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Junghwa Choi

Wesley Wehde

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Venue Preference and Earthquake Mitigation Policy: Expanding the Micro-Model of Policy Choice

Junghwa Choi, *The University of Oklahoma*

Wesley Wehde, *The University of Oklahoma*

Abstract

Seismologists have reported that a majority of recent earthquakes in Oklahoma have been triggered by the activities of oil and gas companies. Despite this fact, there is evidence of strong opposition toward earth-quake mitigation policy. In this article, we argue that how individuals define issues affect their policy choice. Furthermore, we incorporate the concept of venue shopping from the literature on macro theories of the policy process to investigate the effect of problem definition in shaping individual venue preference for policy choice. Using unique survey data, we find that problem definition, particularly issue causality and issue image, is strongly related to individual support for earthquake mitigation policy. However, a more nuanced relationship between individual problem definition and venue preference is observed. Our findings contribute to scholarly endeavors to understand the politics of problem definition at an individual level, which may be the precursor of understanding policy choices at the institutional level.

KEYWORDS: disaster risk management, national governance, regional governance, comparative governance, earthquake mitigation policy, problem definitions, venue shopping

场地偏好和防震减灾政策

扩大政策选择的微观模式: 地震学家表示 ,近期发生在俄克拉荷马州的大多数地震都由石油天然气公司的开采活动引起。除此之外 ,证据表明 ,防震减灾政策受到强烈反对。笔者在本文中主张 ,个人对问题的定义方式会影响其政策选择。此外 ,笔者将政策过程宏观理论文献中的场地竞争（*venue shopping*）概念纳入研究 ,以考察问题定义如何影响个人就政策选择所形成的场地偏好。通过使用独特调查数据 ,笔者发现 ,问题定义与个人对防震减灾政策的支持强烈相关 ,尤其当问题定义与问题的因果关系和形象相关时。然而 ,笔者发现 ,个人对问题的定义和对场地的偏好 ,二者之间存在更微妙的关系。本文从个人层面理解问题定义的相关政治 ,进而促进了学术贡献 ,这可能成为从制度

层面理解政策选择的第一步。

关键词: 灾害风险管理, 国家治理, 区域治理, 比较治理, 防震减灾政策, 问题定义, 决策场所的选择 (venue shopping)

Preferencia de la sede y política de mitigación de terremotos: expandiendo el micro-modelo de elección de políticas

los sismólogos han informado que la mayoría de los terremotos recientes en Oklahoma se han desencade- nado por actividades de compañías de petróleo y gas. A pesar de este hecho, ha habido evidencia de una fuerte oposición a la política de mitigación de terremotos. En este artículo, argumentamos que la forma en que los individuos definen los problemas afecta su elección de política. Además, incorporamos el concepto de compras en el lugar de la literatura sobre macro teorías del proceso de políticas para

investigar el efecto de la definición del problema en la configuración de la preferencia del lugar individual para la elección de políticas. Usando datos de encuestas únicos, encontramos que la definición del problema, particularmente la causalidad del problema y la imagen del problema, está fuertemente relacionada con el apoyo indi- vidual para la política de mitigación de terremotos. Sin embargo, se observa una relación más matizada entre la definición del problema individual y la preferencia del lugar. Nuestros hallazgos contribuyen a los esfuerzos académicos para comprender las políticas de definición de problemas a nivel individual, lo que puede ser el precursor de la comprensión de las opciones de políticas a nivel institucional.

PALABRAS CLAVE: gestión de riesgos de desastres, gobernanza nacional, gobernanza regional, gobernanza comparativa, política de mitigación de terremotos, definiciones de problemas, compra de lugares

Introduction

Earthquakes are a complex and relatively new policy problem to the state of Oklahoma. In most places, earthquakes are generally considered a geophysical natural disaster. However, seismologists have recently found that a majority of recent earth- quakes in Oklahoma have been triggered by the injection of waste water produced by oil and gas companies. Thus, to mitigate risks associated with earthquakes, regulations on the activities of the oil and gas industry are required. Accordingly, there has been evidence of support for government regulation of oil and gas companies as a risk mitigation policy in Oklahoma. However, despite the increase in frequency of earthquakes and their risks, some individuals are against any government intervention. This situation leads to important questions for policy scholars as well as decision makers: what affects individual support or opposition against policy choice potentially addressing these problems?

Scholars of the policy process have argued that problem perceptions and definitions shape the policy choices and preferred venues of policy actors (Baumgartner & Jones, 2010; Boydstun & Glazier, 2013; Cobb, 1983; Jenkins-Smith, Nohrstedt, Weible, & Sabatier, 2014; Kingdon, 1995; Schattschneider, 1960). This is because policy problems are generally multidimensional and the information processing ability of decision makers is limited (Jones & Baumgartner, 2005). Therefore, decision makers may focus on a particular aspect of a problem definition which then affects their choice of policy alternatives and preferred policy venue. While these studies have primarily focused at an institutional, or macro, level, Jones and Baumgartner (2005) argue that problem definition also shapes policy decisions at the individual, or micro, level. In fact, recent research has suggested a micro-model of problem definition and policy choice, finding evidence of a strong but nuanced relationship between the different elements of individual-level problem definitions

and policy choice (Liu, Robinson, & Vedlitz, 2017; Wood & Vedlitz, 2007).

We follow these applications of macro-policy process theory to individual-level policy choices by examining the relationship between problem definition and policy choice for earthquake mitigation in Oklahoma. We extend this model to include a deeper investigation of the preferred venue of individuals for their policy choices. We claim that problem definition may influence individual venue preferences or selections for their policy choices as it does on the ones of institution-level actors (Baumgartner & Jones, 1991; Elder & Cobb, 1983; Jones & Baumgartner, 2005; Kingdon, 1995; Rochefort & Cobb, 1993; Schattschneider, 1960). Drawing on previous research, we ask, how does problem definition, in conjunction with individual characteristics, help explain individual policy choices for earthquake mitigation? We then ask if problem definition is a significant determinant of an individuals' venue preference for their policy choice? If so, how?

