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## **The Cognition of Controversy: Examining Policy Elites' Narrative Cognition and Communication Around Hydraulic Fracturing Practices in the U.S.**

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The Cognition of Controversy: Examining Policy Elites' Narrative Cognition  
and Communication Around Hydraulic Fracturing Practices in the U.S.

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy in Public Policy

by

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## **Abstract**

The use of hydraulic fracturing (HF) technologies to extract oil and gas in the United States has sparked contentious policy debates, producing inconsistent and inefficient policies that have done little to address the impacts of HF in any comprehensive way. Debates are accompanied by competing policy narratives that position HF as either an environmental threat or an economic opportunity, but little is known about how policy narratives around HF are used by individuals. This dissertation systematically examines how individuals cognitively internalize elements of competing HF policy narratives. Organized into three empirical chapters, this dissertation analyzes narrative cognition ([Jones, Shanahan, and McBeth 2014](#)) around HF, providing a rare look at policy elites, those engaged in the energy policy subsystem with the resources and potential to influence HF policy development. The first empirical chapter applies structural topic modeling to examine how policy elites cognitively internalize elements of policy narratives, finding that elite assessment of the overall utility of HF correlates with aspects of the narrative elements used to think about HF. OLS regression analysis and Bayesian Posterior Simulation results indicate that socially constructed worldviews drive policy elites' narrative cognition in theoretically expected ways regardless of their overall perception of the utility of HF. Building on research that identifies political sophistication as fundamental to belief-driven attitudes ([Michaud, Carlisle, and Smith 2009](#); [Ripberger et al. 2012](#)), the second empirical chapter compares cognition patterns of policy elites with members of the general public to examine the role of cognitive sophistication in elite narrative cognition. Empirical evidence supports theoretical expectations, indicating that worldviews have a stronger influence on narrative cognition for those with greater cognitive sophistication. The third empirical chapter builds on recent work by Lawlor and Crow (2018) to analyze how socially constructed risk frames support

narrative cognition. Mediation analysis results indicate that socially constructed risk frames support the cognitive internalization of narrative elements and guide assessments of risk and benefit toward HF. Overall, the empirical and theoretical contributions of this dissertation deepen our understanding of policy narrative cognition and contribute to the development of several policy process theories including the Advocacy Coalition Framework, the Narrative Policy Framework, and Cultural Theory. Each empirical chapter discusses relevant practical and methodological implications of the study.

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## **List of Published Papers**

Moyer, Rachael M., Geoboo Song, and Michael D. Jones. 2019. "Probing Narrative Cognition: How Do Policy Elites and the General Public Internalize Competing Policy Narratives on Hydraulic Fracturing?" Chapter 3 is under review by *Policy Sciences*.

## **Chapter 1. Introduction**

In 2016, the Environmental Protection Agency published the results of a five year study reporting the assessed impacts of hydraulic fracturing activities on U.S. water resources (Office of Research and Development 2016). Although the final assessment represents a scientific report that incorporated multiple methodological approaches and met scientific review standards of the largest independent Science Advisory Board ever convened (2016), the conclusions of the study remain the center of controversy as numerous industry sources and environmental groups maintain opposing interpretations. Uncertainty with regard to the actual scope of the impacts reported, the quality and availability of data used, and political motivations behind the release of the report has been cemented through competing policy narratives (K. Brown 2016; DiChristopher 2016; A. Harder 2016a; Joyce 2012; Marketplace staff 2017; Rapier 2016; Wolfgang 2016; Zoe Schlanger 2014). Debates over hydraulic fracturing address multiple dimensions (Marketplace staff 2017; Oklahoma Earthquake Tied To Fracking Wastewater Draws First Lawsuit, Joins Growing Legal Effort In Arkansas, Texas 2014; Warner and Shapiro 2013; Wines 2015; Zoe Schlanger 2014) and ultimately hold important and broad policy implications for the U.S.

Despite being touted as one of the most important energy technologies of the century due to the accelerated production of oil and natural gas in the U.S. (Greenstone 2018), the ongoing controversy over hydraulic fracturing poses serious implications across a spectrum of substantive policy areas. On one hand, strong regulatory policies may reduce the economy of extraction by restricting access to unconventional fuel resources (Hydraulic Fracturing Technology | Department of Energy 2017; Kerr 2010; US EPA 2016; Warner and Shapiro 2013). A decrease the availability of natural gas for export is then likely to initiate a series of cascading events that

would negatively impact national trade and geopolitical dynamics. On the other hand, weak environmental governance could result in decreasing the quality of human health and natural resources in the U.S. (Federal Multiagency Collaboration on Unconventional Oil and Gas Research: A Strategy for Research and Development 2014). Effective and efficient policy development meant to address the continued use of this technology is dependent on a deeper understanding of how individuals think about or cognitively assess the various policy narratives orbiting this issue.

So, how can such variation in the interpretation of this and other existing scientific reports on hydraulic fracturing be explained? This collection of studies takes a systematic approach to examine the cognition of controversy surrounding hydraulic fracturing in the U.S. Relying on theoretical foundations articulated through the Advocacy Coalition Framework, this research places a great deal of focus on policy elite perceptions. In addition, this work expands application of an emerging policy process theory, the Narrative Policy Framework, to investigate how such individuals cognitively internalize narrative elements of hydraulic fracturing. To begin, this chapter surveys the landscape of this issue by reviewing existing policy research in an effort to characterize primary policy debates around hydraulic fracturing practices in the U.S and identify contributing factors.

## **1.1 Technologies for Unconventional Fuel Extraction and the Broader Policy Context**

Hydraulic fracturing, also referred to as fracking and hydrofracking, is a technique for extracting oil and natural gas from unconventional, or previously inaccessible, sources (US EPA 2013).

Hydraulic fracturing (HF)<sup>1</sup> has made the extraction of natural gas more economical (Kerr 2010; Nuclear Energy Institute - Costs 2014; US EPA 2016) , increasing natural gas production to the

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<sup>1</sup> The controversial nature of this issue has stigmatized certain references to the technology and for this reason, the suite of technologies will be referred to in this body of work as HF.

highest amounts ever recorded in 2017 (U.S. Energy Information Administration 2018). This has resulted in shifts to national trade patterns, geopolitics, and energy markets globally (Jaffe and O’Sullivan 2012) and hold implications for U.S. national security policy (Yergin 2013). Because natural gas has also been identified by some as a “bridge” or “clean fuel,” (Kirkland 2010) debates around HF have also become relevant in discourse around climate change. All of these considerations hold implications for future policy development, but the recorded critical events or accidents associated with fracking has arguably had the most significant influence on policy development (Jaffe and O’Sullivan 2012). Moving forward, policies that address the preparedness and handling of critical events will continue to hold relevance.

## **1.2 Theoretically Informed Approach to Examining HF Policy Debates**

The controversy surrounding HF is supported by intense disagreements over the impacts that result from the use of the technology. The degree of uncertainty surrounding the outcomes of HF practices leaves space for competing explanations that are commonly communicated in narrative form. HF has been touted for stabilizing and lowering energy costs, reducing air pollution and emissions in some energy sectors, creating jobs and positive economic impacts in regions of activity, and strengthening energy security (Federal Multiagency Collaboration on Unconventional Oil and Gas Research: A Strategy for Research and Development 2014; Greenstone 2018). The same technology has also been criticized for its excessive demand on water resources and infrastructure, its contribution to greenhouse gasses, potential negative impact to the environment and to human health, and initiation of seismic activity (Stockton 2015; US EPA National Center for Environmental Assessment and Frithsen 2015; Vengosh et al. 2013).



Policy scholars have examined policy actors' perceptions of HF, characterizing them as competing (Weible and Heikkila 2017a) where meso-level policy narratives tend to emphasize either the associated economic benefits or the potential risks posed to human health (Heikkila et al. 2014). However, research that examines how policy narratives function at the individual or micro-level are quite rare. A study recently published by Zanooco, Song, and Jones (2017) found that the persuasive nature of HF narratives is associated with the individual's affective response to certain narrative features but much is still unknown about how individuals think about or cognitively assess HF and how policy narratives might support the process.

In general terms, this body of research investigates *how policy narratives might be used by policy elites to shape their thinking about the controversial issue of HF and what factors guide this process*. Building from a theoretical foundation, a systematic approach is used to examine relationships among important theoretically identified factors in an effort to understand how policy narratives shape individual attitudes toward HF. From a practical perspective, a more comprehensive understanding of how individuals think about controversial policy issues and the factors that shape individual perceptions can be used to a) inform more constructive communications around policy development and, b) provide some insight into the success of miscommunication strategies that currently plague our society and carry larger implications for other substantive areas of policy and broader democratic processes.

### **1.3 Influential Factors of Attitudes and Policy Support for Hydraulic Fracturing**

Research examining the public perceptions of HF in the U.S. are numerous in recent years (Alcorn, Rupp, and Graham 2017; H. Boudet et al. 2014a; H. S. Boudet et al. 2018; Christenson, Goldfarb, and Kriner 2017; Howell et al. 2017a; Lachapelle and Montpetit 2014; Lee et al. 2019). Within policy literature, the majority of studies examine factors of support for HF

practices. Proximity to HF activities (Alcorn, Rupp, and Graham 2017; H. S. Boudet et al. 2018), demographics (H. Boudet et al. 2014a; H. S. Boudet et al. 2018), worldviews (H. Boudet et al. 2014a; Christenson, Goldfarb, and Kriner 2017; Lachapelle and Montpetit 2014; Tumilson and Song 2019), political ideology or partisan motivations (H. Boudet et al. 2014a; Howell et al. 2017a), exposure to various media sources, and familiarity with the issue (H. Boudet et al. 2014a) have all been found to influence the degree of support individuals report having for this controversial technology. The relationships among these factors, remain largely unspecified.

Policies associated with HF have the potential to impact: 1) future access to fuel resources; 2) renewable energy policies; 3) national trade patterns; 4) geopolitical forces; and 5) hold implications for other substantive policy areas including those in the power and transportation sector. Perhaps one of the most important implications to consider is related to reduced methane emissions from the burning of fracked natural gas as compared to coal. Policies affect HF activity also impact strategies aimed at addressing climate change. The controversy surrounding this issue continues to complicate policy making and scientific evidence has done little to reduce the level of conflict around this issue. This body of work examines debates over HF and attempts to build on previous policy scholarship and advance our understanding of individual level cognition around controversial policy issues. A brief introduction into the primary theoretical frameworks relied on will further refine the research questions addressed in this body of work.

#### **1.4 Theoretical Foundations**

This body of work applies several policy process frameworks, theories, and models in an effort to organize and identify relevant factors for explaining the attitudinal differences represented in controversial policy debates surrounding hydraulic fracturing practices in the United States.

Theoretically based inquiry is essential for focusing the scope of research to a manageable number of factors and for minimizing the impact of cognitive biases among scholars (Sabatier 2007). Frameworks, in particular, aid in identifying “universal elements that any theory relevant to the same kind of phenomena would need to include,” and contain a common “metatheoretical language” that facilitate collective knowledge building among academics (Sabatier 2007, 25). In an effort to explain why policy debates around HF still complicate policymaking despite the publication and availability of scientific-based knowledge, this body of work applies well-established frameworks such as the Advocacy Coalition Framework (ACF) and emerging policy theories contained within the Narrative Policy Framework (NPF). Both frameworks acknowledge that behavioral considerations are fundamental to policy change. Moving beyond examining policy as a series of stages, these frameworks view change as the result of interactions between actors over time. This research focuses on interactions of conflict and in doing so, relies on a third, actively developing theory known as Grid Group Cultural Theory (GGCT) which was developed to explain societal conflict.

Using an ACF lens, this research narrows its focus to policy debates within a policy subsystem and the policy actors who communicate and interact with others who share their beliefs in order to pursue, adopt, ignore, and maneuver around policy options as a coalition (Jenkins-Smith et al. 2014, 195). The NPF sharpens the focus to the function of policy communications. Conceived of as policy marketing, policy narratives in particular are useful for understanding how policy beliefs and strategically constructed policy narratives are used to shape opinions and define policy problems. The NPF outlines fundamental assumptions that rely on previous research surrounding individual level cognition and decision-making processes. Narratives not only function to organize thoughts and beliefs but function as a primary means of

communication and human interaction (DeVereaux and Griffin 2013; Polkinghorne 1988). Policy narratives have strategic value and are available for use by coalitions to expand or contract the policy subsystem. Narratives are conducive to communication and persuasion; both essential to shaping attitudes, forming coalitions, and advocating for policy positions. Because shared beliefs bind coalitions and facilitate communications, this body of work also relies on GGCT to specify prototypical worldviews as a network of reinforcing values that explain societal conflict and provide insight into more specific beliefs about conceptualizations of nature and risk. Each of the theoretical frameworks set a foundation for the research that follows. Three empirical chapters are presented as standalone manuscripts in the following sections. Each chapter contains a more in-depth discussion of contributing theoretical frameworks to advance a collective understanding of policy elites' cognition around controversial policy issues. Each chapter maintains a theoretical focus on policy elites and micro-level policy narratives, relies primarily on original survey data, and uses a diverse set of methodological tools and analytical approaches including structural topic modeling (STM), Bayesian posterior simulation, regression modeling, and mediation analysis. In addition to focusing on culturally biased value predispositions as a primary variable of interest, multiple other theory-driven correlates are also explored including perceptions of utility, party identity, trust, and demographic characteristics. Important theoretical, methodological, and substantive policy implications are addressed separately within each empirical chapter.

The first empirical chapter diverges from a traditional look at public opinion around HF to explore cognition of HF policy narratives. The study provides a rare opportunity to examine a theoretically important group to policy processes, policy elites. Defined as “state actors with some influence over the direction, shape, and timing of policy making” (Skrentny 2006, 1765),

policy elites are conceptualized as policy actors engaged in a policy subsystem and who hold various political resources that may be employed to exert political influence over different phases of policy making process, including agenda setting, policy analysis, policy formulation, policy implementation, and policy feedback (Moyer and Song 2016a). This chapter *examines whether broader meso-level policy narratives around HF are internalized by policy elites and if so, whether culturally biased value predispositions influence this process.*

Political knowledge or sophistication has, as a concept, drawn intense interest and disagreement among political science and policy scholars. It is still unclear how issue salience, or an individual's frame of mind, might influence their political beliefs and in turn, their policy preferences. Political knowledge or cognitive sophistication is relevant to policy communications. Jorgensen et al. (2018) found that the persuasiveness of narratives correlated to the level of political knowledge held and the strength of individual value predispositions, and concluded that cognitive sophistication and value predispositions are both likely to influence how individuals internalize policy narratives. Previous literature has defined distinctions between policy elites and the general public by using measures of knowledge and awareness of policy issues (Converse 1964, 1990; Zaller 1992). Although rare, recent work has used a direct comparison approach (Moyer and Song 2016a, 2017; Tumlison, Moyer, and Song 2017; Tumlison and Song 2019; Zanoocco, Song, and Jones 2017). The second empirical chapter of this study *contributes to a more comprehensive picture of the role that cognitive sophistication plays in the policy process by comparing elite and public cognitive patterns of competing narratives on HF practices.*

It is broadly accepted among policy scholars that policy communications around HF policy issues are strategically constructed to garner attention to particular aspects of the issue. In

addition, there is ample evidence to support that environmental vs. economic framings of the issue are used by both media (Boudet et al. 2014; Sarge et al. 2015) and - in more complete narratives – by advocacy coalitions (Heikkila, Weible, and Pierce 2014). This study follows a recent move to abandon broadly defined risk by identifying particular frames of risk and applying them to examine narrative construction. The cognition of risk is well researched (Bostrom 2017; Bostrom, Fischhoff, and Morgan n.d.; Breakwell 2014; Finucane 2008; Finucane, Alhakami, et al. 2000; Kahneman, Slovic, and Tversky 1982; J. Lerner and Keltner 2001). Recent policy research published in the last year found that narrative communications using risk framing display certain characteristics in their construction (Deserai A. Crow, Lawhon, et al. 2017; Lawlor and Crow 2018) but much about the relationship between narrative form and perceptions of risk at the individual level is still unknown. To gain a more nuanced understanding of how communications around HF are cognitively used by individuals, the third empirical chapter *compares the framing and narrative form present in individuals' mental images (cognition) of HF with that of meso-level narratives around HF* and examines whether *cultural predispositions guide the cognitive internalization of communications (narrative elements and risk-oriented frames) and shape individually held perceptions of utility.*

## **Chapter 2. What Influences Policy Elites' Cognition of Hydraulic Fracturing Policy Narratives?**

Deemed one of the most important energy technologies of the century (Greenstone 2018), hydraulic fracturing (HF) is also a source of controversy and has received the attention of all levels of government. Fracking has been touted for stabilizing and lowering energy costs, reducing air pollution and emissions in some energy sectors, creating jobs and positive economic impacts in regions of activity, and strengthening energy security (Federal Multiagency Collaboration on Unconventional Oil and Gas Research: A Strategy for Research and Development 2014; Greenstone 2018). The same technology has been criticized for its excessive demand on water resources and infrastructure, contribution to greenhouse gasses, potential negative impact to the environment and to human health, and trigger of seismic activity (Stockton 2015; US EPA National Center for Environmental Assessment and Frithsen 2015; Vengosh et al. 2013). The uncertainties associated with fracking activities enable conflictual policy debates where proponents of fracking tend to recognize the economic benefits while those in opposition tend to focus on the various risks associated with fracking most often citing negative impacts to humans and the environment (Boudet et al. 2014; Heikkila, Weible, and Pierce 2014; Sarge et al. 2015). These perceptions are arguably shaped by policy narratives to some extent. Publishing of reports, press releases, and stories by interested groups and the media are made publicly accessible and are often used to influence the policy process. Most recently at the national level, anti-fracking propaganda has been used in targeted social media campaigns to influence foreign and domestic energy policies (U.S. House of Representatives 2018). Similar campaigns are visible at state and local levels as well (Heikkila, Weible, and Pierce 2014).

