, the more accurate the survey estimate. Two factors have undermined the role of the response rate as the foremost authority of survey quality (AAPOR 2020): Mainly resulting from increasing refusals, response rates have decreased, sometimes steeply, among all methods of survey management. Consequently, survey organizations have had to expend more effort in data collection making survey administration much more expensive. Simultaneously, studies comparing survey estimates to benchmark data from the government sample surveys have doubted the positive correlation between response rates and survey quality. Results of these studies have demonstrated that the least bias often comes from surveys with less than ideal response rates.

## ACKNOWLEDGEMENTS

The authors appreciate the feedback from the anonymous reviewers and assistance provided by Utah State University doctoral student Kristen Koci in reviewing and formatting the paper.

## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.



## FUNDING

The authors would like to thank the Dakota Resource Council and the Dakotah Chapter of the Sierra Club for the resources to conduct the survey.

## REFERENCES

- American Association of Public Opinion Research (AAPOR). 2020. "Response Rates: An Overview." Retrieved March 1, 2020 (<https://www.aapor.org/Education-Resources/For-Researchers/Poll-Survey-FAQ/Response-Rates-An-Overview.aspx>).
- Atkin, Emily. 2014a. "Some of The Most Dangerous Crude Oil in the World Is Fueling North Dakota's Energy Boom." *Think Progress*, February 24, p. A1. Retrieved July 13, 2015 (<https://thinkprogress.org/some-of-the-most-dangerous-crude-oil-in-the-world-is-fueling-north-dakotas-energy-boom-73bc9f94c43d/>).
- Atkin, Emily. 2014b. "Radioactive 'Oil Socks' Found Illegally Stockpiled in Abandoned North Dakota Gas Station." *Think Progress*, March 12, p. A1. Retrieved July 13, 2015 (<https://thinkprogress.org/radioactive-oil-socks-found-illegally-stockpiled-in-abandoned-north-dakota-gas-station-f462e76abd55/>).
- Bolsen, Toby, and Fay Lomax Cook. 2008. "Public Opinion on Energy Policy: 1974-2006." *Public Opinion Quarterly* 72(2):364-388.
- Brasier, Kathryn J., Matthew R. Filteau, Diane K. McLaughlin, Jeffrey Jacquet, Richard C. Stedman, Timothy W. Kelsey, and Stephan J. Goetz. 2011. "Residents' Perceptions of Community and Environmental Impacts from Development of Natural Gas in the Marcellus Shale: A Comparison of Pennsylvania and New York Cases." *Journal of Rural Social Sciences* 26(1):32-61.
- Chaussee, Mike. 2014. "Governor Dalrymple's Statement on New York Times Articles on Oil Boom." *KX News*. Retrieved July 13, 2015.
- Chong, Dennis, and James N. Druckman. 2007. "Framing Theory." *Annual Review of Political Science* 10:103-126.
- Clarke, Christopher E., Philip S. Hart, Jonathon P. Schuldt, Darrick T. N. Evensen, Hilary S. Boudet, Jeffrey B. Jacquet, and Richard C. Stedman. 2015. "Public Opinion on Energy Development: The Interplay of Issue Framing, Top-of-Mind Associations, and Political Ideology." *Energy Policy* 81:131-140. doi:10.1016/j.enpol.2015.02.019
- Cournoyer, Caroline. 2011. "North Dakota's Oil Boom is a Blessing and a Curse." *Governing*, August, p. A1. Retrieved July 13, 2015

- (<http://www.governing.com/north-dakotas-oil-boom-blessing-curse.html>).
- Dalrymple, Amy. 2015. "Pipeline Company Didn't Use Remote Sensors Before Leak." *Fargo Forum*, March 1, p. A1. Retrieved July 13, 2015. (<http://www.inforum.com/news/3690442-pipeline-company-didnt-use-remote-sensors-leak>).
- Dalrymple, Amy. 2014. "New State Rules Call for Leak-proof Containers for Filter Socks." *Oil Patch Dispatch*. Retrieved July 13, 2015.
- Dillman, Don A., Jolene D. Smyth, and Leah Melani Christian. 2014. *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. Hoboken, NJ: John Wiley & Sons.
- Donovan, Loren. 2014. "Radioactive Dump Site Found in Remote North Dakota Town." *Bismarck Tribune*, March 11, p. A1. Retrieved July 13, 2015. ([http://bismarcktribune.com/bakken/radioactive-dump-site-found-in-remote-north-dakota-town/article\\_39d0d08a-a948-11e3-8a3b-001a4bcf887a.html](http://bismarcktribune.com/bakken/radioactive-dump-site-found-in-remote-north-dakota-town/article_39d0d08a-a948-11e3-8a3b-001a4bcf887a.html)).
- Druckman, James N. 2001. "The Implications of Framing Effects for Citizen Competence." *Political Behavior* 23(3):225-256.
- Fernando, Felix, Jessica D. Ulrich-Schad, and Eric C. Larson. Forthcoming. "Analysis of Research Methods Examining Shale Oil and Gas Development." Chapter in *Coordinating Research on the Social Impacts of Energy Development: Synthesis Across the Social Sciences*, edited by J. Jacquet, J. Haggerty, and G. Theodori. Louisville, CO: Social Ecology Press.
- Gamson, William A. 1992. *Talking Politics*. New York: Cambridge University Press.
- Goffman, Erving. 1974. *Frame Analysis: An Essay on the Organization of Experience*. Cambridge, MA: Harvard University Press.
- Gitlin, Todd. 1980. *The Whole World is Watching: Mass Media in the Making and Unmaking of the New Left*. Berkeley: University of California Press.
- Hannigan, John A. 1995. *Environmental Sociology: A Social Constructionist Perspective*. New York: Routledge.
- Hirji, Zahra. 2015. "Ice Hinders Cleanup of Yellowstone Oil Pipeline Spill." *Inside Climate News*, January 21, p. A1. Retrieved July 13, 2015 (<http://insideclimatenews.org/news/20150121/ice-hinders-cleanup-yellowstone-oil-pipeline-spill>).
- Iyengar, Shanto. 1991. *Is Anyone Responsible? How Television Frames Political Issues*. Chicago: University of Chicago Press.