In the following article, we first discuss the policy context surrounding the state of Oklahoma. We then review previous studies of problem definition and policy choice, both at the macro and micro levels. We then incorporate research on individual venue preferences for policy choice, including that of Susan Schneider and colleagues (Schneider & Jacoby, 2003; Schneider, Jacoby, & Lewis, 2010). We then describe our data, from the 2017 Oklahoma Weather, Society and Government Survey.[1] We find a nuanced relationship between problem definition, highlighting issue causality and issue image, and individual venue preferences for earthquake mitigation policy in Oklahoma. Finally, we end with a discussion of the implications of our research for future studies of the micro-level model of the policy process. We argue that under- standing micro-level models of policy choice, and venue preference in particular, is important because they may be the precursor of understanding policy choices at the institutional level (Wood & Vedlitz, 2007).

Policy Context in Oklahoma

According to the Oklahoma Geological Survey (OGS), in 2015, more than 900 earth- quakes of magnitude 3.0 or greater occurred. Although the number of earthquakes have decreased, several earthquakes of magnitudes 5.0 or greater have occurred in the following years including some of the highest magnitude earthquakes in Oklahoma history. Seismologists have found that a majority of recent earthquakes in Oklahoma have been triggered by the activities of oil

and gas companies.

The oil and gas industries are particularly important in the state of Oklahoma because they have enhanced and maintained the economic prosperity of Oklahoma. State-level regulators historically tend to understand the importance of the industries in terms of jobs and the state economy (Davis, 2014). Therefore, regulating these industries can be complex and fraught with perverse incentives for state governments. However, as the number of earthquakes has rapidly increased since 2009, under the direction of Governor Fallin in 2014, the state of Oklahoma has sought to address this new issue facing the state.

In the state of Oklahoma, a Coordinating Council on Seismic Activity was formed at the direction of Governor Fallin and includes various state-level participants such as the Oklahoma Corporation Commission (OCC), the OGS, and the Oklahoma Secretary of Energy and Environment along with other nongovernmental organizations. Not a regulatory body, however, they collaborate with stakeholders in order to mitigate earthquakes in Oklahoma in a more efficient and effective way. The OCC is the primary regulator at the state level. Under its statutory authority to oversee the oil and gas industries in the state, the OCC has imposed regulations on oil and gas companies regarding operations and disposal wells. These regulatory actions have in fact contributed to the reduction of earthquakes in Oklahoma according to scientists and regulators (Burke, 2017).

Historically, induced earthquakes have been addressed at the state level. This is mainly due to the efforts of industry and lobbyists representing hydraulic fracturing and horizontal drilling technologies (Davis, 2012). They have argued that there is no evidence that fracking and drilling cause negative environmental outcomes; therefore, there is no need for the federal government to oversee and regulate this issue. Regarding Oklahoma specifically, this has also been the case. The United States Geological Survey, the federal agency most directly related to induced seismicity, has a research, not regulatory, mission; therefore, they only maintain resources and pro- vide information to the state actors in Oklahoma. In the following sections, we use the case of induced seismicity in Oklahoma and the associated regulatory environment to examine an individual-level model of problem definitions and venue preferences.

Problem Definition and Policy Choice at the Individual Level

Over the past few decades, scholars of public policy have accumulated significant insight

into how problem definitions shape the policy choices of institution-level pol- icy actors such as advocacy groups. In particular, these studies have found that institution-level policy actors seek ways to obtain and maintain support for policy choices as the problems they address are constantly redefined (Baumgartner & Jones, 2010; Boydstun & Glazier, 2013; Cobb, 1983; Jenkins-Smith et al., 2014; Kingdon, 1995).

Scholars have focused on many key components of problem definitions including issue image, issue causality, the characteristics of problem populations, and issue associations among many others (Birkland, 2006; Liu, Robinson, & Vedlitz, 2016; Rochefort & Cobb, 1993; Weiss, 1989). Among these dimensions, scholars have studied how advocacy groups and coalitions use issue images to suggest certain solutions and to change policy (Baumgartner & Jones, 2010; Kingdon, 1995; Schneider & Jacoby, 2003; Stone, 1989). These issue images are an overall impression of how an issue will potentially pose harm or provide assistance (Baumgartner & Jones, 1991; Liu et al., 2016). More specifically, issue image is conceived of as the general perception of the benefits or detriments of a policy problem (Baumgartner & Jones, 2010; Jones, 1994; Liu et al., 2016). Issue images can be composed of intensities (strong/weak) and valences (positive/negative) and have been shown to help explain policy change in a variety of domains including death penalty policy (Baumgartner, De Boef, & Boydstun, 2008), disability policy (Jeon & Haider-Markel, 2001), and media trends (Boydstun & Glazier, 2013). Causal stories or issue causality, as an element of problem definition, is also strongly related to policy outcomes (Jones & McBeth, 2010; Somers, 1992; Stone, 1997).