The focus of this study is to understand policy elites' distinctive cognitive patterns of policy narratives, a rarely explored area of research within the Narrative Policy Framework (NPF) scholarship. In particular, this research utilizes the controversial policy debate regarding the benefits and risks associated with the use of HF to investigate whether local policy elites selectively perceive and retrieve certain elements of various competing narratives (e.g., setting, characters, plot, and moral), and if they do, how and why they go about it.

## **2.1 Previous Investigations into the Perceptions of Fracking**

Previous studies have explored the public's perceptions of fracking (Boudet et al. 2014) paying particular attention to political and demographic factors of support (Davis and Fisk 2014), finding that men and individuals who identify with conservative ideologies tend to exhibit higher levels of support for fracking (Sarge et al. 2015). Other factors such as the degree of familiarity with the fracking process itself seem to decrease the general public's level of support (Boudet et al. 2014). Members of the general public who associate fracking practices with existing environmental issues are also less likely to support the practice while those who regard fracking as a solution to economic issues are more likely to show support (Sarge et al. 2015) and narrative framing of fracking has been used by coalitions to persuade others (Heikkila, Weible, and Pierce 2014). The environmental versus economic framing of risks associated with fracking practices is a reoccurring theme that appears in various types of media. Recent research links the general public's support of fracking to increased exposure to television media consumption (Boudet et al. 2014) and research has found visual frames or images of fracking to be selectively perceived in ways that are consistent with individuals' preexisting attitudes (Sarge et al. 2015, 66). Only members of the general public who indicate that they are undecided in their support for fracking are more likely to be persuaded by the use of visual frames (2015). Preexisting attitudes or more



specifically, personally held value predispositions, have been found to influence how individuals perceive various dimensions of risk (Kahan et al. 2010, n.d.; Moyer and Song 2016b) and preliminary research suggests that mental images mediate the influence of personally held values on policy elites' benefit and risk perceptions of fracking (Moyer and Song 2016d). But the process for how and why local policy elites selectively perceive and retrieve certain elements of competing narratives and how this relates to their perceptions of the benefits and risks associated with fracking is still unclear.

For some time, scholars have been interested in how communications about controversial policy issues impact public opinion (Golding, Krinsky, and Plough 1992; McBeth and Shanahan 2004; Shanahan, Mcbeth, and Hathaway 2011; Stone 1989) particularly with regard to HF (Blair et al. 2015; Davis 2012; Gottlieb, Bertone Oehninger, and Arnold 2018; Hopke and Simis 2017; Howell et al. 2017b; Lee et al. 2019; Olive and Delshad 2017; Thomas et al. 2017; Tumilson and Song 2019; Weible and Heikkila 2017a; Zanocco, Song, and Jones 2018) in order to understand how these communications function within the broader context of policymaking. Scholars have also identified the importance of coalitions in driving policy change within subsystems (Ingold, Fischer, and Cairney 2017; Jenkins-Smith et al. 2014; Leifeld 2013; Weible et al. 2011) where communications between engaged policy actors is likely to take place among interest groups, members of government, journalists, and others (Hecl 1974) but, much less is known about policy elite communications. Application of the Narrative Policy Framework facilitates research on the structure of policy communications themselves (M. D. Jones, Shanahan, and McBeth 2014). Some evidence suggests that policy narratives indirectly impact attitudes toward HF (Zanocco, Song, and Jones 2018). This work aims to 1) understand how policy elites cognitively internalize aspects of competing policy narratives and to 2) identify primary factors involved in

narrative cognition. The study relies on original survey data (n=464) that was recently collected in Arkansas and Oregon. Structural topic modeling (STM) is used to computer-analyze related semantic patterns extracted from individuals' open-ended text responses in order to examine narrative cognitive patterns and theory-driven correlates including cultural orientations, perceived utility, political party identity, and demographic characteristics. The following section introduces important theoretical foundations used to identify primary correlates of interest and inform the analysis.

## **2.2 Theoretical Foundations**

### Narrative Policy Framework

Narratives play a vital role in cognition. They comprise a fundamental form of communication and have been identified as cognitively useful for organizing thoughts or beliefs (DeVereaux and Griffin 2013; Polkinghorne 1988). A policy narrative, as defined by the Narrative Policy Framework (NPF), is a strategically constructed story that employs particular words and images in an effort to define policy problems and market policy solutions (M. D. Jones and McBeth 2010; M. D. Jones, Shanahan, and McBeth 2014; Shanahan, Jones, and McBeth 2011).

Narratives accomplish this by focusing attention on specific dimensions of an issue within a policy subsystem (Weible and Heikkila 2017b). While narrative content may vary based on the substantive topic, policy narratives carry generalizable information in their composition.

### *Policy Narrative Structure and Content*

Structural composition is foundational to effectiveness of policy narratives. Structural elements include the setting or context of the issue, the plot or policy problem, the moral or policy solution, and the characters (M.D. Jones, Shanahan, and McBeth 2014). The setting, like any story, conveys important facts, risks, or evidence of the problem while the plot typically defines

the policy problem (M. D. Jones, Flottum, and Oyvind 2017) and its cause (M. D. Jones, Shanahan, and McBeth 2014; Stone 2012). For example, recent studies suggest that the plot is central to policy narrative that communicate risk (Lawlor and Crow 2018). Narrative characters have been found to play an integral role in the persuasiveness of narratives (M. D. Jones, Flottum, and Oyvind 2017). The content of narratives may vary based on the policy issue but the variation is not completely random (M. D. Jones, Shanahan, and McBeth 2014, 7). Policy narrative content is keyed to systematically reflect personally held beliefs which is consistent with shared beliefs posited by the Advocacy Coalition Framework (ACF) (Weible, Sabatier, and McQueen 2009). Studies applying NPF at the micro level have found that policy narratives shape individual beliefs, preferences (Shanahan et al. 2014), and public opinion generally (Shanahan, McBeth, and Hathaway 2011). The policy narratives chosen at the micro level also tend to be congruent with individually held norms (Mcbeth, Lybecker, and Garner 2010a) and ideologies (Lybecker, McBeth, and Kusko 2013).

### *Narrative Cognition*

Conceptually, policy narratives function simultaneously at three levels. They reflect and communicate cultural level (macro-level), collective level (meso-level), and individual (micro-level) understandings of the human experience (M. D. Jones, Shanahan, and McBeth 2014). At the micro-level, narratives facilitate an understanding of the world by conveying shared beliefs and facilitate policy communications among individuals (M. D. Jones, Shanahan, and McBeth 2014; Polkinghorne 1988). NPF posits that broader (meso-level) policy narratives are crafted to be consumed (M. Jones, Shanahan, and McBeth 2014) in order to inform future decision making. Studies have examined meso-level narratives associated with HF (Heikkila et al. 2014; Heikkila, Weible, and Pierce 2014) however, narratives are posited to function simultaneously at various

levels. Research addressing micro-level policy narratives are rare (M. D. Jones and McBeth 2010; M. D. Jones and Song 2013). This study provides a unique examination of micro-level narratives in an attempt to explain how and why policy narratives might be cognitively internalized by policy elites. Our theoretical understanding of how micro-level narratives function draw heavily from work in political and behavioral psychology. The current state of research suggest several processes are engaged, the least of which include bounded rationality (Simon 1955), dual system processing (Kahneman 2003), the use of heuristics (Kahneman 2011), and the influence of affect (Lodge and Taber 2005). The cognitive internalization of narratives at the micro-level involves extracting identifiable structural and contextual elements from the narrative that might function as a ‘cognitive artifact’ in order to mentally catalog situations or experiences that may be useful for projecting future situations. Cognitive processing theories inform the methods and conclusions drawn in this research and are briefly reviewed in the following section.

#### Cognitive Processing Theories: Affect, Risk, Motivated Reasoning

Cognitive functions involving information processing are restricted by bounded rationality, rendering decision making “a constructive and contingent process” where heuristics are used to simplify the complexities of a problem (Kahneman 2003; Kahneman, Slovic, and Tversky 1982; Kahneman and Tversky 1979; Tversky and Kahneman 1992). This is particularly true in situations where uncertainty is high or when judgments are surrounded by complexity. Individual judgements are also subject to dual system processing in which emotion or affective feelings provide an efficient cue for the judgements that follow (Damasio, Everitt, and Bishop 1996). In the context of risk, this tends to position judgments of benefits and risks as negatively correlated (Finucane, Alhakami, et al. 2000). Cognition of risk relies on a dual system of processing model

composed of a “rational” and an “experiential” system that operate in parallel and inform each other (Slovic et al. 2004). The experiential system develops associations between mental concepts or images, tagging them with affective valence and associating other semantic information to be used by the rational system in a way that reduces the mental effort needed for processing complex information (Slovic et al. 2004).

Studies suggest that the cognition of policy narratives are also subject to motivated reasoning. Using observational and experimental approaches, Kahan’s (2013) study found that ideologically motivated cognition explains polarization over climate change. Jones and Song (2014) found individual cultural orientations were used to structure policy narratives around climate change. Narrative content, seemingly relative to a particular policy context, has been found to display systematic variation in the contextual elements or meanings embedded within the narrative. Meaning is often grounded in underlying beliefs that are influenced by cultural systems and social interaction. This has been measured in previous studies through partisanship (Lakoff 2002) or socially and culturally reinforced beliefs or worldviews (M. D. Jones 2014; Kahan et al. 2015; Moyer and Song 2016c; Ripberger et al. 2014; Tumilson, Moyer, and Song 2017; Zanooco, Song, and Jones 2017).

#### Cultural Theory- Culturally Shared Meaning

Belief system theories provide a basis for measuring and understanding how beliefs are embedded within narratives to impart meaning. This research leverages Grid Group Cultural Theory (GGCT). Based on original work developed by anthropologist Mary Douglas to explain societal conflict, GGCT posits that individuals develop and carry predispositions toward certain beliefs or worldviews through social and cultural interaction (Dake 1991a; Douglas and Wildavsky 1982). These worldviews play an important role in social interaction, influencing how

individuals view their relationship to the world around them, their environment, opportunities, and even how they conceive of risks (Dake 1992). GGCT outlines four prototypical worldviews based on the extent to which individuals value externally prescribed rules or norms that are often institutionalized (grid) and the extent to which they value social collectives (group). The worldviews identified include egalitarians, hierarchs, individualists, and fatalists.

Prototypical egalitarians (low-grid, high-group) exhibit an affinity for strong social solidarity and collective decision making. They tend to view nature as fragile and vulnerable to complete collapse therefore, they conceive of energy technologies as an extreme threat to the natural environment (Moyer and Song 2016a, 2017). Individualist (low-grid, low-group) are sensitive and open to opportunities although they tend to reject constraints from either institutionally or socially based sources. They tend to believe that nature, like themselves, are characteristically self-sufficient therefore, they are likely to support technological experimentation particularly if it is associated with economic opportunity (Moyer and Song 2016a, 2017). The prototypical hierarch (high-grid, high-group) values institutionalized authority. They believe nature can be appropriately managed and are predisposed to trust any uncertainties with regard to technological innovation to those individuals within an institutional structure who hold specialized knowledge. Prototypical fatalists (high-grid, low-group) lack social connection although they feel bound by institutional authority. This results in a general disengagement from many issues, including energy technologies (Moyer and Song 2016a, 2017).

Conceptually, policy narratives are strategically constructed to be effective at influencing policy. Effectiveness is dependent on narrative cognition which is the conveyance of meaning in a way that is supported by the cognitive processes that underpin all human judgement. The meaning, embedded in a narrative form, is subject to concepts and beliefs that are defined

through social construction so it follows that socially constructed concepts of conflict, which also happen to be reinforced in a network of other culturally shared values, are identifiable within a narrative and used to make future judgments. The preference for relying on narratives to cognitively organize ideas and communicate them is referred to as narrative cognition (Berinsky and Kinder 2006; M. Jones, Shanahan, and McBeth 2014, 12; Polkinghorne 1988) and spans the distance between meso-level narratives, which are collectively constructed and employed, and micro-level narratives which are constructed/reconstructed and retained by individuals. In the context of HF, this study uses GGCT to identify and compare socially constructed meanings around the issue embedded in both meso-level narratives and micro-level narratives. Following the comparison, an empirical analysis isolates the effects of culturally oriented value predispositions on narrative cognition among policy elites.

### **2.3 Theoretically Founded Expectations**

A broader understanding of the role that policy narratives play in the debates over HF leads scholars to question whether policy elites internalize narrative elements present in meso-level policy narratives and if so, what factors play an integral role in the process? Applying NPF, cognitive processing theories, and GGCT, two hypotheses are tested by analyzing cognitive patterns among policy elites.

*H<sub>1</sub>: Policy elites cognitively internalize elements of meso-level HF narratives when thinking about HF.*

Based on the theories discussed, it is expected that cognitive internalization of HF policy narratives at the micro-level involves extracting identifiable structural and belief-based contextual elements from the narrative to use as a ‘cognitive artifact’ in order to mentally catalog situations or experiences that may be useful for projecting future situations. Due to the essential

role that mental images play in the cognitive organization and retrieval of information; it is expected that distinct patterns among key correlates will be embedded in the semantic expressions chosen by policy elites to describe HF.

*H<sub>2</sub>: Latent semantic patterns in policy elites' HF narrative cognition will be influenced by culturally biased value predispositions.*

Applying GGCT facilitates more precise articulation of the hypothesis. It is expected that policy elites with predispositions toward egalitarianism will internalize elements of meso-level HF narratives that reinforce their belief that the environment is fragile. Policy elites with an affinity for individualism and hierarchism are expected to internalize HF narrative elements that reinforce their beliefs that the environment is a resource with promising economic returns. It is important to emphasize that although it is expected that individualists and hierarchs are expected to view HF in economic terms, the beliefs driving their narrative cognition is distinct. For individualists, the environment is self-sufficient but for hierarchs, the environment is resilient therefore, HF initiates a level of concern for hierarchs not recognized by individualists. Because narrative cognition is subject to dual system processing, it is expected that the mental image used to think about HF is tagged with affective valence which is used to associate narrative elements with judgments of benefits and risks that are negatively correlated.

*H<sub>3</sub>: Judgements of risk are correlated with the cognitive internalization of environmental narrative elements and judgements of benefit are correlated with policy elites' cognitive internalization of economic narrative elements.*

The following sections introduce the data, measures, and various analytical approaches relied on in this study.



## 2.4 Data, Variables, and Measures

### Examining Meso-Level Hydraulic Fracturing Narratives

With regard to the first hypothesis, the first step in the analysis examines how policy elites cognitively internalize elements of HF meso-level narratives to think about HF by examining meso-level narratives associated with HF activity. Other studies have used publicly available documents and manuscripts (Heikkila et al. 2014; Heikkila, Weible, and Pierce 2014) to represent meso-level HF narratives and other studies have examined newspaper articles as a measure of meso-level narrative within particular communities (Deserai A Crow, Berggren, et al. 2017). The data chosen in the analysis to represent meso-level narratives relies on two mainstream media sources in the U.S. likely to report on HF at the national level (not tailored to a particular geographic audience). The analysis included 925 newspaper articles published online in the Wall Street Journal (WSJ), a politically conservative leaning source for business related information, and the New York Times (NYT), a liberal-leaning newspaper was performed. Articles were located using the keywords *hydraulic fracturing* and *fracking*. The corpus was limited by subject (U.S.-based) and by year (2015-2016) to correspond to recent articles available to policy elites who would be sampled and surveyed. This method returned 40 articles (in full text, 25 articles in WSJ and 15 articles in NYT). The corpus of 40 articles included metadata such as the publication, year, headline, and full text of the article and was preprocessed using the *quanteda* in R. Structural topic modeling (*stm* in R) was used to extract three latent topics<sup>2</sup> from the text using the publication as a prevalence covariate.<sup>3</sup> The highest

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<sup>2</sup> STM was used to extract three latent topics (as opposed to 5, 7, or any other number) based on the number of topics that emerged with earlier data analysis using manual coding.

<sup>3</sup> A prevalence covariate may be incorporated into the structural topic model when the variable is believed to affect the frequency with which a particular topic is discussed (M. Roberts, Stewart, and Tingley 2018). In this case, the WSJ and the NYT have been criticized for publishing partisan views so the publication source for the article analyzed was coded (WSJ was coded 1 and NYT 0) and this variable was used in STM of meso-level narratives as the prevalence covariate.

probability words in topic 1 included *gas*, *frack*, *earthquake*, and *seismic*. High frequency words in the second extracted topic included *frack*, *water*, *gas*, and *regulation*. Finally, high frequency words in the third extracted topic included *oil*, *price*, *OPEC*, and *export*. The four most representative documents for each of the three topics (12 documents in total) were examined for narrative elements.

Articles represented by the first topic center on the environmental impacts of HF and more specifically, earthquakes. These articles primarily address increased seismic activity reported in Texas, Oklahoma, Arkansas, and other energy rich states. There are two primary narratives. One narrative portrays the oil and gas industry as a “concerned” and responsible agent diligently “following the data” and “trying to understand” the issues related to HF (Ailworth 2015a). An acknowledgement of increased seismic activity is followed by the statement that man-made and naturally occurring earthquakes are indistinguishable (Bustillo and Gilbert 2015). This portrayal of the oil and gas industry resembles other industry-based narrative discourse published by Kapranov (2017). Regulators are framed as prematurely critical and citizen lawsuits are portrayed as threatening to the economic viability of HF. An opposing narrative suggests that regulators and researchers are heroes protecting the public by seeking out much needed information and data. This narrative argues that a ban on HF is necessary until more information is secured (Wines 2015).

The second extracted topic also focuses on the environmental impacts of HF but specifically, its impact on water resources. The representative articles of this topic portray the oil and gas industry as victim of illegal actions implemented by the Bureau of Land Management to regulate the impacts of HF on water in public lands (A. Harder 2015, 2016b). Among the most representative articles, the oil and gas industry is also portrayed as a conservator of water,

continuing to invest in water management and infrastructure particularly in the western part of the U.S (Ailworth 2015b). Contrastingly, other representative articles portray the oil and gas industry as the villain, contaminating drinking water through HF activities citing that the EPA report on the impact of HF on water resources was inconclusive (Davenport 2015).