- Jacquet, Jeffrey B., and David L. Kay. 2014. "The Unconventional Boomtown: Updating the Impact Model to Fit New Spatial and Temporal Scales." *Journal of Rural and Community Development* 9(1):1-23.
- Jerome, Sarah. 2015. "Cleanup Update Following North Dakota's Biggest Produced Water Spill." *Water Online*, February 10, p. A1. Retrieved July 13, 2015 (<http://www.wateronline.com/doc/cleanup-update-following-north-dakota-s-biggest-produced-water-spill-0001>).
- Johnson, David, and James Creech. 1983. "Ordinal Measures in Multiple Indicator Models: A Simulation Study of Categorization Error." *American Sociological Review*, 48:398-407.
- Keller, Sarah. 2014. "North Dakota Wrestles with Radioactive Oilfield Waste." *High Country News*, July 14, p. A1. Retrieved July 13, 2015 (<https://www.hcn.org/articles/north-dakota-wrestles-with-radioactive-oilfield-waste>).
- Kusnetz, Nicholas. 2014. "How Oil and Gas Firms Gained Influence and Transformed North Dakota." *Center for Public Integrity*, July 21, p. A1. Retrieved July 13, 2015 (<http://www.publicintegrity.org/2014/07/21/15107/how-oil-and-gas-firms-gained-influence-and-transformed-north-dakota>).
- Lachapelle, Erick, and Éric Montpetit. 2014 "Public Opinion on Hydraulic Fracturing in the Province of Quebec: A Comparison with Michigan and Pennsylvania." *Issues in Energy and Environmental Policy* 17.
- Lakoff, George. 1996. *Moral Politics*. Chicago: University of Chicago Press.
- Lakoff, George, and Mark Johnson. 1980. *Metaphors We Live By*. Chicago: University of Chicago Press.
- Lakoff, George, and Mark Johnson. 1999. *Philosophy in the Flesh*. New York: Basic Books.
- Lau, Richard R., and Mark Schlesinger. 2005. "Policy Frames, Metaphorical Reasoning, and Support for Public Policies." *Political Psychology* 26(1):77-114.
- MacPherson, James. 2018. "Massive 2013 Oil Spill in North Dakota Finally Cleaned Up." *Associated Press*, September 19, p. A1. Retrieved May 6, 2019 (<https://apnews.com/6638975264fe41bba6f5820dc410268f/Massive-2013-oil-spill-in-North-Dakota-finally-cleaned-up>).
- McGranahan, Devan Allen, Felix N. Fernando, and Meghan L. E. Kirkwood. 2017. "Reflections on a Boom: Perceptions of Energy Development Impacts in the Bakken Oil Patch Inform