While most studies of problem definition and policy choice focus on institutional actors, Jones and Baumgartner (2005) argue that policy-making institutions are subject to many of the same cognitive and processing limits as the individuals which make them up. Therefore, the relationships between problem definition and policy choice that have been found at the institutional level may also exist at the individual level. One of the limits on institutional and individual processing is that policy problems are multidimensional. For instance, some consider climate change to be an environmental problem while others see it as one related to economic development (Nordhaus & Shellenberger, 2007). Therefore, which aspects decision makers focus on can lead to different policy alternatives. Additionally, decision makers are limited in their ability to process information; they are only able to process one piece of information at a time (Simon, 1996). Given these limitations, decision-makers' views on policy choices is dependent on which dimension of a

problem is highlighted at the time (Pralle, 2003). Recently, scholars have begun to explicitly test these assumptions of similarity between institutions and individuals regarding problem definition and policy choice (Liu et al., 2017; Wood & Vedlitz, 2007). From this research, Liu and colleagues (2017) have developed a micro-model of problem definition and policy choice. They find that issue image and issue association, key components of problem definition, shape individual policy choice regarding power plants.

Additionally, many scholars, especially in risk and environmental studies, have examined the effect of problem definition, particularly issue image, on individual attitudes and behaviors toward policy choices. These studies primarily operationalize issue images as risk perceptions, where issues are first perceived on a scale which ranges from extremely low or no risk to extremely high risk. These studies have found that high-risk perceptions are associated with changes in individuals' behaviors and lead to more support for government mitigation policies (Leiserowitz, 2006; Maestas, Chattopadhyay, Leland, & Piatak, 2018; Martin, Martin, & Kent, 2009; O'Connor, Bard, & Fisher, 1999). Furthermore, numerous studies have demonstrated the effect of issue causality on individual policy choice. Scholars have found that people who believe that climate change is caused by human activities tend to support government policies regarding climate change more than those who do not (Bord, Fisher, & O'Connor, 1998; Leiserowitz, 2006; O'Connor et al., 1999; O'Connor, Bord, Yarnal, & Wiefek, 2002).

Problem Definition as a Mediator

Though we argue that problem definition is an important factor in shaping pol- icy choice at the individual level, individual policy choices are rather complex with many potential explanatory factors. In a recent work, Robinson, Stoutenborough, and Vedlitz (2017) review a broad range of existing literature and conclude that individual attitudes toward policy choice are primarily constructed by three sets of explanatory factors including demographic characteristics (Boudet et al., 2014; Davis & Fisk, 2014; Flynn, Slovic, Mertz, & Carlisle, 1999; Lindell, Arlikatti, & Prater, 2009; Robinson et al., 2017); political predispositions (Lubell, Vedlitz, Zahran, & Alston, 2006; Mumpower, Liu, & Vedlitz, 2016; Mumpower, Shi, Stoutenborough, & Vedlitz, 2013; Murphy, Greer, & Hao-Che, 2018; Reckhow, Grossmann, & Evans, 2015; Song, Silva, & Jenkins-Smith, 2014); and issue-specific explanations such as an individual's attention, knowledge, and experience with the issue at hand (Greer, Wu, & Murphy, 2018; Liu et al., 2016; McCright, 2008; Robinson et

al., 2017; Slovic, 2000; Spence, Poortinga, Butler, & Pidgeon, 2011).

In this article, instead of treating problem definition as another explanatory factor in addition to these sets of variables, we argue that problem definition plays a role as a mediator between three sets of individual predisposition variables and policy choice. This is because individual attitudes, of which problem definitions are a subset, are a function of these same categories of explanatory factors (Liu et al., 2017; Robinson et al., 2017; Slovic, 2000). In fact, Liu and his colleagues (2017) argue that problem definitions work as mediators between the previously mentioned predispositions and policy choice. Therefore, we reasonably expect that problem definition is structured by demographic characteristics, political predispositions, and issue-specific characteristics while problem definition itself is also a determinant or explanatory factor of policy choice. Following these arguments previously described, we arrive at our first two research expectations as follows:

Expectation 1: Problem definition, issue image, and issue causality will be structured by demographic characteristics, political predispositions, and issue specific factors

Expectation 2-a (Issue causality): Individuals who believe earthquakes in Oklahoma are human-induced disasters are more likely to support government interventions

Expectation 2-b (Issue image): Individuals who perceive greater risks associated with earthquakes in Oklahoma are more likely to support government interventions

Problem Definition and Individual Venue Preferences

Once policy actors find an appropriate policy solution based on how they define problems, they must then select a venue for advancing that policy alternative (Baumgartner & Jones, 1991, 2010; Cobb, 1983; Rochefort & Cobb, 1993; Schattschneider, 1960). Just as policy solutions are matched to venues, in some cases so are problem definitions (Pralle, 2006). In this process, the policy makers search for policy venues more amenable to their particular solution, or problem definition, among the various levels and branches of government (Baumgartner & Jones, 1991; Cobb, 1983; Jones & Baumgartner, 2005; Kingdon, 1995; Rochefort & Cobb, 1993; Schattschneider, 1960). It should be noted that different levels of government provide different opportunities and capacities for alternatives to policy actors (Baumgartner & Jones, 2010; Piatak, 2017; Pralle, 2003). Furthermore, policy venues are characterized by different levels of professionalization and openness for policy alternatives (Jenkins-Smith & Sabatier, 1993). Therefore, policy change will

succeed according to the match between problem definition, policy solution, venue, and the venue's corresponding characteristics. Policy actors prefer a certain venue over others and their venue selection can occur across levels of government such as from local to state (Holyoke, Brown, & Henig, 2012) or from national to international (Beyers & Kerremans, 2012) or across institutions such as between the legislative and judicial branch or between elected and bureaucratic officials (Buffardi, Pekkanen, & Smith, 2015).