The third extracted topic focuses on economic outcomes related to HF activity. The most representative articles position the oil and gas industry as a hero whose ingenuity and entrepreneurship have increased domestic production of gas during a time of economic decline (Luskin and Warren 2015). The articles blame political inefficacy and illegal regulations for the industry's inability to sustain jobs and economic earnings and for its inability to achieve energy independence for the nation (Anonymous 2015; Cook and Eaton 2015).

#### Examining Micro-level Narrative Cognition Using Survey Data

The data for this study was recorded using two Internet based surveys administered and conducted between 2015-2017 focusing on local energy policy issues. An email was employed to invite respondents to participate. The email included a brief description with a link to the survey embedded and was sent to 2,396 potential survey respondents in Arkansas and 5,384 in Oregon using email addresses publicly available on municipal and relevant professional websites. Among survey recruits were city council representatives, chamber of commerce members residing in various cities in Arkansas and Oregon. Of those that opened the survey (788 in Arkansas 1,404 in Oregon), 167 in Arkansas and 469 in Oregon completed some survey questions. After removing entries with incomplete data for all of the variables used, the data set used in this study contains 464 policy elites residing in Arkansas and Oregon. This sample of Arkansas and Oregon policy elites was chosen due to the variation in experience with HF activities in each state. While both Arkansas (Davenport, 2015) and Oregon (Fahey, Manning Jr.,

and Helm 2019) have placed moratoriums on certain HF activities, Arkansas had recorded more than 4,000 active fractured wells. In contrast, Oregon had no recorded extraction activity.

### *Variables and Measures*

This study examines micro-level narrative cognition using a 2-stage analysis. The first stage corresponds to the expectation that *policy elites cognitively internalize elements of meso-level HF narratives when thinking about HF*. The process of using narratives to think about HF or narrative cognition is operationalized by recording policy elites' metacognitive policy image. Cognitive internalization of some concept can be measured by the individual expression of that mental image. Conceptually, cognitive mental images are anchored to an individual's real world and practical experiences, and can be expressed semantically (P. Harder 1954, 47). The expression of cognitive images are fundamental for facilitating group interactions and cooperative behavior (1954, 80) and accomplished through the use of words, formalized symbols that represent mental images and reflect an individual's "realm of reality" (P. Harder 1954, 53). The semantic expression of that image is referred to here as the metacognitive policy image or the expression used to describe the mental policy image. If meso-level HF narrative elements are internalized by policy elites and stored as a cognitive artifact, the image descriptions expressed (metacognitive policy images) and intended to describe HF would be structurally and contextually similar to those embedded in meso-level narratives. *The first step of the analysis then, involves examining* metacognitive policy images for narrative elements also present in meso-level policy narratives. The second stage of the analysis corresponds to the second hypothesis and conceives of the metacognitive policy image as the primary dependent variable. This stage is primarily interested in the relationship between culturally biased value predispositions, risk/benefit perceptions, and the cognitive selection of narrative elements while

controlling for other factors that have been identified in previous research. The measures used are displayed in Table I.

### *Narrative Cognition-Metacognitive Policy Images and Affect*

To understand how individuals cognitively internalize policy narratives, this study operationalizes the cognitive internalization of narratives by measuring policy elites' recollection of cognitive images associated with HF or their 'metacognitive policy image'. Images and words operate as formalized symbols representing an individual's "realm of reality" (P. Harder 1954, 53). Cognitive mental images are anchored to an individual's real world and practical experiences, and can be expressed semantically (P. Harder 1954, 47) therefore, the metacognitive policy image represents policy elites' recall of the mental image they used to think about HF. Respondents' metacognitive policy image is therefore operationalized by recording their semantic expression in response to the question posed in the survey, *when you think about fracking, what is the first image that comes to mind?* Data collection allowed respondents to input their description in an unstructured manner with no character limit. The unstructured nature of this measure is meant to avoid *a priori* researcher-specified assessments and directly record the respondents' metacognitive policy image of hydraulic fracturing.

Cognition of information relies on heuristics to simplify the process. Narrative cognition is subject to dual system processing in which also implicates emotions or affective feelings as responsible for cueing judgements. For this reason, affect is expected to play a central role in the cognition of HF narratives and is used as a prevalence covariate in the first stage of analysis detailed below. General affect or respondents' general feelings about HF is operationalized by asking respondents to indicate how they generally feel about fracking on a scale of one (extremely negative) to seven (extremely positive).

**Table I Chapter 2 Variables and Measures**

<b>Variable</b>	<b>Measure</b>
Metacognitive Policy Image of Hydraulic Fracturing	When you think about fracking, what is the first image that comes to mind? (Open-response)
Affect	Indicate how you generally feel about fracking. (1=Extremely Negative to 7=Extremely Positive)
Egalitarianism	Society works best if power is shared equally. (1=Strongly disagree to 7=Strongly agree)
	It is our responsibility to reduce differences in income between the rich and the poor. (1=Strongly disagree to 7=Strongly agree)
	What society needs is a fairness revolution to make the distribution of goods more equal. (1=Strongly disagree to 7=Strongly agree)
Egalitarianism index	Index using factor score of above three items ( $\alpha=0.82$ )
Individualism	We are all better off when we compete as individuals. (1=Strongly disagree to 7=Strongly agree)
	Even the disadvantaged should have to make their own way in the world.(1=Strongly disagree to 7=Strongly agree)
	Even if some people are at a disadvantage, it is best for society to let people succeed or fail on their own. (1=Strongly disagree to 7=Strongly agree)
Individualism index	Index using factor score of above three items ( $\alpha=0.79$ )
Hierarchism	Society is in trouble because people do not obey those in authority. (1=Strongly disagree to 7=Strongly agree)
	The best way to get ahead in life is to do what you are told to do to the best of your abilities. (1=Strongly disagree to 7=Strongly agree)
	Society would be much better off if we imposed strict and swift punishment on those who break the rules. (1=Strongly disagree to 7=Strongly agree)
Hierarchism index	Index using factor score of above three items ( $\alpha=0.69$ )
Fatalism	For the most part, succeeding in life is a matter of chance. (1=Strongly disagree to 7=Strongly agree)
	No matter how hard we try, the course of our lives is largely determined by forces beyond our control. (1=Strongly disagree to 7=Strongly agree)
	Most of the important things that take place in life happen by random chance. (1=Strongly disagree to 7=Strongly agree)
Fatalism index	Index using factor score of above three items ( $\alpha=0.78$ )

**Table I (Cont.)**

Benefit Risk Perception	1=Risks outweigh the benefits to 7=Benefits outweigh the risks
Political Party Identification	1=Democrat; 0=Others (Republican or Independent) 1=Republican; 0=Others (Democrat or Independent)
Race	1=Non-Hispanic White
Gender	1=Male
Age	Age in years
Education	Level of education (1=Elementary through some high school to 7=Doctorate (of any type))
Income	Total estimated annual household income (1=less than \$20,000 to 9=\$300,000 or more)
State	1=Arkansas; 0=Oregon
Year	1=2017; 0=2015

*Cultural Orientations or Worldviews*

The primary variable, policy elites' culturally biased value predispositions are operationalized using GGCT. Three survey questions corresponding to each of the four prototypical worldviews (i.e., egalitarianism, individualism, hierarchism, and fatalism) render a total of twelve culturally nuanced statements (provided in random order in the survey) rated one to seven, with one indicating that the respondent strongly disagrees and seven indicating strong agreement. Factor analysis (with the *varimax* rotation method) of the twelve CT measures reveal four latent factors, which parallel with the four distinctive dimensions of the cultural worldviews. Consistent high factor loadings exist among each of the three related CT measures (i.e., factor loading greater than 0.5) while loading low on remaining unrelated factors. Based upon this factor structure, factor scores for each of four latent dimensions (representing each of four cultural orientations) were calculated and are used as an index for measuring each cultural orientation. Cronbach's  $\alpha$  scores for the three survey items (constituting each CT index) among policy elites range from 0.69 to 0.82 indicating that the related survey measures are reasonably reliable.

### *Overall Risk-Benefit Perception*

As discussed in the theoretical section of the paper, perceptions of risk impinge on cognitive processes. For this study, operationalization of the perceived risks and benefits regarding HF is achieved by asking respondents to rate the overall balance of the risks and benefits associated with fracking operations in their community using a scale of one to seven where one indicates that risks outweigh the benefits and seven indicating that benefits outweigh the risks.

### *Control Variables*

Control variables include political party identification, demographics, state and year. Identification with a political party is more stable than political values (Goren 2005) and may therefore be used to process information and form judgements on political or policy related matters. Respondents' identification with a political party is operationalized by asking policy elites to indicate which political party they most identify among Democratic, Republican, or Independent. Measures were recoded to capture respondents' primary identification with the Democratic party (coded 1) or not (coded 0) or with the Republican party (coded 1) or not (coded 0).

Demographic characteristics of respondents used in this study include race (coded 1 for Non-Hispanic Whites and 0, otherwise), gender (coded 1 for Male and 0, otherwise), age (age in years), education (a 7-point scale with higher rating representing higher education level) and annual household income (1 to 9-point scale ranging from less than \$20,000 to \$300,000 or more) and serve as control variables. Responses received from those residing in Arkansas were coded 1 and those residing in Oregon were coded 0. Responses received in the 2016/17 release of the survey were coded 1 and those received in the 2015 release of the survey were coded 0.



## 2.5 Empirical Analysis and Results

### Descriptive Statistics

The average policy elite is a white (96.8%) male, (96.8%), approximately 55 years old with a college education and an annual household income of between \$70,000 and \$100,000 (see Table II And III).

**Table II Chapter 2 Descriptive Statistics**

Variable	N	Mean	St. Dev.	Min.	Max.
<b>Egalitarianism</b>	464	-0.01	1.00	-2.58	2.62
<b>Individualism</b>	464	-0.05	0.98	-2.74	2.99
<b>Hierarchism</b>	464	0.06	1.02	-2.42	3.32
<b>Fatalism</b>	464	-0.04	1.02	-1.73	3.36
<b>Risk/Benefit Perception</b>	464	3.46	1.92	1	7
<b>Age</b>	464	54.49	12.84	22	91
<b>Education</b>	464	4.63	1.41	2	7
<b>Income</b>	464	5.36	1.57	1	9
<b>Affect</b>	464	3.35	2.02	1	7

**Table III Chapter 2 Frequency Table**

Variable	n	Category (%)		
<b>Race</b>	464	Non-White (3.8%)		White (96.2%)
<b>Gender</b>	464	Female (35.8%)		Male (65.2%)
<b>Political Party Identification</b>	464	Democrat (36.0%)	Republican (33.1%)	Other (30.9%)

### Step 1: Examining Narrative Elements Embedded in HF Meso-level Policy Narratives

To determine whether policy elites cognitively internalize elements of competing meso-level policy narratives, structural topic modeling (STM) is used to extract latent topics from policy elites' metacognitive policy image. STM has been used to analyze unstructured text in multiple applications across disciplines (M. Roberts, Stewart, and Tingley 2018). A hallmark of STM analysis is the ability to incorporate other relevant metadata or covariates to estimate meaningful

variation present in the frequency with which a topic is discussed (topical prevalence) and within the words chosen to describe or discuss a particular topic (topical content) (2018). This approach relies on a semi-supervised learning approach within a machine learning scheme to extract topics for each individual response based on the distribution of words represented by a semantic theme (K) using a mixed-membership model.<sup>4</sup> Given the role of affective emotion in cognitive processing and association between mental images and semantic expressions under a dual system (Slovic et al. 2004), the variable *affect*<sup>5</sup> was used to determine topical prevalence when calculating the frequency with which a topic is discussed. Estimations are sensitive to the distribution over words for a particular topic so “Spectral” initialization was used (M. Roberts, Stewart, and Tingley 2018). The selection of three topics (K=3) was used based on previously identified dimensions of the ongoing policy debate<sup>6</sup> using a maximum of 500 iterations. Meaningful topics within the metacognitive images are summarized through the calculation of prioritized words (those words that have the highest frequency of use for a given topic as calculated in various ways)<sup>7</sup> using the *stm* package in the R computing environment.

A correlation between the narrative elements found in meso-level HF policy narratives and policy elites metacognitive policy images would support the expectation that policy elites cognitively internalize elements of HF meso-level narratives to think about HF. The analysis begins by characterizing the metacognitive imagery of elites and then comparing the topics

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<sup>4</sup> Mixed membership models assign a topic to each word in a document resulting in one document defined as a vector of proportions that represent the fraction of words within each document that belong to an inferred topic.

<sup>5</sup> As discussed before, valenced affect was operationalized by asking respondents to indicate on a scale from 0 to 7, where 1 means *extremely negative* and 7 means *extremely positive*, how they generally feel about fracking.

<sup>6</sup> As mentioned in the introduction, previous dimensions of the policy debate over fracking include positive associations with job creation and economic security as well as negative impacts relating to health and the environment.

<sup>7</sup> FREX weights words based on overall frequency and exclusivity to the topic. Lift weights words by giving a greater weight to words that appear less frequently in other topics. Score divides the log frequency of the word in primary topic by the log frequency of the word in other topics (M. Roberts, Stewart, and Tingley 2018).

**Table IV Probable Word Use Among Policy Elites for Topics 1-3**

		<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
<i>When you think about fracking, what is the first image that comes to mind? (open-response)</i>	<b>Highest probability of use based on frequency of use</b>	<i>water, pollut, damage, chemic</i>	<i>energi, larg, independ, job</i>	<i>pressur, high, big, fuel</i>
	<b>Highest probability of use based on exclusivity of use</b>	<i>water, pollut, earthquak, ground</i>	<i>energi, job, cheap, independ</i>	<i>oil, drill, gas, pressur</i>

extracted from metacognitive imagery to the topics extracted from meso-level HF narratives.

Table IV characterizes metacognitive imagery of HF using three latent topics.<sup>8</sup> The most probable words (based on frequency and exclusivity of use) extracted are displayed in Table V along with the corresponding representative responses. The words with the highest probability of occurring in Topic 1 based on the frequency and weighting of words consist of *water*, *earthquak(e)*, *damage(e)*, *pollut(e)*, *contamin(ate)*, and *destroy* (see Table IV and V). For this reason, Topic 1 is broadly categorized as environmental. A second latent topic (Topic 2) contains words like *energy*, *abund*, *cheap*, and *job* attempt to quantify the effects of HF through abundant production, the decreased cost of energy, and the impact to the labor market. This topic is characterized as economic. The third latent topic (Topic 3) contains words like *oil*, *earth*, *drill*, and *gas*. A review of representative responses for this topic reveal that this topic may be characterized as a technical or mechanical description of the process.

As stated in H<sub>1</sub>, commonalities between meso-level narratives and the language used to describe HF at the micro level would be supportive of elite internalization of meso-level narrative elements to think about HF. Table VI displays the extracted topics from meso-level

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<sup>8</sup> Correlation analysis indicates that each topic is unique in that it is uncorrelated with any of the other topics.

**Table V Policy Elites’ Most Frequent Words and Representative Responses for Topics 1-3**

		<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
<i>When you think about fracking, what is the first image that comes to mind? (open-response)</i>	<b>Most Frequent Words</b>	<i>water, earthquak, ground, pollut,</i>	<i>energi, abund, cheap, job</i>	<i>Oil, earth, drill, gas</i>
	<b>Representative Responses</b>	<i>Diminishing water levels. Polluted ground water. Earthquakes and polluted ground water.</i>	<i>Energy independence. Abundant oil and gas produced in the U.S. Cheaper energy for the U.S. Jobs and energy self-sufficiency.</i>	<i>Extracting oil. Much like traditional oil drilling. Drilling in the earth. Drilling to release gas. Water sprayed from high pressure device to retrieve gas.</i>

narratives with the topics embedded in elite metacognitive imagery for ease of comparison. With regard to the content of environmental focused narratives, the metacognitive imagery used by policy elites to describe HF share frequently used terms found in meso-level narratives (25% of the words within a topic are shared). More explicitly, policy elites’ propensity to describe HF as responsible for the “pollution of water” is consistent with Davenport’s (2015) account while both the public and elites are concerned with seismic activity as alluded to in Bustillo and Gilbert (2015) and Wines (2015). With regard to narrative structure, meso-level narratives emphasize various characters including the oil and gas industry, regulators, and researchers. In contrast, infrastructure development and water management are not present in elite metacognitive imagery and characters are noticeably missing. The narrative structure of metacognitive imagery most closely resembles only a partial plot.

With respect to economic-based narratives, a comparison of the most frequently used language present in meso-level narratives with language used by elites to describe HF reveals that 0% of the most probable terms are shared. Although elite responses describing HF as

**Table VI Comparison of Topics Extracted from Meso-level HF Policy Narratives with Policy Elite Narrative Cognition**

		<b>Environmental</b>		<b>Economic</b>
<b>Highest probability of use based on frequency of use</b>	<b>Nationally Distributed Newspaper Articles</b>	<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
		<i>gas, frack, earthquak, seismic</i>	<i>frack, water, gas, regulation</i>	<i>oil, price, OPEC, export</i>
	<b>Policy Elite Metacognitive Images</b>	<b>Topic 1</b>		<b>Topic 2</b>
	<i>water, pollut, earthquak, ground</i>	<i>energi, job, cheap, independ</i>		
		25%	0%	

providing “energy independence” and “cheaper energy” seem to echo elements of collective level narratives that argue economic outcomes would be better if political inefficacies and regulations were less constraining on the industry (Cook & Eaton, 2015).

With regard to the third latent topic, an analysis of the content reveals that the imagery most closely resembles a narrative setting by characterizing facts that are not contested or indisputable and by speaking to the context within which the policy issue exists. The content of these images does not appear to directly mirror any of the meso-level fracturing narratives analyzed.