- Environmental Science & Policy Priorities." *Science of the Total Environment*, 599:1993-2018.  
<https://doi.org/10.1016/j.scitotenv.2017.05.122>
- Nelson, Thomas E., Rosalee A. Clawson, and Zoe M. Oxley. 1997. "Media Framing of a Civil Liberties Conflict and Its Effect on Tolerance." *American Political Science Review*, 91(3):567-583.
- Nicas, Jack. 2012a. "Oil Fuels Population Boom in North Dakota City." *Wall Street Journal*, April 6, p. A1. Retrieved July 13, 2015 (<https://www.wsj.com/articles/SB10001424052702304072004577328100938723454>).
- Nicas, Jack. 2012b. "North Dakota Tops Alaska in Oil Output." *Wall Street Journal*, May 15, p. A1. Retrieved July 13, 2015 (<https://www.wsj.com/articles/SB10001424052702304192704577406493478214670>).
- Nimmo, Dan, and James Combs. 1980. *Subliminal Politics: Myths and Mythmakers in America*. Englewood Cliffs: Prentice-Hall.
- Norman, Geoff. 2010. "Likert Scales, Levels of Measurement and the 'Laws' of Statistics." *Advances in Health Sciences Education*, 15(5):625-632.
- Nowatzki, Mike. 2014. "Activists Call for Probe into State's Oil Industry Regulation, Waste Handling." *Dickinson Press*, November 28, p. A1. Retrieved July 13, 2015 (<http://www.thedickinsonpress.com/content/activists-call-probe-states-oil-industry-regulation-waste-handling>).
- Nunez, Christina. 2014. "N. D. Oil Train Fire Spotlights Risks of Transporting Crude." *National Geographic*. Retrieved July 13, 2015 (<http://news.nationalgeographic.com/news/energy/2013/12/131231-north-dakota-oil-train-fire/>).
- Pan, Zhongdang, and Gerald M. Kosicki. 2005. "Framing and the Understanding of Citizenship." Pp. 165-204 in *The Evolution of Key Mass Communication Concepts*, edited by Sharon Dunwoody, Lee B. Becker, Douglas M. McLeod, and Gerald M. Kosicki. Cresskill, NJ: Hampton Press.
- Price, Vincent, and David Tewksbury. 1997. "News Values and Public Opinion: A Theoretical Account of Media Priming and Framing." Pp. 173-212 in *Progress in the Communication Sciences: Advances in Persuasion*, edited by George A. Barnett and Franklin J. Boster. Greenwich, CT: Ablex.
- Salmon, Ryan, and Andrew Logan. 2013. "Flaring Up: North Dakota Natural Gas Flaring More Than Doubles in Two Years." *Ceres*, July

- 29, P. A1. Retrieved July 13, 2015  
(<https://www.ceres.org/resources/reports/flaring-north-dakota-natural-gas-flaring-more-doubles-two-years>).
- Schlesinger, Mark, and Richard R. Lau. 2000. "The Meaning and Measure of Policy Metaphors." *American Political Science Review* 94:611-626.
- Schön, Donald, and Martin Rein. 1994. *Frame Reflection: Toward the Resolution of Intractable Policy Controversies*. New York: Basic Books.
- Simon, A. E. 2001. "A Unified Method for Analyzing Media Framing." Pp. 75-89 in *Communication in U.S. Elections: New Agendas*, edited by Roderick P. Hart and Daron R. Shaw. Lanham, MD: Rowman and Littlefield.
- Sontag, Deborah, and Robert Gebeloff. 2014. "The Downside of the Boom." *New York Times*, November 22, p. A1. Retrieved July 13, 2015 (<http://www.nytimes.com/interactive/2014/11/23/us/north-dakota-oil-boom-downside.html>).
- Starbuck, Amanda. 2014. "North Dakota Fails to Collect Fines for Fracking Violations." *Center for Effective Government*, November 11, p. A1. Retrieved July 13, 2015.  
(<https://www.foreffectivegov.org/blog/north-dakota-fails-collect-fines-fracking-violations>).
- Stofferahn, Curtis, Cordell Fontaine, and Don Morrison. 2015. "Public Opinion about Oil Development Regulation and Enforcement." Presented at the Annual Meeting of the Rural Sociological Society, Madison, WI, Aug. 6-9, 2015.
- Stone, Deborah A. 1988. *Policy Paradox and Political Reason*. Glenview: Scott, Foresman.
- Sullivan, Gail, and Anthony Artino Jr. 2013. "Analyzing and Interpreting Data from Likert-Type Scales." *Journal of Graduate Medical Education*, 5(4):541-542.
- Tabachnick, Barbara G. and Linda S. Fidell. 1996. *Using Multivariate Statistics*. Harper Collins College Publishers: New York.
- Theodori, Gene L. 2009. "Paradoxical Perceptions of Problems Associated with Unconventional Natural Gas Development." *Southern Rural Sociology*, 24(3):97-117.
- Theodori, Gene L., and Douglas Jackson-Smith. 2010. "Public Perception of the Oil and Gas Industry: The Good, the Bad, and the Ugly." Paper presented at the SPE Annual Technical Conference and Exhibition, Florence, Italy, September.

- Ulrich-Schad, Jessica D., Michael Fedder, and Julie Yingling. 2019. "You Shouldn't Worry Walking a Block and a Half to Your Car': Exploring Perceptions of Crime and Anomie in the Bakken Oil Play." *International Journal of Rural Criminology*, 4(2):193-216. doi:10.18061/1811/87910
- Zumbo, Bruno, and Donald Zimmerman. 1993. "Is the Selection of Statistical Methods Governed by Level of Measurement?" *Canadian Psychology*, 34:390-400.