Some argue that the public does not clearly distinguish between the responsibilities and orders of different levels of government (Cantril & Cantril, 1999; Thompson & Elling, 1999). However, scholars have shown that the public can identify the different responsibilities of each level of government (Arceneaux, 2005) and that the public has preferences regarding one level of government over another for policy implementation (Arceneaux, 2005; Konisky, 2010; Schneider & Jacoby, 2003; Schneider et al., 2010). Following these arguments, scholars have investigated which levels of government the public chooses or prefers to address particular policy issues. These studies have found that political predispositions such as ideology and partisanship (Maestas et al., 2018; Schneider & Jacoby, 2003; Schneider et al., 2010), beliefs about the role of government (Wolak, 2016), and trust in different levels of government (del Pino & van Ryzin, 2013; Konisky, 2010) all affect individuals' venue selection.

While these studies have significantly contributed to the discussions around individual policy venue preferences, these studies primarily rely on theories of federalism or descriptively investigate the factors affecting which venues individuals prefer for their policy choice (see Maestas et al., 2018, for a recent exception). There is a lack of studies investigating venue preference of individuals from a policy process perspective.

Therefore, we incorporate the insights from these studies, with macro-level institutional ones on venue preferences and venue selection (Baumgartner & Jones, 2010), into a micro-model of the policy process. As previously stated, induced seismic events have been traditionally addressed at the state level. In fact, state-level policy actors have established a policy venue to mitigate earthquakes in Oklahoma. Under this circumstance, we expect that individuals generally prefer the state government over the federal government as institutional policy actors do. However, given the logic of Jones and Baumgartner (2005) and the micro-model of policy choice developed by Liu et al. (2017), we expect that problem definition explains the variations in individual venue preference for the state government for their policy choice.

Expectation 3: Individuals' problem definitions, both issue image and causality, will be related to venue preferences for their policy choices

Data and Methods

To examine our expectations and answer our questions, we use data from the 2017 Oklahoma Weather, Society and Government Survey (13th wave), which relies on an address-based sampling frame. This wave of the panel survey measured the individual perceptions of weather and views on government policies of 2,581 Oklahoma residents[2] from March 9 to April 17, 2017. The median completion time was approximately 35 minutes. The survey includes a set of questions regarding natural disaster issues, risk perceptions, and citizens' knowledge of and attention to earthquakes in Oklahoma.[3]

The first dependent variable in our study is problem definition. We focus on two key components of problem definition, issue causality and issue image. In order to measure issue image, we operationalize issue image as individuals' perceived risk of earth- quakes. The respondents were asked to rate how much risk they think earthquakes pose to people and property in Oklahoma (from 0 = "no risk" to 10 = "extreme risk"). For issue causality, we are interested in if people think earthquakes in Oklahoma are a human induced disaster or a naturally induced hazard. In the survey, each respondent was asked to answer the following question: "What is the primary cause of the increase in earthquakes that some parts of Oklahoma have experienced over the last few years?" Respondents who answered that earthquakes are a human-induced hazard are coded as 1 while those who answered that earthquakes are natural disasters were coded as 0.

Our next dependent variable is policy choice. We operationalize policy choice as individual support for government earthquake mitigation policy. We measure individual support for both federal and state government earthquake mitigation policy. The respondents were asked to rate the following statement from 0 = "not at all involved" to 10 = "extremely involved": "On a scale from zero to ten, how involved do you think

U.S Federal government/Oklahoma State government should be in managing/regulating the risks associated with earthquakes?"[4]

Finally, from these two variables we construct a measure of venue preferences of individuals where we subtract support for state government mitigation policy from sup- port for federal government mitigation policy. Therefore, negative numbers suggest individuals would prefer the

state as their preferred venue while positive numbers indicate a choice of the federal government as the preferred venue. These questions were not directly posed as in opposition and individuals were not forced to choose between them. However, they were asked in direct succession; therefore, individuals likely processed their response on one question in relation to their response on the other. Given this structure of our survey, we have a hard test for venue preferences because many respondents reported the same desire for intervention from both levels of governance. Therefore, we believe this serves as a useful proxy for individuals' venue preference as it measures the preference for one venue over the other directly. We consider five important pieces of demographic information in our models. In our model specifications, we include measures of gender (0 = "female," 1 = "male"), age (respondents' reported age), education (a dummy variable where 1 = "bachelor's degree" and another dummy variable where 1 = "graduate school"), race (1 ="non-Hispanic White," 0 = "otherwise"), and income (logged income[5]).

For political predispositions, respondents were asked to report their political ide- ology (from 1 = "strongly liberal" to 7 = "strongly conservative"). In addition, they were also asked to self-identify their party affiliation (Republican, Independent, or Democrat). Based on this, we created a dummy variable (1 = "Republican," 0 = "otherwise").

We re-coded some items from the survey in order to measure issue-specific variables. First, to measure issue attention, the respondents answered the following questions: "Would you say that earthquakes have happened more frequently, less frequently or with about the same frequency this winter as in previous winter?"[6] Since 2015 in Oklahoma, strong earthquakes have been on the decline: 904 magnitude 3.0+ earthquakes occurred in 2015 compared to 623 in 2016 and 304 in 2017. For the study period specifically, according to data from the OGS, 261 earthquakes of magnitude 3.0+ occurred during the "previous winter," while only 64 3.0+ earthquakes occurred during the "this winter" referenced in the above survey question. Based on this, we created a dummy variable. If the respondents answered "less frequently," they are coded as 1 for "attentive." Other answers were coded as 0 for "not attentive." For earthquakes particularly in Oklahoma, another potential issue-specific dimension, oil and gas industry experience, is relevant for issue image and causality of earthquakes as well as policy choice. We believe members, past or present, of the oil and gas industry will have self-interested motives to understate or minimize the negativity of earth- quakes, especially in states where their activities have been linked to the uptrend in earthquakes.