The analytical results are not inconsistent with expectations stated in H<sub>1</sub> particularly with regard to the environmental dimension of HF. When policy elites are compelled to describe HF, they are likely to use language frequently found in meso-level narratives to describe the environmental implications of HF. The next stage of the analysis examines factors theorized to drive cognitive selection and internalization of narrative elements associated with HF. While Topic 3 contains valuable information, it did not reflect any elements found present in meso-level narratives and therefore holds less theoretical interest for this paper. Stage 2 will focus on

policy elites' metacognitive policy images represented by Topic 1 (environmental narrative elements) and Topic 2 (economic narrative elements). This first stage of STM analysis on micro-level responses, assigns each response a proportion that corresponds to each topic. In the next stage of analysis, that proportion serves as the primary dependent variable.

### Step 2: Estimating Effects of Cultural Orientations and Benefit/Risk Perceptions on Cognitive Internalization of Narrative Elements

The second step of the analysis applies OLS regression to estimate the relationships between the topics and other covariates. Topical distribution serves as the dependent variable with multiple covariates serving as independent variables (M. E. Roberts et al. 2014). Estimations can be computed with effects of the covariates reported given that all other covariates in the model are being controlled for or held constant. In this study, the analysis incorporates individual covariates in an additive manner ending with a full model represented below. Covariates include demographic characteristics, risk/benefit perceptions, political party identification, and value predispositions or culturally biased worldviews.

Table VII summarizes the results of the analysis. Models 1a and 1b summarize the influence of demographic variables on the internalization of environmental and economic narrative elements respectively. Older policy elites (0.002, p-value <0.05 in Model 1b) who are male (0.148, p-value <0.05 in Model 1b) are more likely to internalize economic narrative elements. Models 2a and 2b incorporate party affiliation and analytical results indicate that elites who self-identify as Democrats are more likely to cognitively internalize environmental narrative elements (0.080, p-value <0.05 in Model 2a) while those who identify as Republicans are more

**Table VII Regression Results - Factors Influencing Policy Elites' Cognitive Internalization of HF Narrative Elements**

Variable	Model 1a	Model 2a	Model 3a	Model 4a	Model 1b	Model 2b	Model 3b	Model 4b
	<b>Dependent Variable:</b> Response Frequently Incorporates <b>Environmental</b> Metacognitive Artifact				<b>Dependent Variable:</b> Response Frequently Incorporates <b>Economic</b> Metacognitive Artifact			
<b>Risk/Benefit Perception</b>				<b>-0.045*</b> (0.005)				<b>0.070*</b> (0.006)
<b>Egalitarian</b>			<b>0.052*</b> (0.010)	<b>0.023*</b> (0.009)			<b>-0.069*</b> (0.012)	<b>-0.025*</b> (0.012)
<b>Individualism</b>			<b>-0.063*</b> (0.010)	<b>-0.041*</b> (0.010)			<b>0.057*</b> (0.013)	0.022 (0.012)
<b>Hierarchism</b>			<b>-0.020*</b> (0.009)	<b>-0.017*</b> (0.008)			-0.003 (0.011)	-0.007 (0.010)
<b>Fatalism</b>			-0.006 (0.009)	-0.005 (0.008)			-0.017 (0.011)	-0.018 (0.010)
<b>Republican</b>		<b>-0.080*</b> (0.022)	-0.020 (0.022)	-0.001 (0.021)		<b>0.070*</b> (0.028)	0.011 (0.029)	0.021 (0.026)
<b>Democrat</b>		<b>0.080*</b> (0.022)	<b>0.051*</b> (0.022)	0.032 (0.020)		<b>-0.152*</b> (0.028)	<b>-0.095*</b> (0.029)	<b>-0.062*</b> (0.026)
<b>Age</b>	-0.000 (0.001)	-0.007 (0.006)	-0.001 (0.001)	-0.001 (0.001)	<b>0.002*</b> (0.001)	<b>0.002*</b> (0.001)	<b>0.002*</b> (0.001)	<b>0.001*</b> (0.001)
<b>Gender (Male)</b>	<b>-0.111*</b> (0.020)	<b>-0.056*</b> (0.021)	-0.033 (0.019)	-0.005 (0.018)	<b>0.148*</b> (0.026)	<b>0.080*</b> (0.026)	<b>0.068*</b> (0.025)	0.025 (0.023)
<b>Race (White)</b>	0.012 (0.051)	0.000 (0.005)	0.020 (0.046)	0.022 (0.042)	-0.014 (0.065)	-0.006 (0.061)	-0.017 (0.059)	-0.015 (0.053)
<b>Education</b>	0.012 (0.007)	0.001 (0.006)	-0.005 (0.006)	-0.003 (0.006)	-0.017 (0.009)	-0.003 (0.008)	-0.002 (0.008)	-0.002 (0.007)
<b>Income</b>	-0.006 (0.006)	-0.003 (0.006)	0.002 (0.006)	0.006 (0.005)	0.006 (0.008)	0.003 (0.007)	-0.006 (0.007)	-0.013 (0.007)
<b>Intercept</b>	<b>0.377*</b> (0.069)	<b>0.500*</b> (0.067)	<b>0.402*</b> (0.065)	<b>0.466*</b> (0.061)	<b>0.163*</b> (0.088)	<b>0.008*</b> (0.085)	<b>0.120*</b> (0.083)	<b>0.022*</b> (0.075)
<b>n</b>	464	464	464	464	464	464	464	464
<b>Adjusted R<sup>2</sup></b>	0.06	0.18	0.26	0.37	0.19	0.19	0.40	0.41
<b>F statistic</b>	5.93	13.52	14.75	21.74	15.02	14.44	35.21	25.43

Note: Parentheses indicate calculated standard errors. \* denotes a t value >1.96 and a p-value < 0.05. State and year were included as control variables in all models but were not statistically significant and not reported here for the sake of clarity.

likely to think about HF using economic narrative elements (0.070, p-value<0.05 in Model 2b). Analytical results in the third regression model incorporate the effect of culturally biased value predispositions and indicate that egalitarian values drive cognitive internalization of environmental narratives (0.052, p-value<0.05 in Model 3a). This is contrasted with policy elites who hold predispositions toward individualism. Strong individualists are likely to use economic narrative elements (0.057, p-value<0.05 in Model 3b) to think about HF rather than consider the environmental implications (-0.063, p-value<0.05 in Model 3a). Finally, those with hierarchy value predispositions are unlikely to internalize environmental narrative elements to think about HF (-0.020, p-value<0.05 in Model 3a). Incorporation of value predispositions significantly increased the amount of variation explained (increase in Adjusted R<sup>2</sup> from 0.18 in Model 2a to 0.26 in Model 3a and from 0.19 in Model 2b to 0.40 in Model 3b). Models 4a and b incorporate elites' overall assessment of the risks and benefits associated with HF. As H<sub>3</sub> posits, those who feel as though the risks outweigh the benefits are more likely to internalize environmental narrative elements (-0.045, p-value<0.05 in Model 4a). Conversely, elites who indicate that the benefits of HF outweigh the risks are more likely to cognitively internalize economic narrative elements (0.070, p-value<0.05 in Model 4b). The effect of egalitarianism holds even when assessments of risk are included in the model (Model 4a and b) however, the effect of individualism and hierarchism drops under a statistically significant level in Model 4b. Overall, the OLS regression results provide strong support for H<sub>2</sub> and H<sub>3</sub>.

#### Bayesian Posterior Simulation

To more clearly visualize the relationship between cultural orientations, utility judgments, and narrative cognition while overcoming some of the limitations for prediction due to estimation uncertainties (King, Tomz, and Wittenberg 2000), Bayesian posterior simulation is applied in the

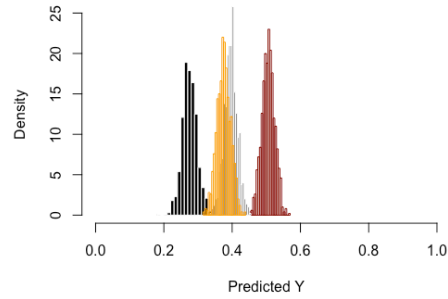


final analysis. Simulations were run in the R environment using the *arm* package. The dependent variable in this analysis is the proportion of elites' metacognitive image indicating the cognitive internalization of both environmental and economic narrative elements. Using variables included in regression model 4a and 4b of the previous analysis, further estimations were run by reducing the regression model using a dummy variable that represents policy elite risk perceptions. Those who indicated that overall, the risks of HF outweighed the benefits (1-3 on the risk/benefit scale) were coded 1 and 0 was assigned to those who assessed that the benefits outweighed the risks (5-7 on the risk/benefit scale). Egalitarianism, individualism, hierarchism, and fatalism were used as primary explanatory variables. Bayesian posterior simulation is used to further explore the relationships between these two primary variables.

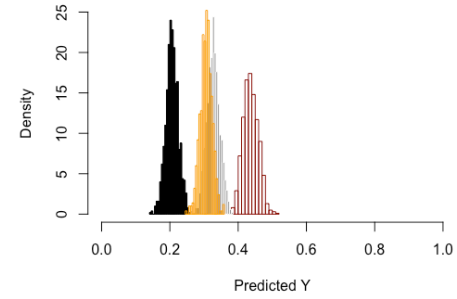
Based on the procedures outlined in King et al. (2000), 1,000 simulations produced vectors of estimated regression coefficients for each CT operationalized value predisposition or worldview. Distributions were obtained corresponding to each worldview. These distributions over four worldviews were obtained for two groups. One group included those elites who assessed HF as primarily a risk and a second group who reported that HF risks were predominate. The distributions of predicted likelihood for internalizing environmental narrative elements is displayed in Figure 1. The horizontal axis represents the proportion of metacognitive imagery that corresponds to environmental narrative and economic narrative respectively. The histograms in Figure 1 display the estimated distributions where each distinct worldview is represented by different color (egalitarians are red, individualists are black, hierarchs are orange, and fatalists are grey). Histogram *a* and *b* display the predicted proportion of cognitively internalized environmental narrative elements for policy elites who perceive HF risks as outweighing the benefits (*a*) and for those who report that the benefits outweigh the risks (*b*).

Policy elites with egalitarian value predispositions, without regard to their overall risk assessment, are most likely to internalize environmental narratives while strong individualists are the least likely to do so. These two particular value predispositions exhibit very little overlap. Hierarch and fatalist tendencies to internalize environmental narratives are more difficult to distinguish from each other. Their distributions suggest that hierarchs may be slightly less likely than fatalists to internalize environmental narratives. Histograms c and d also display the distributions for policy elites of all four worldviews. This histogram graphically represents the predicted proportion of policy elites' cognitive internalization of economic narratives and allow for the comparison of those who report the risks outweigh the benefits (*c*) against those who report HF as primarily beneficial (*d*). Again, regardless of how policy elites assess the overall risks or benefits of HF, individualists and egalitarians show distinct cognitive patterns. Individualists are most likely to cognitively internalize economic narrative elements. Conversely, there is virtually no chance that egalitarians who view HF as risky are going to internalize economic narratives and even among elites who indicate that the benefits outweigh the risks, egalitarians are least likely to internalize economic narratives. While a greater proportion of environmental narrative elements are likely to be internalized by elites who perceive HF as risky and a greater proportion of economic narrative elements are likely to be internalized by elites who judge HF to be primarily beneficial, the distributions show distinct patterns of narrative cognition driven by value predispositions regardless of how policy elites judge overall risks of HF with egalitarians and individualist taking consistently competing views.

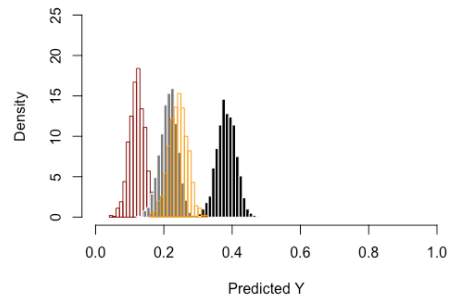
a) Predicted Proportion of **Environmental Narratives** Internalized by Policy Elites Who Perceive the **Risks of HF Outweigh the Benefits**



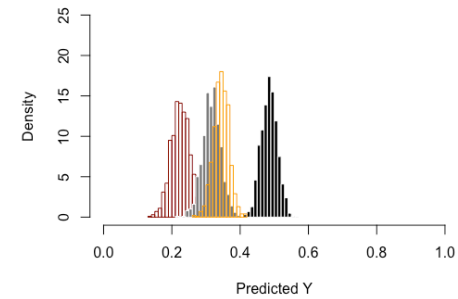
b) Predicted Proportion of **Environmental Narratives** Internalized by Policy Elites Who Perceive the **Benefits of HF Outweigh the Risks**



c) Predicted Proportion of **Economic Narratives** Internalized by Policy Elites Who Perceive the **Risks of HF Outweigh the Benefits**



d) Predicted Proportion of **Economic Narratives** Internalized by Policy Elites Who Perceive the **Benefits of HF Outweigh the Risks**



█ Egalitarianism   
 █ Individualism   
 █ Hierarchism   
 █ Fatalism

**Figure 1. Predicted Likelihood of Cognitively Internalizing Narrative Elements by Worldview and Assessment of Overall HF Risk/Benefit**

## 2.6 Conclusions and Discussion

HF activities in the U.S. have been the center of entrenched policy debates. Previous studies have examined public attitudes toward HF and identified multiple factors that contribute to the controversy over HF. Studies suggest that the issue tends to be framed such that opponents focus on the impacts to the environmental and public health while proponents tend to focus on associated economic impacts. This study provides a unique opportunity to examine policy elite attitudes and identify driving factors that work to sustain such debates. Policy narratives are an essential element to the discourse around this controversial issue and this research set out to examine how and why policy elites cognitively process narratives around this issue. The results of this study provide evidence to suggest that, not only are narratives relevant, they are fundamental to understanding the debates orbiting this controversial policy issue. Results suggest that policy elites may cognitively retain some narrative elements at the micro-level and the cognitive selection and retention is guided by their worldview.

Based on previous studies and guided by theory, this study set out to determine whether larger (meso-level) narratives were relevant to policy elites' thinking on HF. Findings suggest that policy elites' cognition around HF involves communications that contain structural and contextual information that is substantively similar to that found in meso-level HF narratives. Broadly, both larger meso-level narratives and policy elites' metacognitive policy images reflect similarly competing perspectives on the issue. STM results reveal similarly distinct latent patterns, one representing environmental impacts and another representing broader economic implications of HF. Interestingly, this finding is consistent with the environmental vs. economic framing of the issue visible in other studies focused on the media (Boudet et al. 2014; Sarge et al. 2015) and evident in more complete narratives at the coalition level (Heikkila, Weible, and

Pierce 2014). In regard to narrative content, empirical results indicate that 25% of policy elites metacognitive policy images relating to the environmental impacts of HF, are exactly the same as the most frequently used words found in meso-level HF narratives. When it comes to the environmental dimensions of HF, these findings appear consistent with expectations that elites cognitively internalize meso-level narrative elements, storing these elements as cognitive artifact to later describe HF environmental impacts. This analysis, however, suffers from some significant limitations in that it relies on the exact same wording. The limitations are more obvious in the results associated with economic dimensions of HF. Metacognitive images that describe HF economic impacts were not precisely the same those most often used in meso-level narratives despite the fact that a general reading of the content revealed similarities. Possible explanations for these findings provide some direction for future study. First, the study used nationally focused meso-level narratives which might take a slightly broader economic perspective. This finding could be interpreted to suggest that perhaps local policy elites may rely on different or even more geographically proximal sources to gather economic information on HF. Whether this is a result of differing sources, the author's choice of sources, the analytical method selected, or something related to coalition success within the policy subsystem, a more complete analysis of cognitive internalization is not possible using this data set. With that said, there is some evidence to suggest that meso-level narrative elements are used by policy elites to think about and describe HF. In terms of narrative content, aspects of nationally distributed meso-level narratives and the micro-level narratives used to construct a description of HF impacts are similar and, in some cases, the semantic patterns are the same. In terms of narrative form, the plot element found in meso-level narratives are present in an abbreviated form in policy elite descriptions of HF. Given the preference of individuals to rely on narratives to

cognitively organize and communicate ideas (Berinsky and Kinder 2006; M. Jones, Shanahan, and McBeth 2014, 12; Polkinghorne 1988), this finding provides some evidence to suggest that the narrative plot plays an important role in narrative cognition.

While previous studies have found the character component of narrative in communications on HF at the organizational level, it is of theoretical interest to note that this study finds elements of a plot embedded within policy elites' responses with no reference to a character component. As already mentioned, the content of policy elites' HF descriptions were similar and sometimes even identical to those found in meso-level narratives however, narrative structural elements were not consistent with the structural elements of meso-level narratives in other studies. The NPF defines the plot as functioning to assign blame by connecting the character to the issue. For HF, important issues are perceived of either as causing harm to the environment or facilitating economic growth and independence for a region or nation, but the character component is absent in elites' descriptions. It is possible that the bounded rationality of elites' result in an abbreviated version of the plot that is available for further elaboration depending on the context, type of communication, or other unidentified factors? Are there functional characteristics of narrative content and narrative structure that have important implications for policy communications? Of course, it is also possible that the results are simply related to the measure chosen for this study. Further research is needed to fully explore the connection between cognitive patterns and narrative components.