Individuals in the oil and gas industry will also face professional pressure and self-interested motives to oppose government regulation of these human-induced earthquakes.[7] Therefore, we created an industry variable. Respondents who answered the question: "Do you currently or have you ever worked in a business or industry that relates to any of the following natural resources in Oklahoma?" with either "Oil/ Petroleum" or "Natural gas" are coded as 1 = "Industry experience," otherwise 0 = "No industry experience." Last, we created a variable to represent previous earthquake experience. If respondents answered that they have recently experienced an earthquake, they are coded as 1 = "Experience of earthquake," otherwise 0 = "No experience of earthquakes." Summary statistics for these variables and demographic covariates are presented below in Table 1.

Table 1. Summary Statistics

	Mea n	St. Dev	Min	Max
Problem Definition				
Issue image: Earthquake risk	6.5	2.4	0	10
Causality: Man-made	0.64	0.48	0	1
Policy Choice				
Risk management: OK	7.2	2.7	0	10
Risk management: Federal	5.8	3.4	0	10
Venue Selection				
Difference in risk mitigation	−1.3	2.3	−10	9
venue preferences: Federal minus state				
Demographics				
Age	59.9	14.1	20	93
Male	0.41	0.49	0	1
Bachelor's degree	0.28	0.45	0	1
Graduate school	0.24	0.43	0	1
Logged income	10.9	0.72	9.2	14.7
White	0.88	0.33	0	1
Political Predisposition Variables				
Republican	0.47	0.50	0	1
Ideology	4.6	1.7	1	7
Issue-Specific Variables				
Experience earthquakes	0.45	0.50	0	1
Attention	0.31	0.46	0	1
Industry experience	0.08	0.28	0	1

Results

Determinants of Problem Definition

To examine the relationships between problem definition and individual predisposition characteristics, we use a binary measure of issue causality and a 10-point scale treated as a continuous variable as a measure of issue image. Thus, we use logistic regression to assess the determinants of issue causality while we used OLS regression to assess the determinants of issue

image. In order to address heteroscedasticity, we calculate and report robust standard errors for our OLS analysis. VIF indicators show that there is not multicollinearity among independent variables: all VIFs were less than 2.

Table 2 shows that individuals' perceptions of issue causality are associated with several predispositions. The coefficients on our age and gender variables are positive and statistically significantly different from zero. Older people and males are more likely to believe earthquakes are caused by human activities. Furthermore, more educated people are more likely to report that earthquakes are caused by human activities. In contrast, politically conservative individuals and those who have worked in the oil and gas industry are less likely to perceive that earthquakes in Oklahoma are human-induced disasters. Last, those who are more attentive to earthquake issues in Oklahoma and those who have recently experienced earthquakes are more likely to perceive that earthquakes in Oklahoma are caused by human activities.

Given that Table 2 reports logged-odds coefficients, we also calculated predicted probabilities, holding all other variables at their means or modes, for concepts of inter- est. Each of the issue-specific concepts is related with approximately a 10% change in the probability of belief that earthquakes in Oklahoma are caused by human activities.

Earthquake experience and issue attention increase the probability that individuals believe earthquakes are caused by human activities by 0.092 and 0.099, respectively. On the other hand, industry experience decreases the probability that individuals believe earthquakes are caused by human activities by 0.099.

Table 2 also indicates that individuals' demographic characteristics and political predispositions are related to their issue image of earthquakes in Oklahoma. The findings show that the older an individual is the higher they perceive the risk associated with earthquakes. In contrast, males and non-Hispanic white individuals view earthquakes as less risky and potentially less of a policy problem than their non-white, female counterparts. The effect of being white and male is equivalent to approximately a 1-point change on the issue image scale, or approximately 0.4 standard deviations. These findings are in line with those of risk researchers, extensive documentation of the "white male effect" (Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000; Kahan, Braman, Gastil, Slovic, & Mertz, 2007). Furthermore, Republicans and politically conservative individuals perceive less risks associated with earthquakes and therefore have a different issue image than their liberal or other party (including Democrat) counterparts. However,

those who are more attentive to earthquake issues and those who have experienced an earthquake in Oklahoma perceive higher risks. The relationship between issue attention and issue image is the strongest of those reported, with an effect size of approximately 0.73. Finally, people who have worked in the oil and gas industries report lower risk perceptions than those who have not.[8]

Table 2. Determinants of Issue Causality and Issue Image

	Issue Causality	Issue Image
	Logit	OLS
Demographics		
Age	0.010***	−0.008**
	(0.004)	(0.003)
Male	0.260**	−0.647***
	(0.102)	(0.097)
Bachelor's degree	0.565***	0.079
	(0.119)	(0.111)
Graduate school	0.452***	0.121
	(0.133)	(0.120)
Logged income	0.070	−0.112
	(0.075)	(0.075)
White	−0.106	−0.318**
	(0.153)	(0.145)
Political Predispositions		
Republican	−0.210*	−0.217*
	(0.116)	(0.120)
Ideology	−0.470***	−0.352***
	(0.040)	(0.036)
Issue-Specific Variables		
Issue attention	0.418***	0.730***
	(0.126)	(0.110)
Industry experience	−0.398**	−0.288
	(0.171)	(0.180)
Experienced earthquakes	0.385***	0.495***
	(0.112)	(0.105)
Constant	1.108	9.936***
	(0.862)	(0.881)
N	2,232	2,232
Adj. R-squared		0.184
Log Likelihood	−1,261.579	
F statistics		46.600*** (df = 11; 2,220)

*p < .1; **p < .05; ***p < .01.

Overall, the findings indicate that, in line with previous research (Liu et al., 2017), individual predispositions influence how individuals perceive and define problems. These findings provide evidence for our first expectation that problem definitions are structured by demographic characteristics, political predispositions, and issue-specific variables.