Narrative cognition requires that meaningful aspects of the narrative be conveyed in a way that is supported by the cognitive processes that underpin all human judgement. The results of this study suggest a network of reinforcing beliefs or value predispositions drive the cognitive selection and internalization of policy narrative elements. After applying OLS

regression modeling and Bayesian posterior simulation modeling, some demographic factors, identification with a particular political party, and even policy elites' overall assessment of utility can influence how narrative elements are internalized. Older male policy elites were more likely to think about HF in economic terms. This is consistent with previous studies of public attitudes on HF (Whitmarsh et al. 2015). In risk literature, this phenomena is known as the "white male effect" (Finucane, Slovic, et al. 2000a). Policy elites who identified with the Democratic party were more likely to think of the environmental impacts while those who identified strongly Republican were more likely to take an opposing view. This is not surprising given that other studies have reported similar findings among the general public (Davis and Fisk 2014). After all, this issue has become highly politicized. It is important to note however, that the regression results indicate that some explanatory power attributable to party identification is lost once worldviews are included in the model. Additionally, analytical results also indicate that policy elites' overall assessment of utility also influences how policy elites think about HF. Those who see HF as primarily risky are more likely to internalize aspects of HF's environmental impacts and elites who recognize the benefits are likely to express the economic ramifications of the technology. Under conditions of uncertainty, the bounded rationality of the individual combined with dual process cognition, render mental images an essential factor in cognitive processing (Slovic et al. 2004) emphasizing that perceptions of risk can be a strong force in cognition. But most importantly, the analytical results show that regardless of the overall risk assessments of HF, policy elites' Again, the focus identifies culturally biased value predispositions are fundamental drivers of narrative cognition. Bayesian posterior simulations produced predicted distributions that visually represent the relationships between narrative cognition, value predispositions, and utility assessments among policy elites. The results reveal that while policy

elites' overall assessment of the risks and benefits may vary, value predispositions consistently guide the cognitive internalization of narrative elements. Policy elites with strong egalitarian worldviews are likely to internalize narratives that frame hydraulic fracturing as harmful to the environment act. This acts to reinforce egalitarian concerns for inequality as well as their desire for regulatory intervention in order to protect the environment. Contrastingly, policy elites with strong predispositions toward individualism are more likely to internalize narratives that position hydraulic fracturing as an economic opportunity. This is consistent with their preference for deregulation and freedom to make choices about environmental resources.

In conclusion, subject to dual system processing, it is strong predispositions toward certain worldviews that motivate the cognitive internalization of value-congruent narrative elements through the cognitive process of motivated reasoning. Motivated reasoning is a well-developed concept in behavioral psychology where judgments on one issue are unconsciously reliant on some other goal that is unrelated to the issue under judgment for the sake of maintaining cognitive coherence or consistency when making complex decisions (Russo et al. 2008) and for maintaining shared values (Westfall et al. 2015). In other words, policy elites internalize elements of HF policy narratives that confirm what they already believe. Socially constructed meanings embedded in policy narratives are cognitively identified, selected, and stored by policy elites to use for future judgments of HF in ways that reinforce pre-existing culturally shared values to preserve cognitive coherence and identity with value-based groups. This is particularly important for policy elites who interact with other elites who share their values and work together in order to codify shared beliefs and accompanying concepts of risk in policy.



From a methodological perspective, this study features a couple of unique approaches. By focusing on policy elites, this study provides a more comprehensive examination of attitudes toward this controversial policy issue. Previous work examining attitudes toward fracking have focused on public perceptions (Boudet et al. 2014; Brown et al. 2013; Davis 2012; Rabe and Borick 2011) which hold a degree of conceptual importance in a representative democracy. However, previous studies suggest that members of the public have less influence on policy than economic elites and organized groups who generally retain substantial influence on policy across issues (Gilens and Page 2014). This is consistent with theoretical foundations in policy process that rely on the formation and behavior of advocacy coalitions to explain policy change. This is not meant to imply that public opinion has no importance in understanding the debates. Rather, recent developments in policy theory suggest coalitions play a primary role in policy change and define coalitions as composed primarily of policy elites rather than the general public (Sabatier and Jenkins-Smith 1999, 30).

Another distinguishing methodological feature of this study is its use of the open-ended survey question. Open-ended survey questions provide an advantage of providing a more direct view of respondents' thoughts by allowing them to structure the response with less researcher-imposed constraints (cite Iyengar 1996). However, it is not without limitations. No response or short responses may result from this approach and as noted, this may have important implications for the conclusions drawn from this study. Regardless, this approach provides a novel measure and relevant insights (Geer 1991, 360) with results that are most valuable when combined with other relevant studies. The addition of unsupervised machine learning techniques, particularly when applied to the analysis of large-scale text data, render this approach more feasible.

In summary, the results of this study suggest that the cognitive patterns of policy narratives among local policy elites involve images of environmental degradation or economic boom and closely mirror the plot of more complete policy narratives. This suggests that, due to the bounded rationality and subject to motivated reasoning, policy elites' worldviews guide their selection, internalization, and retrieval a more elegant narrative form that is somehow functional. This knowledge is important for developing a deeper understanding of policy communication, interaction, and decision making at the micro level particularly because of the propensity for micro-level understandings to evolve into macro-level issues (Baumgartner and Mahoney 2008). From a practical perspective, the cognition of policy narratives is relevant not only to risk communications relating to HF practices and the future of policy in the U.S. Global attention at the intersection of information warfare and policy is gaining momentum (Berkowitz 1995; Cavelti 2008; Old Tactics, New Tools: A Review of Russia's Soft Cyber Influence Operations. 2017). Deeper comprehension of narrative cognition promises to provide much needed insight into how competing narratives remain vulnerable to exploitation in ways that have broad policy implications.

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### **Chapter 3. Probing Narrative Cognition: How Do Policy Elites and the General Public Internalize Competing Policy Narratives on Hydraulic Fracturing?**

The use of technologies, such as horizontal drilling and hydraulic fracturing (collectively referred to as “fracking”), to extract oil and gas from unconventional sources have become increasingly controversial in the U.S. and other parts of the world. In addition to producing inconsistent policies (Zirotiannis et al. 2016), debates over fracking have recently been targeted in cyber-based disinformation campaigns (Old Tactics, New Tools: A Review of Russia’s Soft Cyber Influence Operations. 2017; U.S. House of Representatives 2018). Recent government investigations provide evidence to support that competing policy narratives regarding the impacts of hydraulic fracturing are being exploited in an effort to further polarize the issue and destabilize the U.S. energy market (U.S. House of Representatives 2018). A more comprehensive understanding of how individuals internalize hydraulic fracturing narratives holds implications not only for energy policy but for other policy domains including national security and economic policy. This paper probes the concept of narrative cognition outlined in the Narrative Policy Framework by examining the individual level cognitive patterns of hydraulic fracturing (HF) imagery. The study uses a comparative approach, analyzing how policy elites and the general public cognitively internalize or recall elements of competing policy narratives on HF.

#### **3.1 Hydraulic Fracturing Narratives**

The controversy surrounding hydraulic fracturing is supported by intense disagreements over the impacts that result from the use of the technology. The degree of uncertainty surrounding the outcomes of hydraulic fracturing practices leaves space for competing explanations that are most commonly communicated in narrative form. Hydraulic fracturing has been touted for stabilizing

and lowering energy costs, reducing air pollution and emissions in some energy sectors, creating jobs and positive economic impacts in regions of activity, and strengthening energy security (Federal Multiagency Collaboration on Unconventional Oil and Gas Research: A Strategy for Research and Development 2014; Greenstone 2018). The same technology has also been criticized for its excessive demand on water resources and infrastructure, its contribution to greenhouse gasses, potential negative impact to the environment and to human health, and initiation of seismic activity (Stockton 2015; US EPA National Center for Environmental Assessment and Frithsen 2015; Vengosh et al. 2013).

Focusing on the collective or shared narrative understandings of policy goals or solutions communicated by advocacy coalitions (M. D. Jones, Shanahan, and McBeth 2014), meso-level research examining hydraulic fracturing (HF) policy narratives have identified them as competing (Weible and Heikkila 2017a) in a manner that emphasizes either the associated economic benefits or the potential risks posed to human health (Heikkila et al. 2014). Given that the debates themselves are now the subject of exploitation, our understanding of how narratives are understood and constructed by individual policy actors, a micro-level analysis, holds importance to the broader field of public policy studies. Research that examines how hydraulic fracturing (HF) policy narratives function at the micro-level are quite rare but a study published by Zanocco, Song, and Jones (2017) recently tested the effectiveness of narratives on members of the general public and found that the persuasive nature of HF narratives is associated with individual affective response to certain narrative features, namely, the characters portrayed within the narrative. Other developing research has found that policy elites<sup>9</sup>, those with the

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<sup>9</sup> Following Elgin & Weible (2013), in this research, we conceptualize policy elites as individuals engaged in energy policy issues with the potential and resources to influence policy at the local level. Policy elites surveyed in this study, for instance, include mayors, city council members, chamber of commerce members, and non-profit organization affiliat

resources and potential to participate in the policy process, recall mental images of hydraulic fracturing using narrative elements that directly reflect larger, meso-level narratives (Moyer et al. 2018; Moyer, Song, and Jones 2018). Elites' cognitive internalization of these larger narratives are driven by their value predispositions (Moyer, Song, and Jones 2018). Tumilson and Song (2019) argue that the values held by elites and the public are similarly mediated by trust to influence perceptions toward HF but it is not clear how narratives factor into the formation of related attitudes held by these two groups. This study aspires to contribute a more comprehensive picture of the role that narratives play in the policy process by comparing elite and public cognitive patterns of competing narratives on HF practices.

### **3.2 Examining Public and Elite Attitudes Toward Hydraulic Fracturing**

In recent years, research has explored the public perceptions of HF (Alcorn, Rupp, and Graham 2017; H. Boudet et al. 2014a; H. S. Boudet et al. 2018; Christenson, Goldfarb, and Kriner 2017; Howell et al. 2017a; Lachapelle and Montpetit 2014; Lee et al. 2019). Much of the research within policy literature has identified factors of support for HF practices finding that proximity to HF activities (Alcorn, Rupp, and Graham 2017; H. S. Boudet et al. 2018), demographics (H. Boudet et al. 2014a; H. S. Boudet et al. 2018), worldviews (H. Boudet et al. 2014a; Christenson, Goldfarb, and Kriner 2017; Lachapelle and Montpetit 2014; Tumilson and Song 2019), political ideology or partisan motivations (H. Boudet et al. 2014a; Howell et al. 2017a), exposure to various media sources, and familiarity with the issue (H. Boudet et al. 2014a) all influence the degree of support that individuals report having for this controversial technology to some extent. Relatively few studies have examined the attitudes of individuals who play specialized roles within the policy process. Certain attributes of policy actors within a policy subsystem may also explain how such conflict is sustained (Heikkila and Weible 2017). The comparison of general

public attitudes with those of other individuals who are more actively engaged in the policy process is an important area of research. Studies suggest that members of the public have less influence on policy formulation than economic elites and organized groups (Gilens and Page 2014) and it is generally accepted that policy images are shaped by policy elites (B. D. Jones and Baumgartner 2005) who play a central role, as members of advocacy coalitions bound by shared beliefs, to effect policy making (Jenkins-Smith et al. 2014). Elites tend to be more educated, more informed and experienced in political issues (Griffin 2013; Chin, Bond, & Geva 2000).

In the context of policy debate concerning hydraulic fracturing practices, we suspect that policy narratives play a pivotal role. As such, this study examines 1) how policy elites and the general public internalize particular elements of competing policy narratives addressing HF practices and 2) what factors might shape their narrative cognition or characterization of related narratives. We utilize original survey data, recently collected in Arkansas and Oregon, to computer-analyze related semantic patterns extracted from individuals' open-ended text responses and implement structural topic modeling (STM) techniques to examine narrative cognitive patterns and theory-driven correlates including cultural orientations, political party identity, trust, and demographic characteristics. The following section introduces important theoretical foundations used to identify primary correlates of interest and inform our analysis.

### **3.3 Theoretical Foundations**

#### The Narrative Policy Framework: Narrative Cognition

Policy narratives routinely accentuate different dimensions of an issue that can be analyzed at the subsystem level (Weible and Heikkila 2017b) and are likely to be compositionally varied both in terms of structural and contextual elements. In essence, policy oriented narrative communications are crafted for persuasion or to draw attention and may be subject to evaluation

based on the level of trust placed in the source of the narrative (Iyengar and Kinder 1985). The Narrative Policy Framework (NPF) posits that narratives are strategically crafted to function at the micro-level as a ‘cognitive artifact’ which facilitates mental categorization of situations or experiences that may be useful for projecting future situations (Herman 2003; Herman and Childs 2003; M. Jones, Shanahan, and McBeth 2014). This process of narrative cognition relies on embedded, interpretable and generalizable features of the narrative form where socially constructed policy realities are incorporated into policy narratives in systematic ways that also happen to support objective analysis (M. D. Jones, Shanahan, and McBeth 2014). More specifically, policy narratives are comprised of 1) structural elements such as a setting, character, plot, or moral and 2) content which are elements of the narrative imbued with socially constructed meaning that extends from shared value-based beliefs and is represented symbolically (M. D. Jones et al., 2014).

#### *Policy Narrative Form: Structure and Content*

Structural elements are the foundational features of a narrative and are identifiable. Primary features include the setting or context of the issue, the plot or policy problem, the moral or policy solution, and the characters (M.D. Jones, Shanahan, and McBeth 2014). The setting typically includes facts or evidence of the problem that supports known or unknown risks while the plot is essential to policy problem definition (M. D. Jones, Flottum, and Oyvind 2017) and typically addresses causality (M. D. Jones, Shanahan, and McBeth 2014; Stone 2012). Recent studies have identified the plot as central to narratives communicating risk (Lawlor and Crow 2018) and hero characters play an integral role in the persuasiveness of narratives (M. D. Jones, Flottum, and Oyvind 2017).

#### *Narrative Cognition*

Conceptually, policy narratives function to reflect and communicate collective level understandings of the human experience (meso-level) (M. D. Jones, Shanahan, and McBeth 2014). Narratives are crafted to be consumed. At the individual level (micro-level) narratives facilitate an understanding of the world and play a fundamental role in individual level communication (M. D. Jones, Shanahan, and McBeth 2014; Polkinghorne 1988). So, how are meso-level narratives consumed? The internalization or mental use of policy narratives are assumed to rely on various cognitive processes (M. Jones, Shanahan, and McBeth 2014), the least of which include bounded rationality (Simon 1955), dual system processing (Kahneman 2003), the use of heuristics (Kahneman 2011), and the influence of affect (Lodge and Taber 2005). The cognition of narratives involves extracting elements from the narrative that might function as a ‘cognitive artifact’ (Herman 2003; Herman and Childs 2003; M. Jones, Shanahan, and McBeth 2014), facilitating mental categorization of situations or experiences that may be useful for projecting future situations.

Studies suggest that the cognition of policy narratives are also subject to motivated reasoning. Using observational and experimental approaches, Kahan’s (2013) study found that ideologically motivated cognition explains polarization over climate change. Jones and Song (2014) found individual cultural orientations were used to structure policy narratives around climate change. Narrative content, seemingly relative to a particular policy context, has been found to display systematic variation due to the meanings embedded within the narrative. Meaning may be grounded in the underlying beliefs that are influenced by social interaction and shared culturally. This has been measured in previous studies through partisanship (Lakoff 2002) or socially and culturally reinforced beliefs or worldviews (M. D. Jones 2014; Kahan et al. 2015;



Moyer and Song 2016c; Ripberger et al. 2014; Tumilson, Moyer, and Song 2017; Zanocco, Song, and Jones 2017).

### Cultural Theory- Socially Constructed Worldviews

This study leverages Cultural theory (CT) to conceptually define symbols imbued with generalizable meaning embedded within narratives. Originally established by cultural anthropologist Mary Douglas, CT posits that culture and social interactions reinforce worldviews or beliefs, and shape how individuals define risks and rewards (Dake 1991b, 1992; Douglas and Wildavsky 1982) and specifies prototypical cultural values and views on nature (Thompson, Ellis, and Wildavsky 1990). Four of those worldview types are discussed. Egalitarians' view nature as fragile and believing that manipulation or experimentation with nature will trigger a total collapse. Individuals with strong egalitarian values view energy technologies as risky, threatening the delicate balance of nature (Moyer and Song 2015, 2017) while those with strong individualist values are more open to technological experimentation believing that nature is self-correcting. Individualists have ignored the uncertainties associated with energy technologies in favor of pursuing economic opportunity (Moyer and Song 2015, 2017). Conceptually, hierarchs value institutionalized authority, entrusting decisions for society to those with specialized knowledge or expertise. They view nature as requiring proper management and have been found to hold relatively optimistic attitudes toward energy technologies (Moyer and Song 2015, 2017). Finally, prototypical fatalists lack of social integration render them subject to institutional authority, which they often view as capricious (Thompson, Ellis, and Wildavsky 1990; Wildavsky 1987).

## Cognitive Sophistication, Beliefs, and Narrative Cognition

Cognitive sophistication may influence an individual's cognitive internalization of policy narratives. Conceptually, cognitive sophistication implies an awareness of issue salience that functions as a "frame of mind" or mental model (Druckman 2011, 4). Also conceptualized as political knowledge, the concept has suffered from dissonant measurement (Carpini and Keeter 1993). Previous literature has defined distinctions between the general public and policy elites using measures of awareness and knowledge of policy issues (Converse 1964, 1990; Zaller 1992) regardless of whether political knowledge is assumed to be causal or intermediary (Carpini and Keeter 1993). Previous studies also suggest that political knowledge is essential to the formation of politically oriented beliefs (Carpini and Keeter 1997) such that individuals with low levels of political sophistication may exhibit inconsistent political belief systems that led to incoherent policy preferences (Michaud et al. 2009; Converse 1964; Zaller 1992; Stimson 1975; Carpini and Keeter 1997). Other scholars, however, argue that worldviews are foundations for policy preferences regardless of the level of political sophistication held (Goren 2004; Popkin 1991). Ripberger et al. (2012) found that individuals were able to recognize distinct worldviews regardless of their level of political knowledge suggesting that worldviews play a more intrinsic role. The relationship between political knowledge and beliefs is of particular interest when it comes to understanding narrative cognition. Jorgensen et al. (2018) examined how policy narratives, cultural predispositions, and political knowledge influences policy preferences and found policy narratives to be most influential in preferences toward campaign finance reform among individuals with higher levels of political knowledge, particularly those with strong culturally-oriented value predispositions. This distinction has important implications for political

strategies and dynamics between elites and the general public within the context of a democratic system.