Problem Definition and Individual Policy Choice

As previously mentioned, we operationalize individual policy choice as individual support for government earthquake mitigation policy. Based on prior research, we expect that individual problem definition will shape individual policy choice.

In order to test the relationship between problem definition and policy choice, we measured individual support for federal and state government earthquake mitigation policy as 10-point scales which we treat as continuous variables. Therefore, we use OLS regression analyses. In order to address heteroscedasticity, we calculate and report robust standard errors. Finally, as before, VIF indicators show that there is no excessive multicollinearity among independent variables: all VIFs were less than 2. In our models, we include demographic characteristics, political predispositions, issue-specific variables as well as problem definition, individuals' issue causality, and issue image, to explain policy choice.

As Table 3[9] shows, our models indicate that several predisposition variables are significantly related to individual policy support for both federal and state government earthquake mitigation policy. Specifically, for state government support, age is positively and significantly related to support for state government intervention. However, both Republicans and politically conservative individuals are less likely to support state government earthquake mitigation policy. Issue-specific variables such as attention or experience are not significantly related to policy choice at the state level.

Our model of federal government policy choice shows similar patterns as the model of state government mitigation policy choice. Both education and income are significantly related to less support for federal policy intervention. Politically conservative and Republicans also show less support for federal government mitigation policy. However, those who are attentive to earthquake issues in Oklahoma tend to support federal government earthquake mitigation policy more than others. Finally, people who have worked for the oil and gas industry are less supportive of federal government mitigation policy. These assessments indicate that, as previous studies have found, individual policy choice is influenced by a variety of individual predisposition variables.

In this paper, we claimed that individuals' problem definitions, particularly issue causality and issue images, explain individuals' policy choices. To test this expectation, we constructed regression models which include problem definition variables as well as other relevant individual-level characteristics. The results across the two models indicate strong and consistent evidence of expectation 2. For both federal and state earthquake mitigation policy, issue causality and issue image show statistically significant effects on individual policy support, independently of individual demographic characteristics, political predispositions, and issue-specific attributes. In other words, people who perceive and define earthquakes as human-induced disasters and those who perceive

higher risks associated with earthquakes support both federal and state government earthquake mitigation policy more than others.

Table 3. Determinants of Policy Choice

	Policy Support for State Gov.	Policy Support for Fed. Gov.
Demographics		
Age	0.01***	−0.002
	(0.003)	(0.004)
Male	−0.02	0.04
	(0.08)	(0.11)
Bachelor's degree	−0.09	−0.45***
	(0.09)	(0.13)
Graduate school	−0.003	−0.25*
	(0.10)	(0.14)
Logged income	−0.05	−0.26***
	(0.06)	(0.08)
White	−0.06	−0.23
	(0.12)	(0.16)
Political Predispositions		
Republican	−0.37***	−0.54***
	(0.10)	(0.14)
Ideology	−0.17***	−0.48***
	(0.03)	(0.04)
Issue-Specific Variables		
Issue attention	0.08	0.34***
	(0.09)	(0.13)
Industry experience—Oil/Gas	−0.12	−0.59***
	(0.15)	(0.20)
Experienced earthquakes	0.09	−0.15
	(0.09)	(0.12)
Problem Definition		
Causality: Man-made	0.75***	1.04***
	(0.10)	(0.13)
Issue image	0.58***	0.58***
	(0.02)	(0.03)
Constant	3.18***	7.33***
	(0.77)	(0.98)
N	2,232	2,232
Adj.R-squared	0.58	0.47
Residual Std. Error	1.77 (df = 2,218)	2.44 (df = 2,218)

*p < .1; ***p < .01.

Problem Definition and Individual Venue Selection

Finally, we investigate the venue selection of individuals. Following the arguments of previous studies, we expect that problem definition may affect individual venue selection for their preferred policy choice. In order to test these arguments, we use the combined measure of individual support for federal and state government earth- quake mitigation policy. Specifically, we subtract support for state government mitigation policy from support for federal government mitigation policy. This results in a variable which allows for us to directly assess how individual demographics, political predispositions, issue-specific variables, and problem definitions are related to a choice between a federal or state venue for mitigating earthquakes in Oklahoma.

Approximately 50% of individuals have no venue preference, i.e., the difference between

federal and state policy support equals zero. However, as we expected, those who do tend to prefer state over federal government earthquake mitigation policy, reflected in the mean presented in Table 1. This may be a result of the unique nature of the earthquakes in Oklahoma and their man-made origins. Individuals may view the problem as unique to Oklahoma and therefore prefer a solution at that level as opposed to federal involvement (Konisky, 2010).

As previously stated, both issue causality and issue image, elements of problem definition, have positive and significant relationships with individual policy support for both state and federal government. However, when we examine problem definition in an explicitly comparative manner, the significant relationship for issue image becomes null, seen in Figure 1 below, in contrast to the findings of Maestas et al.'s (2018) study of food regulation.

In Figure 1, all variables to the left of the zero line suggest a preference for state government policy, while variables to the right suggest a preference for federal pol- icy. Given this, we see that the issue causality dimension of problem definition is strongly associated with venue selection. In particular, the estimate suggests individuals who believe earthquakes in Oklahoma are caused by human activities prefer state as opposed to federal government mitigation policy. Table 4 indicates that believing earthquakes are caused by human activity is associated with a 0.72 unit shift toward a preference for the state as opposed to the federal government as the policy venue when accounting for other individual characteristics. Table 4 presents all other coefficient estimates for venue selection models in three stages. We begin modeling only with relevant problem definitions. We then examine the influence of demographic and political disposition covariates on venue preferences. Finally, we include all relevant concepts in our final model in Table 4.

Additionally, the issue-specific attributes of earthquake experience and oil and gas industry experience are both related with a preference for Oklahoma policy intervention but issue attention is associated with a preference for federal government policy. Finally, conservative ideology but not party identification is associated with a preference for state as opposed to federal policy intervention in earthquake mitigation in Oklahoma.

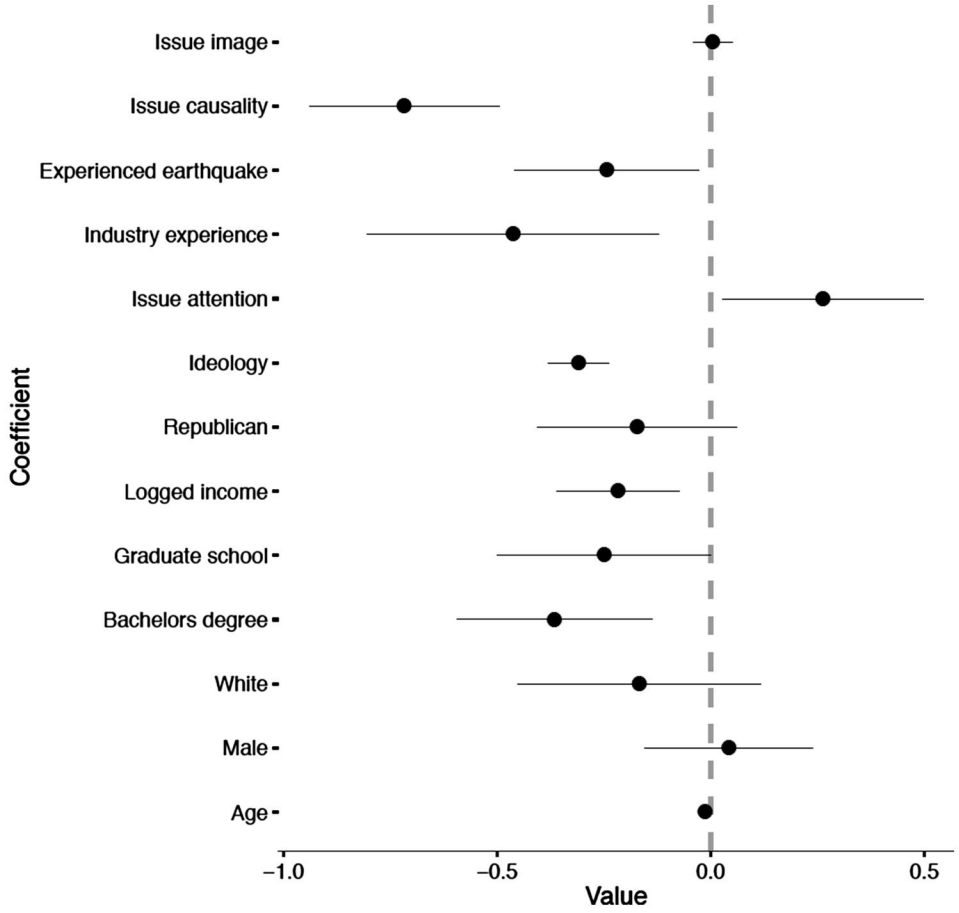

Figure 1. Coefficient Plot for OLS Regression of Demographics, Political Predispositions, Issue-Specific Variables, and Problem Definition on Individual Venue Selection

Conclusions

In this study, we find support for our first expectation that individual demographics, political dispositions, and issue-specific attributes help explain problem definition. We also find support for our second expectation that a relationship between problem definition and policy choice at the individual level, as opposed to the institutional level, exists. Our results are in line with prior research but in a new and nascent pol- icy domain (Liu et al., 2017). Finally, we answer our research question and find that problem definitions affect an individual's choice of preferred venues for their policy choice. To do so, we have utilized data from a survey conducted in Oklahoma and performed regression analyses. We highlight two important components of a problem definition, issue causality and issue image, and their effects on individual policy support for different levels of government, federal versus state.

Table 4. Determinants of Venue Preference

Difference between Support for Federal and State Policy Intervention			
Problem Definition			
Issue causality	−0.48***		−0.72***
	(0.12)		(0.12)
Issue image	0.08***		0.005
	(0.02)		(0.02)
Demographics			
Age		−0.01***	−0.01***
		(0.003)	(0.003)
Male		0.01	0.04
		(0.10)	(0.10)
White		−0.44***	−0.37***
		(0.12)	(0.11)
Bachelor's degree		−0.31**	−0.25**
		(0.12)	(0.12)
Graduate school		−0.23***	−0.22***
		(0.07)	(0.07)
Logged income		−0.15	−0.17
		(0.14)	(0.14)
Political Predispositions			
Republican		−0.14	−0.17
		(0.12)	(0.12)
Ideology		−0.25***	−0.31***
		(0.03)	(0.04)
Issue-Specific Variables			
Issue attention		0.21*	0.26**
		(0.12)	(0.12)
Industry experience		−0.40**	−0.46**
		(0.19)	(0.19)
Experienced earthquake		−0.30***	−0.24**
		(0.11)	(0.11)
Constant	−1.53***	3.69***	4.15***
	(0.13)	(0.82)	(0.86)
N	2,232	2,232	2,232
Adj. R-squared	0.01	0.07	0.09
F Statistic	11.65***	16.41***	17.72***
	(df = 2;2,229)	(df = 11; 2,220)	(df = 13;2,218)

*p < .1; **p < .05; ***p < 01.

Our analyses suggest that problem definition is first structured by individual pre- disposition characteristics. In addition, our study demonstrates that how individuals perceive and define problems plays a significant role in the construction of their pol- icy support. These results, in fact, support the findings of previous studies and our arguments (Liu et al., 2016, 2017; Maestas et al., 2018).