As previously mentioned, scholarship has paid considerable attention to the examination of public attitudes towards hydraulic fracturing (HF). Relatively little scholarship has focused on the role of policy elites despite its importance. Elites actively shape policy images held by the public (B. D. Jones and Baumgartner 2005) and occupy an important role in the policy process as members of coalitions, bound by shared beliefs and working together to effect policy change (Jenkins-Smith et al. 2014). Recently, scholars have begun to examine the relationship between elite and public attitude through direct comparison (Moyer and Song 2016a, 2017; Tumlison, Moyer, and Song 2017; Tumlison and Song 2019; Zanocco, Song, and Jones 2017) but studies of this nature are relatively rare particularly with regard to HF practices.

### **3.4 Theoretically Founded Expectations**

Application of the NPF and CT lead to expectations that both policy elites and members of the general public cognitively internalize elements of competing policy narratives that remain available as a cognitive artifact for use in thinking about and forming attitudes toward hydraulic fracturing when compelled to do so. Applying the NFP, we expect individuals to cognitively internalize elements of meso-level narratives that position HF as either an environmental issue or an economic one.

*H<sub>1</sub>: Both policy elites and the general public cognitively internalize elements of HF meso-level narratives to think about HF.*

Furthermore, given culturally defined social constructions of reality, we expect that cultural orientations will guide the selection of narrative content serving as cognitive artifact in distinct

ways for policy elites (higher cognitive sophistication) and the general public (lower cognitive sophistication).

*H<sub>2</sub>: Cognitive internalization of HF narrative elements are guided by more intrinsic cultural worldviews. Specifically, we expect policy elites and the general public with strong egalitarian worldviews to mentally frame HF as an environmental concern. Those with predispositions toward individualist values are expected to cognitively frame HF as an economic issue. Policy elites and the general public with a strong affinity for hierarchism are expected to cognitively frame HF as an economic issue, trusting existing institutionalized authority to manage environmental tradeoffs.*

*Worldviews are expected to guide the selection of narrative elements for both policy elites and members of the general public but cognitive sophistication results in some distinctions.*

*H<sub>3</sub>: The influence of worldviews in the cognitive internalization of narrative elements are expected to be stronger among elites who possess a level of cognitive sophistication greater than that held by the general public.*

The following sections introduce the data and analytical approaches used to test these expectations.

### **3.5 Data, Variables, and Measures**

#### Examining Meso-Level Hydraulic Fracturing Narratives

In order to determine whether policy elites and members of the general public cognitively internalize elements of HF meso-level narratives to think about HF, we must first characterize meso-level narratives associated with HF activity. To accomplish this, we examined two mainstream media sources in the U.S. that were likely to report on HF in a way that would

capture national level attention (not tailored to a particular geographic audience) and be readily available to both policy elites and the general public. An analysis of newspaper articles published online in the Wall Street Journal (WSJ), a politically conservative leaning source for business related information, and the New York Times (NYT), a liberal-leaning newspaper was performed. Relevant articles were located using the keywords *hydraulic fracturing* and *fracking*, yielding 925 articles which were then limited by subject (U.S.-based) and by year (2015-2016) to correspond to recent articles available to our sample prior to participating in our survey, returning 40 articles (in full text, 25 articles in WSJ and 15 articles in NYT). A corpus consisting of the 40 articles was formed and included metadata such as the publication, year, headline, and full text of the article. The corpus was preprocessed using the *quanteda* in R. Structural topic modeling (*stm* in R) was used to extract three latent topics<sup>10</sup> from the text using the publication as a prevalence covariate.<sup>11</sup> The highest probability words in topic 1 included *gas*, *frack*, *earthquake*, and *seismic*. High frequency words in the second extracted topic included *frack*, *water*, *gas*, and *regulation*. Finally, high frequency words in the third extracted topic included *oil*, *price*, *OPEC*, and *export*. The four most representative documents for each of the three topics (12 documents in total) were examined for narrative elements.

Articles represented by the first topic center on the environmental impacts of HF and more specifically, earthquakes. These articles primarily address increased seismic activity reported in Texas, Oklahoma, Arkansas, and other energy rich states. There are two primary narratives. One narrative portrays the oil and gas industry as a “concerned” and responsible agent

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<sup>10</sup> STM was used to extract three latent topics (as opposed to 5, 7, or any other number) based on the number of topics that emerged with earlier data analysis using manual coding.

<sup>11</sup> A prevalence covariate may be incorporated into the structural topic model when the variable is believed to affect the frequency with which a particular topic is discussed (M. Roberts, Stewart, and Tingley 2018). In this case, publication type is a binary covariate, either the WSJ or not (coded 1 or 0).

diligently “following the data” and “trying to understand” the issues related to HF (Ailworth 2015a). An acknowledgement of increased seismic activity is followed by the statement that man-made and naturally occurring earthquakes are indistinguishable (Bustillo and Gilbert 2015). This portrayal of the oil and gas industry resembles other industry-based narrative discourse published by Kapranov (2017). Regulators are framed as prematurely critical and citizen lawsuits are portrayed as threatening to the economic viability of HF. An opposing narrative suggests that regulators and researchers are heroes protecting the public by seeking out much needed information and data. This narrative argues that a ban on HF is necessary until more information is secured (Wines 2015).

The second extracted topic also focuses on the environmental impacts of HF but specifically, its impact on water resources. The representative articles of this topic portray the oil and gas industry as victim of illegal actions implemented by the Bureau of Land Management to regulate the impacts of HF on water in public lands (A. Harder 2015, 2016b). Among the most representative articles, the oil and gas industry is also portrayed as a conservator of water, continuing to invest in water management and infrastructure particularly in the western part of the U.S (Ailworth 2015b). Contrastingly, other representative articles portray the oil and gas industry as the villain, contaminating drinking water through HF activities citing that the EPA report on the impact of HF on water resources was inconclusive (Davenport 2015).

The third extracted topic focuses on economic outcomes related to HF activity. The most representative articles position the oil and gas industry as a hero whose ingenuity and entrepreneurship have increased domestic production of gas during a time of economic decline (Luskin and Warren 2015). The articles blame political inefficacy and illegal regulations for the

industry's inability to sustain jobs and economic earnings and for its inability to achieve energy independence for the nation (Anonymous 2015; Cook and Eaton 2015).

### Examining Micro-level Narrative Cognition Using Survey Data

The data for this study was recorded using two Internet based surveys administered and conducted between 2015-2017 focusing on local energy policy issues. An email was employed to invite respondents, both policy elites and members of the general public located in Arkansas and Oregon to participate. The email included a brief description and included a link to the survey. To collect data on policy elites in both states, emails from publicly available municipal and relevant professional websites were used (2,396 emails in Arkansas and 5,384 in Oregon). In Arkansas, 167 partially completed the survey and 469 completed some portion of the survey in Oregon. Responses for a representative sample of the general public in both states were collected through Qualtrics (details available in the panel management guide on their website). After removing data entries with incomplete data for the variables chosen for the following analysis, the data set contains 1,411 responses ( $n=470$  for policy elites and  $n=941$  for the general public<sup>12</sup>) of individuals<sup>13</sup> residing in Arkansas and Oregon. The policy elite sample includes city council representatives, chamber of commerce members. Members of the general public include individuals residing in 50 various cities across Arkansas and 150 cities in Oregon. Arkansas and Oregon each state represent contrasting experiences with regard to unconventional fuel extraction. Arkansas' Fayetteville Shale is one of the largest shale gas formations in the U.S. and at the time of the survey, had recorded more than 4,000 active fractured wells as well as a

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<sup>12</sup> The make-up of the general public sample are similar to characteristics of the U.S. population in that they are male (49.6% sample vs. 49% U.S. population) but contain more white/non-Hispanics (84.6% sample vs. 76.6% U.S. population) (U.S. Census Bureau QuickFacts 2016).

<sup>13</sup> The current sample of 470 policy elite and 941 general public respondents resulted after removing all observations that failed to have complete responses for all variables included in the analysis.

moratorium in place on permanent disposal wells in designated areas (Davenport, 2015). In contrast, Oregon recorded no extractive activities and had proposed a bill that would prohibit the use of HF practices for any possible future recovery (Fahey, Manning Jr., and Helm 2019).

### *Variables and Measures*

The analysis takes place in two stages and relies on the variables and measures described in detail below. The first stage corresponds to our expectation that individuals *cognitively internalize elements of HF meso-level narratives to think about HF*. Analytical results indicating that metacognitive policy images containing aspects of the competing (environmental versus economic) nature of meso-level policy narratives would indicate support for this hypothesis. The second stage of the analysis corresponds to the remaining hypotheses and conceives of the metacognitive policy image as the primary dependent variable to investigate the power of socially constructed worldviews, party identity, trust, and demographic characteristics in the cognitive selection of narrative elements.

### *Narrative Cognition-Metacognitive Policy Images and Affect*

To understand how individuals cognitively internalize policy narratives, this study operationalizes the cognitive internalization of narratives by measuring respondents' recollection of cognitive images associated with HF or their 'metacognitive policy image'. In other words, a metacognitive policy image represents the respondent's recall of the mental image used to think about HF. Conceptually, cognitive mental images are anchored to an individual's real world and practical experiences, and can be expressed semantically (P. Harder 1954, 47). The expression of cognitive images are fundamental for facilitating group interactions and cooperative behavior (1954, 80) and is accomplished through the use of words which operated as formalized symbols representing an individual's "realm of reality" (P. Harder 1954, 53). Respondents' metacognitive



policy image is therefore operationalized by recording their semantic expression in response to the question posed in the survey, *when you think about fracking, what is the first image that comes to mind?* Data collection allowed respondents to input their description in an unstructured manner with no character limit. The unstructured nature of this measure is meant to avoid *a priori* researcher-specified assessments and directly record the respondents' metacognitive policy image of hydraulic fracturing.

Cognition of information is restricted by bounded rationality, rendering decision making “a constructive and contingent process” where heuristics are necessary to simplify the complexities of a problem (Kahneman 2003; Kahneman, Slovic, and Tversky 1982; Kahneman and Tversky 1979; Tversky and Kahneman 1992). It is also acknowledged that this process is subject to dual system processing in which emotion or affective feelings provide an efficient cue for the judgements that follow (Damasio, Everitt, and Bishop 1996). For this reason, affect is expected to play a central role in the cognition of hydraulic fracturing narratives and is used as a prevalence covariate in the first stage of analysis detailed below. General affect or respondents' general feelings about fracturing is operationalized by asking respondents to indicate how they generally feel about fracking on a scale of one (extremely negative) to seven (extremely positive).

#### *Cultural Orientations or Worldviews*

Individuals' worldviews or orientations toward culturally biased values function as a primary independent variable in this study. Worldviews are operationalized using cultural theory (CT) with three survey questions corresponding to each of the four cultural worldviews (i.e., egalitarianism, individualism, hierarchism, and fatalism) for a total of twelve culturally nuanced statements (provided in random order in the survey) rated one to seven, with one indicating that

**Table VIII Chapter 3 Variables and Measures**

<b>Variable</b>	<b>Measure</b>
Metacognitive Policy Image of Hydraulic Fracturing	When you think about fracking, what is the first image that comes to mind? (Open response)
Affect	Indicate how you generally feel about fracking. (1=Extremely Negative to 7=Extremely Positive)
Egalitarianism	Society works best if power is shared equally. (1=Strongly disagree to 7=Strongly agree)
	It is our responsibility to reduce differences in income between the rich and the poor. (1=Strongly disagree to 7=Strongly agree)
	What society needs is a fairness revolution to make the distribution of goods more equal. (1=Strongly disagree to 7=Strongly agree)
Egalitarianism index	Index using factor score of above three items ( $\alpha=0.82$ for elite and $\alpha=0.79$ for public)
Individualism	We are all better off when we compete as individuals. (1=Strongly disagree to 7=Strongly agree)
	Even the disadvantaged should have to make their own way in the world. (1=Strongly disagree to 7=Strongly agree)
	Even if some people are at a disadvantage, it is best for society to let people succeed or fail on their own. (1=Strongly disagree to 7=Strongly agree)
Individualism index	Index using factor score of above three items ( $\alpha=0.79$ for elite and $\alpha=0.70$ for public)
Hierarchism	Society is in trouble because people do not obey those in authority. (1=Strongly disagree to 7=Strongly agree)
	The best way to get ahead in life is to do what you are told to do to the best of your abilities. (1=Strongly disagree to 7=Strongly agree)
	Society would be much better off if we imposed strict and swift punishment on those who break the rules. (1=Strongly disagree to 7=Strongly agree)
Hierarchism index	Index using factor score of above three items ( $\alpha=0.69$ for elite and $\alpha=0.67$ for public)
Fatalism	For the most part, succeeding in life is a matter of chance. (1=Strongly disagree to 7=Strongly agree)
	No matter how hard we try, the course of our lives is largely determined by forces beyond our control. (1=Strongly disagree to 7=Strongly agree)
	Most of the important things that take place in life happen by random chance. (1=Strongly disagree to 7=Strongly agree)
Fatalism index	Index using factor score of above three items ( $\alpha=0.78$ for elite and $\alpha=0.76$ for public)

**Table VIII (Cont.)**

Trust in internet as an information source	How much would you trust the following sources for providing reliable information about fracking processes and operations? Internet discussion groups, Internet blogs, Internet News Sources (0=No trust whatsoever to 10=Complete trust)
Trust index	Index using mean score of above three items ( $\alpha=0.86$ for elite and $\alpha=0.76$ for public)
Political Party Identification	1=Democrat; 0=Others (Republican or Independent) 1=Republican; 0=Others (Democrat or Independent)
Race	1=Non-Hispanic White
Gender	1=Male
Age	Age in years
Education	Level of education (1=Elementary through some high school to 7=Doctorate (of any type))
Income	Total estimated annual household income (1=less than \$20,000 to 9=\$300,000 or more)
State	1=Arkansas; 0=Oregon
Year	1=2017; 0=2015

the respondent strongly disagrees and seven indicating strong agreement. Factor analysis (with the *varimax* rotation method) of the twelve CT measures reveal four latent factors, which parallel with the four distinctive dimensions of the cultural worldviews. Consistent high factor loadings exist among each of the three related CT measures (i.e., factor loading greater than 0.5) while loading low on remaining unrelated factors. Based upon this factor structure, factor scores for each of four latent dimensions (representing each of four cultural orientations) were calculated and are used as an index for measuring each cultural orientation. Cronbach's  $\alpha$  scores for the three survey items (constituting each CT index) among policy elites range from 0.69 to 0.82 and from 0.67 to 0.79 for the general public indicating that the related survey measures are reasonably reliable.

#### *Control Variables*

Goren (2005) argues that identification with a political party is more stable than political values and may therefore be used to process information and form judgements on political or policy

related matters. Respondents' identification with a political party is considered a control variable in this study. Respondents are asked to indicate which political party they most identify among Democratic, Republican, or Independent. Measures were recoded to capture respondents' primary identification with the Democratic party (coded 1) or not (coded 0) or with the Republican party (coded 1) or not (coded 0).

Because trust has been identified as an important mediating variable in the relationship between individuals' value predispositions and their attitudes toward hydraulic fracturing (Tumilson & Song, 2019), trust is included as a control variable in this analysis. The advancement of information technologies in particular are staged to impact attitudes and expectations of policy (Marburger 2011). While various forms of trust (trust in government or particular advocacy groups) are arguably relevant, up-to-date information regarding the rapidly evolving technologies of HF are readily and routinely available online. For this reason, this study measures trust in internet-based platforms to function as a control variable in the analysis. Respondents are asked to rate the level of trust they have in the internet as a reliable source of information about hydraulic fracturing processes and operations. Trust is measured using an index of mean scores to three separate questions that address internet-based discussion groups, blogs, and news sources. Respondents indicate their trust on a scale of 0 to 10 with 0 representing no trust whatsoever and 10 indicating complete trust. Cronbach's  $\alpha$  for the trust mean score index ranges between 0.83 and 0.86, indicating high levels of scale reliability.

Demographic characteristics of respondents used in this study include race (coded 1 for Non-Hispanic Whites and 0, otherwise), gender (coded 1 for Male and 0, otherwise), age (age in years), education (a 7-point scale with higher rating representing higher education level) and annual household income (1 to 9-point scale ranging from less than \$20,000 to \$300,000 or

more) and serve as control variables. Responses received from those residing in Arkansas were coded 1 and those residing in Oregon were coded 0. Responses received in the 2016/17 release of the survey were coded 1 and those received in the 2015 release of the survey were coded 0.

### **3.6 Empirical Analysis and Analytical Results**

#### Descriptive Statistics

The average policy elite is white (96.8%), male, (63.4%) and approximately 55 years old with a college education and a median annual household income of between \$70,000 and \$100,000 (see Table IX and X). In contrast, the average member of the general public is white (84.6%), female, (50.4%) and approximately 49 years old with some college education and a median annual household income of between \$35,000 and \$70,000.

#### Step 1: Examining HF Narrative Elements

Our examination of how policy elites and the general public cognitively internalize particular elements of competing policy narratives addressing HF begins by analyzing respondents' metacognitive policy images. We analyze respondents' open-ended survey responses using structural topic modeling (STM) which extracts latent topics from unstructured text and has been used in multiple applications across disciplines (M. Roberts, Stewart, and Tingley 2018). STM facilitates the incorporation of other relevant metadata or covariates in order to estimate meaningful variation present in the frequency with which a topic is discussed (topical prevalence) and within the words chosen to describe or discuss a particular topic (topical content) (2018). This method uses a semi-supervised learning approach within a machine learning scheme to infer topics for each individual response based on the distribution of words

**Table IX Chapter 3 Descriptive Statistics**

Variable	General Public	Policy Elite	General Public	Policy Elite	General Public	Policy Elite	General Public		Policy Elite	
	<i>n</i>		Mean		St. Dev.		Min	Max	Min	Max
<b>Egalitarianism</b>	941	470	0.01	-0.01	1.00	1.00	-2.65	2.09	-2.56	2.60
<b>Individualism</b>	941	470	0.01	-0.04	0.99	0.97	-3.02	2.69	-2.78	3.01
<b>Hierarchism</b>	941	470	-0.01	0.06	1.01	1.02	-2.69	2.49	-2.41	3.32
<b>Fatalism</b>	941	470	-0.02	-0.05	1.00	0.97	-2.35	2.64	-1.72	3.37
<b>Trust</b>	941	470	3.46	2.95	2.08	1.74	0	10	0	7.33
<b>Age</b>	941	470	49.23	54.57	16.91	12.71	18	88	22	84
<b>Education</b>	941	470	3.60	4.59	1.34	1.42	1	7	2	7
<b>Income</b>	941	470	3.31	5.36	1.69	1.57	1	9	1	9
<b>Affect</b>	941	470	3.42	3.36	1.78	2.00	1	7	1	7

**Table X Chapter 3 Frequency Table**

Variable	<i>n</i>	Category (%)							
		General Public			Policy Elite				
	<i>General Public/ Policy Elite</i>								
<b>Race</b>	941/470	Non-White (15.4%)		White (84.6%)		Non-White (3.2%)		White (96.8%)	
<b>Gender</b>	941/470	Female (50.4%)		Male (49.6%)		Female (36.5%)		Male (63.4%)	
<b>Political Party Identification</b>	941/470	Democrat (38.2%)	Republican (29.6%)	Other (32.2%)	Democrat (36.8%)	Republican (33.2%)	Other (30.0%)		

**Table XI Word Use for Topics 1-3 Among General Public and Policy Elites (stemmed form)**

			<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
<i>When you think about fracking, what is the first image that comes to mind? (open-response)</i>	<b>Highest probability of use based on frequency of use</b>	<b>General Public</b>	<i>ground, earthquak, damage, frack</i>	<i>earth, drill, gas, energy</i>	<i>water, rock, break, well</i>
		<b>Policy Elite</b>	<i>water, pollut, damage, chemic</i>	<i>energi, larg, independ, job</i>	<i>pressur, high, big, fuel</i>
	<b>Highest probability of use based on exclusivity of use</b>	<b>General Public</b>	<i>destroy, earthquak, damage, frack</i>	<i>gas, earth, abund, energi</i>	<i>water, rock, oil, break</i>
		<b>Policy Elite</b>	<i>water, pollut, earthquak, ground</i>	<i>energi, job, cheap, independ</i>	<i>oil, drill, gas, pressur</i>

**Table XII Word Use and Representative Responses Among the General Public and Policy Elites**

			<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
<i>When you think about fracking, what is the first image that comes to mind? (open-response)</i>	<b>High Probability Words</b>		ground, earthquak, damage, frack	earth, dril, gas, energ	water, oil, environ, rock
	<b>Representative Responses</b>	<b>General Public</b>	<i>Ground collapsing. Ground damaged. Environmental damage. I don't know a lot about fracking. Fracking causing earthquakes.</i>	<i>Drilling into the earth. Drilling for gas. Good for energy independence. Lots of natural gas that can be used for energy independence.</i>	<i>Shale water. Oil rigs and trucks hauling dirty water. Disruption of the environment. Rock breaking.</i>
	<b>High Probability Words</b>		water, earthquak, ground, pollut	energ, abund, cheap, job,	oil, earth, drill, gas
	<b>Representative Responses</b>	<b>Policy Elite</b>	<i>Diminishing water levels. Polluted ground water. Earthquakes and polluted ground water.</i>	<i>Energy independence. Abundant oil and gas produced in the U.S. Cheaper energy for the U.S. Jobs and energy self-sufficiency.</i>	<i>Extracting oil. Much like traditional oil drilling. Drilling in the earth. Drilling to release gas. Water sprayed from high pressure device to retrieve gas.</i>



**Table XIII Comparison of Topics Extracted from Meso-level HF Policy Narratives with Micro-level Narrative Cognition**

		<b>Environmental</b>		<b>Economic</b>
		<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
<b>Highest probability of use based on <i>frequency</i> of use</b>	<b>Nationally Distributed Newspaper Articles</b>	<i>gas, frack, earthquak, seismic</i>	<i>frack, water, gas, regulation</i>	<i>oil, price, OPEC, export</i>
		<b>Topic 1</b>		<b>Topic 2</b>
	<b>General Public</b>	<i>destroy, earthquak, damage, frack</i>		<i>gas, earth, abund, energi</i>
	<b>Policy Elite</b>	<i>water, pollut, earthquak, ground</i>		<i>energi, job, cheap, independ</i>
<b>Percentage of high probability words shared by meso-level narrative topics and metacognitive policy image topics</b>	<b>General Public</b>	50%	25%	0%
	<b>Policy Elite</b>	25%	25%	0%

represented by a semantic theme (K) using a mixed-membership model.<sup>14</sup> The variable *affect*<sup>15</sup> was used to determine topical prevalence when calculating the frequency with which a topic is discussed since affective valence is implicated in the development of associations between mental images and semantic expressions related to the processing of complex information under a dual system (Slovic et al. 2004). Because estimations are sensitive to the distribution over words for a particular topic, “Spectral” initialization was used (M. Roberts, Stewart, and Tingley 2018). The selection of three topics (K=3) was used based on previously identified dimensions of the ongoing policy debate<sup>16</sup> using a maximum of 500 iterations. Topical inference allows us to summarize meaningful topics through the calculation of prioritized words (those words that have the highest frequency of use for a given topic as calculated in various ways).<sup>17</sup> Analysis was implemented using the *stm* package in the R computing environment. We expect that policy elites and the general public cognitively internalize elements of HF meso-level narratives to think about HF. Our analysis begins by characterizing and comparing the metacognitive imagery of elites and the general public after which, we compare the topics extracted from meso-level HF narratives to the topics embedded within individual level metacognitive imagery of HF among elites and the public.

Table IX characterizes metacognitive imagery of HF by reporting the most probable words based on both the frequency and exclusivity of use within each of the three latent topics<sup>18</sup>

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<sup>14</sup> Mixed membership models assign a topic to each word in a document resulting in one document defined as a vector of proportions that represent the fraction of words within each document that belong to an inferred topic.

<sup>15</sup> As discussed before, valenced affect was operationalized by asking respondents to indicate on a scale from 0 to 7, where 1 means *extremely negative* and 7 means *extremely positive*, how they generally feel about fracking.

<sup>16</sup> As mentioned in the introduction, previous dimensions of the policy debate over fracking include positive associations with job creation and economic security as well as negative impacts relating to health and the environment.

<sup>17</sup> FREX weights words based on overall frequency and exclusivity to the topic. Lift weights words by giving a greater weight to words that appear less frequently in other topics. Score divides the log frequency of the word in primary topic by the log frequency of the word in other topics (M. Roberts, Stewart, and Tingley 2018).

<sup>18</sup> Correlation analysis indicates that each topic is unique in that it is uncorrelated with any of the other topics.

extracted for elites and the general public. Table X displays the most probable words within each topic and corresponding representative responses. We find that among members of the general public, words with the highest probability of occurring in Topic 1 based on the frequency and weighting of words consist of *ground*, *earthquak(e)*, *damage*, and *frack*. Policy elites' most probable metacognitive policy imagery includes *water*. Images of *water*, *earthquak(e)*, *damage(e)*, *pollut(e)*, *contamin(ate)*, and *destroy* (see Table IX and X) therefore, Topic 1 is broadly categorized as environmental. A comparison of elite and public responses reveals that policy elites' metacognitive policy images include environmental concerns related to earthquakes and water pollution. A second latent topic (Topic 2) reflects more variation in the metacognitive policy imagery used by the public and elites. Both the general public and policy elites are highly likely to use the word *energy* to describe HF. Public imagery focuses on words like *earth*, *drill*, and *gas*, emphasizing how that energy is accessed while elite imagery focuses on words like *abund*, *cheap*, and *job* attempt to quantify the effects of HF through abundant production, the decreased cost of energy, and the impact to the labor market.

As stated in H<sub>1</sub>, we expect to see commonalities between meso-level narratives and the language used to describe HF at the micro level. Table XIII displays the extracted topics from meso-level narratives with the topics embedded in public and elite metacognitive imagery for ease of comparison. With regard to the content of environmental focused narratives, we find that the metacognitive imagery used by policy elites and the general public to describe HF share frequently used terms found in meso-level narratives. The general public use between 25-50% of the frequently used words present in meso-level narratives to think about and describe HF while policy elites use only about 25%. More explicitly, policy elites' propensity to describe HF as responsible for the "pollution of water" is consistent with Davenport's (2015) account while both

the public and elites are concerned with seismic activity as alluded to in Bustillo and Gilbert (2015) and Wines (2015). With regard to narrative structure, important distinctions arise. Meso-level narratives emphasize various characters including the oil and gas industry, regulators, and researchers. In contrast, infrastructure development and water management are not present in elite and public metacognitive imagery and characters are noticeably missing. The narrative structure of metacognitive imagery most closely resembles only a partial plot.

With respect to economic-based narratives, we do not find consistencies between the most frequently used language present in meso-level narratives with language used to describe narrative cognition (0% of the most probable terms are shared) although elite responses describing HF as providing “energy independence” and “cheaper energy” seem to echo elements of collective level narratives that argue economic outcomes would be better if political inefficiencies and regulations were less constraining on the industry (Cook & Eaton, 2015).

It is worth noting that a third latent topic in policy elite and public opinion metacognitive imagery (Topic 3 in Table IX and X) was discovered in our analysis and can be best represented by the term *oil*. An analysis of the content reveals that while the public and elites emphasize different components of the process of HF, the imagery may be characterized neither as environmental nor economic but rather, as descriptive. In terms of the narrative structure, an examination of representative responses suggests that they most resemble a narrative setting by characterizing facts that are not contested or indisputable and speak to the context within which the policy issue exists. The content of these images does not appear to directly mirror any of the meso-level fracturing narratives analyzed.

Based on NPF, we expected that the *both policy elites and the general public cognitively internalize elements of HF meso-level narratives to think about HF*. We find some support for

this hypothesis particularly with regard to the environmental dimension of HF. Our analysis suggests that when compelled to describe HF, policy elites and the general public are likely to use language frequently found in meso-level narratives to describe the environmental implications of HF. The next stage of the analysis examines factors theorized to drive cognitive selection and internalization of narrative elements associated with HF. While Topic 3 contains valuable information, it did not reflect elements of meso-level narratives and therefore holds less theoretical interest for this paper. The remainder of the study will focus on Topics 1 and 2. This first stage of STM analysis on micro-level responses, assigns each response a proportion that corresponds to each topic. In the next stage of analysis, that proportion functions as the dependent variable.

#### Step 2: Estimating Effects of Theoretical Factors on Narrative Selection

This study also seeks to explain why and how certain elements of competing policy narratives associated with hydraulic fracturing are internalized. STM applies a standard regression model to estimate the relationships between the topics and other covariates. Topical distribution serves as the dependent variable with multiple covariates serving as independent variables (M. E. Roberts et al. 2014). Estimations can be computed with effects of the covariates reported given that all other covariates in the model are being controlled for or held constant. In this study, OLS regression analysis incorporates individual covariates in an additive manner ending with a full model represented below. Covariates include demographic characteristics, trust in internet sources for information about HF, political party identification, and predispositions toward culturally biased worldviews. As shown in Table XIV and Table XV, the base model includes an analysis of demographic characteristics only (see Model 1). Results indicate that males generally are less likely to internalize environmental narrative elements (-0.066, p-value<0.05 for general

**Table XIV Regression Results- Factors Influencing the Use of Environmental Narrative Elements**

Variable	General Public				Policy Elite			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
<b>Dependent Variable: High Proportion of Response Incorporates Environmental Metacognitive Artifact</b>								
<b>Egalitarian</b>				<b>0.031*</b> (0.029)				<b>0.076*</b> (0.012)
<b>Individualism</b>				<b>-0.022*</b> (0.006)				<b>-0.050*</b> (0.013)
<b>Hierarchism</b>				<b>-0.010*</b> (0.006)				-0.012 (0.011)
<b>Fatalism</b>				-0.008 (0.014)				0.009 (0.011)
<b>Trust in Internet</b>			-0.000 (0.003)	-0.002 (0.003)			<b>0.015*</b> (0.006)	0.010 (0.006)
<b>Republican</b>		-0.027 (0.014)	-0.027 (0.014)	-0.009 (0.014)		<b>-0.139*</b> (0.028)	<b>-0.139*</b> (0.027)	<b>-0.076*</b> (0.028)
<b>Democrat</b>		<b>0.029*</b> (0.013)	<b>0.029*</b> (0.013)	0.014 (0.013)		<b>0.110*</b> (0.027)	<b>0.106*</b> (0.027)	0.054 (0.028)
<b>Age</b>	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)
<b>Gender (Male)</b>	<b>-0.066*</b> (0.011)	<b>-0.062*</b> (0.011)	<b>-0.062*</b> (0.011)	<b>-0.059*</b> (0.011)	<b>-0.126*</b> (0.025)	<b>-0.055*</b> (0.025)	<b>-0.056*</b> (0.025)	-0.036 (0.024)
<b>Race (White)</b>	0.024 (0.015)	0.033 (0.016)	0.033 (0.016)	<b>0.034*</b> (0.015)	0.060 (0.067)	-0.045 (0.062)	0.033 (0.062)	-0.067 (0.069)
<b>Education</b>	0.004 (0.005)	0.002 (0.004)	0.002 (0.005)	0.001 (0.005)	0.013 (0.008)	-0.001 (0.008)	0.001 (0.008)	-0.007 (0.008)
<b>Income</b>	-0.004 (0.004)	-0.002 (0.004)	-0.002 (0.004)	0.000 (0.004)	-0.011 (0.008)	-0.008 (0.007)	-0.006 (0.007)	0.002 (0.007)
<b>Intercept</b>	<b>0.323*</b> (0.026)	<b>0.317*</b> (0.027)	<b>0.318*</b> (0.029)	<b>0.309*</b> (0.029)	<b>0.484*</b> (0.088)	<b>0.523*</b> (0.103)	<b>0.463*</b> (0.087)	<b>0.418*</b> (0.084)
<b>n</b>	941	941	941	941	470	470	470	470
<b>Adjusted R<sup>2</sup></b>	0.04	0.05	0.05	0.08	0.06	0.19	0.20	0.27
<b>F statistic</b>	6.84	7.37	6.54	6.94	5.55	15.02	14.15	14.20

Note: Parentheses indicate calculated standard errors. \* denotes a t value >1.96 and a p-value < 0.05. State and year were included as control variables in all models but were not statistically significant and not reported here for the sake of clarity.

public and  $-0.126$ ,  $p\text{-value} < 0.05$  for elites) and more likely to internalize economic narrative elements ( $+0.037$ ,  $p\text{-value} < 0.05$  for general public and  $+0.083$ ,  $p\text{-value} < 0.05$  for elites). Model 2 incorporates political party identification into the base model (see Model 2). The explanatory power of gender holds. Identification with Democratic party leaves the public ( $+0.029$ ,  $p\text{-value} < 0.05$ ) and elites ( $+0.110$ ,  $p\text{-value} < 0.05$ ) more likely to think of HF in environmental terms. Elites who identify as Republicans, are less likely to retain an environmental cognitive image ( $-0.139$ ,  $p\text{-value} < 0.05$ ). Both members of general public and policy elites who identify as Republican are more likely to think of HF in economic terms ( $+0.038$ ,  $p\text{-value} < 0.05$  and  $+0.054$ ,  $p\text{-value} < 0.05$  respectively). In Model 3, respondents trust in internet sources as an information source are incorporated into the regression model. Results show that policy elites with high levels of trust in the internet are more likely to internalize environmental aspects of fracturing narratives ( $+0.015$ ,  $p\text{-value} < 0.05$ ). The final regression model (see Model 4) incorporates cultural orientations. Gender continues to hold explanatory power for members of the general public but not for policy elites. The effects of party identification lose statistical significance for the general public while some effects of party identification and all effects of trust lose statistical significance for elites. Most interestingly, both policy elites and the general public who strongly identify with egalitarianism are likely to internalize environmental aspects of fracturing narratives ( $+0.031$ ,  $p\text{-value} < 0.05$  for public and  $+0.076$ ,  $p\text{-value} < 0.05$  for elites) and less likely to think about fracturing in terms of economics ( $-0.025$ ,  $p\text{-value} < 0.05$  for public and  $-0.058$ ,  $p\text{-value} < 0.05$  for elites). Those individuals with a strong predisposition toward individualism, however, are more likely to internalize economic narrative elements ( $+0.019$ ,  $p\text{-value} < 0.05$  for public and  $+0.034$ ,  $p\text{-value} < 0.05$  for elites) over environmental elements ( $-0.22$ ,  $p\text{-value} < 0.05$  for public and  $-0.050$ ,  $p\text{-value} < 0.05$  for elites). Members of the general public who have a strong