The relationship between problem definition and individual venue preference is more nuanced. While issue image has no relationship with venue preference, issue causality does. These results suggest that individuals with higher risk perception, our measure of issue image, want policy intervention regardless of venue, unlike in Maestas et al.'s (2018) study of food regulation. This may be due to the different policy areas and the particular causes of earthquakes in Oklahoma being due to local factors. In fact, individuals who believe earthquakes are caused by human activity, on the other hand, strongly prefer policy intervention at the state level. Earthquakes in Oklahoma are primarily caused by the oil and gas industry, one of the largest industries in the

state, and the Oklahoma government may be more sensitive to the needs of the industry than the federal government. Additionally, earthquakes in Oklahoma mostly, if not only, affect Oklahoma residents and therefore may be considered a local problem to be addressed at the local level (Konisky, 2010). Furthermore, this fits with prior research that suggests individuals prefer state policy for economic development, of which the oil and gas industry is a major player in Oklahoma (Schneider et al., 2010).

However, we do not intend to make a generalized argument regarding individual venue preferences. We believe that the factors affecting venue preferences of individuals may vary depending on the substance of policies and policy areas. Previous studies have in fact shown that various factors affect the choice of policy venue in different policy areas. For example, in the context of Hurricane Katrina, research suggests national elite efforts to shift blame to state-level failures were most effective for Republicans (Maestas, Atkeson, Croom, & Bryant, 2008). Rather, in other policy domains, values other than ideology and partisanship are more central to explaining individuals' preferred policy venues.

For future studies, we suggest several considerations. While the current study has only looked at one policy option, future studies need to consider various and more specific policy options and examine individual policy choices among them. By doing so, we expect to see more detailed explanations about why and how problem definitions lead to certain policy choices among individuals. Second, while scholars argue that problem definitions have various dimensions (Rochefort & Cobb, 1993; Weiss, 1989), many have primarily focused on issue image. To address the effect of problem definition rigorously, more components of problem definition should be tested. Future studies may also need to examine the individual choice of policy venue over time as problem definitions are constantly revisited. By doing so, we will be able to see how changes in individual choices of policy venue may follow or lead to changes in problem definition. Last, some may argue that there is a problem of endogeneity between problem definition and policy choice. To address this problem, future research may need to consider using longitudinal data. By looking at the changes in how Oklahoma residents perceive the issues and changes in their policy support, we may be able to see more clear causal relationship between these two variables.

There have been numerous studies focusing on the role of problem definition in the formation of policy choice among institution-level actors as well as their preferred venue selection (Baumgartner & Jones, 2010; Boydstun & Glazier, 2013; Cobb, 1983; Jenkins-Smith et al., 2014;

Kingdon, 1995). However, there have been insufficient efforts to test this argument at an individual level, despite the fact that scholars have suggested institutions are largely a result of their individual-level microfoundations (Jones, 2001). By examining the relationship between problem definition and policy choice at the individual level, we expect to contribute to scholarly discussions regarding individual choice of policy alternatives and preferred venues for those pol- icy choices. As of yet, there has been less development of an overarching theory of individual policy choice when compared to institutional policy choice. We suggest that the micro-model of problem definition and policy choice, initially tested by Liu and his colleagues (2017) and further developed here, may be one way of addressing the absence of an overarching theory.

Notes

1 The data for this project were collected with support from the National Science Foundation under Grant No. IIA-1301789.

2 We focus on 2,232 full observations for the purpose of this analysis.

3 While intended to be a random sample of all addresses in Oklahoma, the underlying panel nature of the data skew the sample to be slightly older, more educated, and wealthy than the population of the state.

4 The experimental treatment, randomly varying the word choice of managing versus regulating, did not lead to significantly different responses ($t = 1.18$ for state policy and $t = 0.03$ for federal policy); there- fore, we combine responses to both versions of the question in our analysis.

5 We log income in order to reduce the influence of high values of income and make the distribution more symmetric.

6 A potential confounding factor for the frequency of earthquakes could be their magnitude. For the study period and the period during which the survey was fielded, only six earthquakes occurred that had Modified Mercalli Intensities of V or greater (the level at which most people would feel shaking). Because of the relative rarity of these earthquakes over this almost 5-month period, we do not expect this will be driving our results. Our models are robust to including an indicator variable for the counties where these earthquakes occurred.

7 Royalties from oil and gas wells may represent another measure of self-interest. Our data do not allow us to include this measure in our models; however, future research should consider this and other meth- ods of measuring self-interest that might affect policy beliefs.

8 Another potential measure of self-interest that might particularly affect issue image, in this case risk perceptions, is home ownership. Our models are robust to the inclusion of variables for both home ownership and square footage.

9 The dependent variables for the second column in Table 2 and both columns in Table 3 are 11-point survey scales which can be interpreted as ordered not continuous data. We use OLS regression for ease of interpretation as well as under the assumption that 11 points may approximate continuous data. However, we also analyzed these data using ordered logit, ordered probit, and tobit regression with top censoring (due to clustering at the top-end of the scale). Our results are robust to each of these estimation techniques and available upon request.

About the Authors

Junghwa Choi is a PhD candidate in the Department of Political Sicence, University of Oklahoma. Her research interest includes disaster management, public opinion, and co-production of public service.

Wesley Wehde is a PhD candidate in the Department of Political Sicence, University of Oklahoma. In Fall 2019, he will be an Assistant Professor of Political Science and Public Administration at East Tennessee State University. His research interests include public opinion about climate and disaster policy, individual and organizational response to disaster, and policy process theory. His research can be found in journals including *Policy Studies Journal*, *Public Administration Review*, and *Social Science Quarterly*.

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