**Table XV Regression Results- Factors Influencing the Use of Economic Narrative Elements**

Variable	General Public				Policy Elite			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
<b>Dependent Variable: High Proportion of Response Incorporates Economic Metacognitive Artifact</b>								
<b>Egalitarian</b>				<b>-0.025*</b> (0.027)				<b>-0.058*</b> (0.009)
<b>Individualism</b>				<b>0.019*</b> (0.005)				<b>0.034*</b> (0.009)
<b>Hierarchism</b>				<b>0.021*</b> (0.005)				0.008 (0.088)
<b>Fatalism</b>				0.001 (0.005)				-0.010 (0.008)
<b>Trust in Internet</b>			0.002 (0.002)	0.002 (0.002)			-0.008 (0.005)	-0.003 (0.005)
<b>Republican</b>		<b>0.038*</b> (0.013)	<b>0.038*</b> (0.013)	0.015 (0.013)		<b>0.054*</b> (0.020)	<b>0.054*</b> (0.020)	0.007 (0.021)
<b>Democrat</b>		<b>-0.024*</b> (0.012)	<b>-0.025*</b> (0.012)	-0.009 (0.012)		<b>-0.091*</b> (0.020)	<b>-0.089*</b> (0.020)	<b>-0.051*</b> (0.021)
<b>Age</b>	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
<b>Gender (Male)</b>	<b>0.037*</b> (0.010)	<b>0.033*</b> (0.010)	<b>0.033*</b> (0.010)	<b>0.031*</b> (0.010)	<b>0.083*</b> (0.018)	<b>0.041*</b> (0.018)	<b>0.041*</b> (0.018)	0.027 (0.018)
<b>Race (White)</b>	-0.012 (0.015)	-0.022 (0.015)	-0.021 (0.015)	-0.023 (0.033)	-0.005 (0.048)	-0.004 (0.046)	-0.002 (0.046)	-0.012 (0.044)
<b>Education</b>	-0.008 (0.004)	-0.007 (0.004)	-0.007 (0.004)	-0.021 (0.014)	-0.009 (0.006)	-0.001 (0.006)	-0.002 (0.006)	0.004 (0.006)
<b>Income</b>	0.004 (0.003)	0.002 (0.003)	0.002 (0.003)	-0.001 (0.003)	0.007 (0.006)	0.006 (0.005)	0.005 (0.005)	-0.002 (0.005)
<b>Intercept</b>	<b>0.395*</b> (0.025)	<b>0.398*</b> (0.025)	<b>0.392*</b> (0.027)	<b>0.395*</b> (0.027)	<b>0.173*</b> (0.063)	<b>0.171*</b> (0.062)	<b>0.201*</b> (0.064)	<b>0.234*</b> (0.062)
<b><i>n</i></b>	941	941	941	941	470	470	470	470
<b>Adjusted R<sup>2</sup></b>	0.02	0.04	0.04	0.08	0.05	0.14	0.14	0.22
<b>F statistic</b>	4.16	6.26	5.60	7.57	4.99	10.52	9.69	10.93

Note: Parentheses indicate calculated standard errors. \* denotes a t value >1.96 and a p-value < 0.05. State and year variables were included as control variables in all models but were not statistically significant and not reported here for the sake of clarity.



affinity for hierarchism are more likely to retain economic metacognitive images (+0.021, p-value<0.05) over environmental imagery (-0.010, p-value<0.05) although this finding in the general public but not in policy elites may be explained in part by the smaller sample size of policy elites. Overall, worldviews appear to play a fundamental role in the cognition of narrative elements as evidenced by the loss of significant effect of political party identification (between models 3 and 4) and the increase in adjusted  $R^2$  (between 0.03-0.08). When comparing policy elites to the general public, worldviews have a consistently stronger effect on the cognitive internalization of narrative elements for policy elites. This is consistent with Jorgensen's (2017) study suggesting that cognitive sophistication and worldviews play concomitant and essential roles in narrative cognition.

### **3.7 Conclusions and Discussion**

This study set out to examine how policy elites and the general public cognitively internalize particular elements of competing policy narratives surrounding the controversial practice of hydraulic fracturing in the U.S. Analytical results suggest that broader policy narratives associated with hydraulic fracturing are used by both policy elites and the general public to cognitively process or think about this policy issue. Using the NPF, we found that the narrative elements cognitively retained were similar in content and structure when comparing policy elites with members of the general public. The structure of the narrative elements holds specific theoretical interest, revealing a thread that connects broader narrative elements to mental-based policy images that upon expression or communication, still retain recognizable elements of a larger narrative. This supports the analogy of narratives functioning as a 'cognitive artifact' with which to project policy realities when needed.

Our examination into what guides the selection of competing narrative elements found that policy elites and the general public display some similarities in narrative cognition but some very important distinctions. For all individuals, gender influences how narrative elements are internalized. Males are more likely to recall cognitive images corresponding to economically oriented policy narratives about hydraulic fracturing than their counterparts. Known as the “white male effect,” risks generally tend to be evaluated as lower among males than among females across various risk domains (Finucane, Slovic, et al. 2000b) and this is consistent with a U.K. based study of public attitudes which found women more concerned than men over the impacts of hydraulic fracturing (Whitmarsh et al. 2015). While identification with a particular political party has correlated with levels of support for hydraulic fracturing practices among the public (Davis and Fisk 2014), our results indicate that worldviews play a fundamental role that is distinct from identification with a political party when it comes to how individuals think about the issue.

We expected worldviews to drive the internalization of certain narrative elements and we found that policy elites and members of the general public with strong egalitarian worldviews were more likely to cognitively internalize narrative elements that frame hydraulic fracturing as an environmental concern and while those with an orientation toward individualist values were more likely to cognitively internalize images that frame fracturing as an economic issue. We did not find hierarchism or fatalism to influence the internalization of hydraulic fracturing narratives at a statistically significant level. This finding might be partially explained by lower internal consistency for hierarchism measures, however, it is more likely that because this issue is understood to be a human-generated hazard (Xue et al. 2014), that the social construction of risk around this issue reinforces certain preferences for social ordering. For egalitarians, narratives

that frame hydraulic fracturing as harmful to the environment act to reinforce egalitarian concerns for inequality and reinforce their desire for regulatory intervention in order to protect the environment. Contrastingly, individualists are more likely to internalize narratives that position hydraulic fracturing as an economic opportunity, reinforcing their preference for deregulation and freedom to make choices about environmental resources. In narrative cognition, strong value-based worldviews motivate the cognitive internalization of value-congruent narrative elements through the process of motivated reasoning.

We expected that worldviews would have greater influence in the selection of narrative elements for elites who possess greater cognitive sophistication regarding this issue and our findings confirm this. Policy elites' worldviews had a stronger effect on the cognitive internalization of narrative elements. The results of this study provide some insight into why some elite policy narratives are more persuasive than others. This is consistent with research by Jorgensen et al. (2018) concluding that high levels of political knowledge certain increased policy support in ways that were consistent with cultural types over those with lower levels of political knowledge. The results of this study suggest that the relationship between worldviews and cognitive sophistication may be linked to the persuasiveness of policy narratives by way of cognitive internalization of narrative elements however, it is unclear how and under what conditions certain narrative elements might be used to construct more complete policy narratives. That remains a direction worthy of future research.

This study offers some unique methodological approaches. First, the study offers a rare opportunity to compare the attitudes of policy elites with the general public. Most studies have focused on public perceptions (H. Boudet et al. 2014a; E. Brown et al. 2013; Davis 2012; Rabe and Borick 2011) however, policy communications within a democratic framework involve

complex interactions between the general public and elites and previous work suggests that members of the public have less influence on policy than economic elites and organized groups (Gilens and Page 2014). This study examines this interaction by comparing the cognitive patterns of hydraulic fracturing narratives among policy elites and the general public. Additionally, this study contributes to our knowledge of attitudes toward hydraulic fracturing by contributing a more nuanced perspective that expands on purely quantitative analysis. Although it is not without limitations, the use of open-ended survey questions to facilitate unstructured responses minimize researcher-imposed constraints or biases. Of course, blank and short responses resulting from this approach may have important implications for the conclusions drawn from this study. Regardless, this approach provides a novel measure and relevant insights (Geer 1991, 360) with results that are most valuable when combined with other relevant studies. Unsupervised machine learning techniques used to generate topics render this approach more feasible and is well suited to examine attitudes on a much larger scale.

In summary, this study identifies similarities in how policy elites and the general public think about the controversial issue of hydraulic fracturing and the factors that explain how and why competing policy narratives are internalized, offering insight into the policy oriented public discourse around technological risks and benefits (Tosun 2017). Hydraulic fracturing is understood to be a human-created hazard and subject to be evaluated in terms of risk, rendering males less likely to internalize environmental-oriented narrative elements. Culturally biased worldviews underpin the narrative cognition of policy elites and the general public, coloring how individuals think about and describe this policy issue. This discovery has practical importance for concerns relating to information as warfare. For example, strategic communication

campaigns that appeal to underlying worldviews are likely to be effective at spreading misinformation or exacerbating policy debates.

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## **Chapter 4. Risk-Oriented Policy Narratives and the Cognition of Risks Associated with Hydraulic Fracturing**

The production of natural gas through the use of hydraulic fracturing technologies (HF) has been hailed as “a game changer” (Soeting et al. 2012, 2) but inconsistent environmental regulations have slowed unconventional fuel development (Soeting et al. 2014, 8). Public perceptions of HF have been generally viewed as responsible for governmental responses to regulate and even ban HF activity, fueling intense policy debates. This has prompted the oil and gas industry to and seek professional advisement for developing media communication strategies (Mayor 2018) aimed at managing negative public views (P. Jones, Hillier, and Comfort 2013). At the same time, interest groups opposing HF have enlisted the help of powerful public relations firms to craft a counter message (Fenton Communications History 2019; Smith 2014). Such strategies have contributed to contentiousness of the issue. Close analysis of the communications around HF reveal that meso-level narratives routinely position HF activities as either a risk to the environment or contrastingly, as economically beneficial (H. Boudet et al. 2014a; Heikkila, Weible, and Pierce 2014; Sarge et al. 2015). Other scholars are concerned with how communications are received finding that, when it comes to communicating the risks of HF, the public seems to hold some preferences in terms of the format (Knoblauch, Stauffacher, and Trutnevyte 2017). Policy narratives associated with HF have no doubt been carefully crafted but it not clear what aspects of these communications are useful for thinking about the issue. Conditions of uncertainty can impact individual judgements. Might communications that convey the uncertainty associated with HF influence how individuals think about the issue? Research indicates that risk perceptions often influence decision making in ways that are not advantageous. For example, it can result in the discounting or ignoring relevant information

which can lead to devastating results for individuals and for society more broadly (Robinson and Hammitt 2015). To improve decision making under these conditions, it is imperative that we understand the relationships between the construction of policy narratives around HF, narrative cognition, and risk perceptions. Recent studies have examined the general use of narratives in the media using a framing lens, finding that risk-oriented meso-level narratives around natural disasters display certain characteristics in their construction (Deserai A. Crow, Lawhon, et al. 2017; Lawlor and Crow 2018). The exact relationship between frames and narratives however, have not been fully articulated but studies suggest that narratives function to provide details under a broader story frame (M. D. Jones and Song 2013). Following the lead of Lawlor and Crow (2018), this study extends message framing to a narrative framework where conceptually, frames capture broad themes or story angles and narratives capture more deliberate decisions by storytellers (Stone 1989) that are identifiable by analyzing the structure of the story (M. D. Jones, Shanahan, and McBeth 2014). In this way, this study applies principles of framing theory to both media sourced and individual communications about HF for comparison and then relies on the Narrative Policy Framework to analyze the narrative structure of those communications. A review of relevant literature will serve to refine this study's research objectives and begins by placing the importance of frames and narratives within the broader policy process.

#### **4.1 Framing, Narratives, and the Policy Process**

Framing has been traditionally referenced with regard to the media's conveyance of policy information through the use of policy images (Wolfe, Jones, and Baumgartner 2013). Through signaling, priming, and feedback mechanisms, the media focus attention on policy issues (B. D. Jones and Wolfe 2010; Wolfe, Jones, and Baumgartner 2013) and even influence policy by either moving public opinion in a direction that constrains policymakers, or less explicitly by providing

information that fills a void of public awareness on any given issue (Arnold 1992). Media framing of an issue has been found to impact how people evaluate political issues (Iyengar, 1991; Iyengar & Kinder, 1987; Iyengar & Simon, 1993; Krosnick & Kinder, 1990; McCombs, Shaw, & Weaver, 1997; McGuire, 1989), how people think (Entman, 1989; Iyengar & Kinder, 1987; McCombs, 1993; Protess et al., 1987), and how they act (McCombs, 2004, pp. 124–132). While media narratives have also been acknowledged (Baumgartner et al. 2009; McBeth and Shanahan 2004; Zaller 1992), research has also identified the strategic use of policy images to by policy elites to attempt to influence policy outcomes (Baumgartner & Jones, 2009).

#### **4.2 Framing, Conflict, and Cognition**

Policy conflicts hinge on how an issue is perceived (Mcbeth, Lybecker, and Garner 2010b). This may happen through the media's coverage of focusing events (Deserai A. Crow, Lawhon, et al. 2017; Lawlor and Crow 2018) in part because such events are dramatic or less well understood and require further interpretation (Bennett & Lawrence, 1995; Lawrence, 2000, 2001; Molotch & Lester, 1974; Soroka, 2002). Interpretation involves focusing on particular aspects of the issue which can result in framing the conflict in such a way as to persuade and market swift and efficient policy solutions to address a some dimension of the issue (McBeth and Shanahan 2004). For policy scholarship, the interpretation of focusing events' associated with a crisis or disaster hold particular interest as this often precedes policy change (Birkland 2006; Birkland and Warnement 2013) and are identifiable by the sense of threat, uncertainty, and urgency conveyed (Boin and Hart 2007). These particular conditions produce decision-making that cognitively differs from routine or rational processing (Kahneman 2011; Kahneman, Slovic, and Tversky 1982; J. S. Lerner and Keltner 2000; Tversky and Kahneman 1992) and may heighten attentions and facilitate policy change. Conceptually, message framing simplifies the attributes of an issue

in a finite way, thereby cognitively limiting the consideration of salient points and the discussion on a topic. Empirically, frames “reveal the critical textual choices... that would otherwise remain submerged in undifferentiated text” rendering selected aspects of the issue more salient in such a way that only the comparison of frames reveals what other aspects of the issue might be missing (Entman 1991, 6). Therefore, framing a policy issue in terms of risk can be conceived of as a cognitively effective strategy especially if it is accompanied by some focusing event. This view has recently been introduced by policy scholars who have consciously integrated framing theories with the Narrative Policy Framework (NPF) to better understand how the media’s use of policy narratives affect the policy process (Deserai A. Crow and Lawlor 2016) particularly with regard to risk-related policy issues (D. Crow and Jones 2018; Deserai A. Crow, Lawhon, et al. 2017; Lawlor and Crow 2018).

### **4.3 Risk, Framing, and Policy Narratives**

In their 2018 study, Lawlor and Crow applied framing theory to define four types of risk frames to aid their analysis of narrative structure (Lawlor and Crow 2018). The authors developed measurable risk frames supported within the broader risk literature which allowed them to form hypotheses based on the assumption that narratives would be crafted to “instill a sense of urgency or importance related to the problem under discussion” (Lawlor and Crow 2018, 850). The frames they used characterized risk severity and proximity among other qualities but acknowledged that other risk frames are possible. These frames address objective concepts of risk and could be applied to better understand communications around hydraulic fracturing narratives however, it is also important to address the fact that individuals also process and understand risk in relative terms (Kaplan and Garrick 1981).



From a behavioral perspective, conceptions of risk involve processing that is highly contingent on cognitive processes (Kahneman 2003; Kahneman, Slovic, and Tversky 1982; Kahneman and Tversky 1979; Tversky and Kahneman 1992) but is also socially constructed (Kasperson et al. 1988; Kasperson, Jhaveri, and Kasperson 2001) and therefore heavily influenced by social and cultural factors. Therefore, it is reasonable to think that risk-oriented frames strategically crafted in order to highlight or downplay a sense of urgency associated with controversial issues would employ frames that leverage social constructions of risk.

#### **4.4 Risk-Oriented Frames and Cultural Theory**

Social constructions of risk are measurable. Recent policy scholarship has applied Cultural Theory (CT) to advance our understanding of the policy process (Swedlow 2014). CT posits that value-based worldviews or value predispositions function to influence individuals' behavior by guiding selective attention which determines risk perceptions and explains social conflict (Douglas and Wildavsky 1982; Thompson, Ellis, and Wildavsky 1990; Wildavsky 1987; Wildavsky and Dake 1990). Four distinct types of worldviews, hierarchism, egalitarianism, individualism, and fatalism are derived by overlaying the extent to which 1) externally prescribed rules or norms (*grid*) and 2) social collectives (*group*) are valued. Hierarchs (*high-grid, high group*) hold preferences for defined roles, procedures, and institutions. They are oriented toward assuming risks as long as that risk is supported by governmental authorities and experts. Individualists (*low grid, low group*) reject constraints from institutionally or socially based sources, viewing them as barriers to their own success. They perceive of risk as opportunity. Egalitarians (*low grid, high group*) hold an affinity for strong social solidarity and a rejection of external rules or pressures coming from outside of a recognized social structure. Expert and institutional attempts to address risks are distrusted and viewed as a threat to group

well-being. Fatalists (*high grid, low group*) feel bound by external, institutionalized prescriptions without a sense of social connection and stay uncommitted to addressing risks, believing it is useless to do so. Each prototypical worldview also holds beliefs about nature (Thompson, Ellis, and Wildavsky 1990). Hierarchs view nature as tolerant of human manipulation or experimentation up to a point but believe that nature can be vulnerable given some external shock or surprise. This supports their reliance on expert and institutional management. Individualists conceive of nature as fully robust and able to support experimentation and bounce back even under extreme circumstances. Egalitarians see nature as fragile and unable to withstand interference from humans requiring collective action for protection. Fatalists do not know what to expect from human interactions with the environment therefore, previous experiences do not offer lessons for future action with regard to the environment.

An effective “narrative that sways opinion in one case ... may not work in another ... and the best we can do is offer our best portrayal” of the process (Cairney and Weible 2017, 621). Frames that rely on objective concepts of risk are predisposed to make use of technically based assessments and are therefore likely to appeal to individuals holding one concept of risk however; because alternate concepts of risk exist, namely those subject to social and cultural biases, alternative frames may be successful and helpful in analyzing narrative elements. This study draws from CT to identify and characterize a risk frame based on a socially constructed concept of risk. As defined by egalitarian values, technological innovations like HF pose an inevitable risk to the environment while individualist values define risk primarily as opportunity. Conceptualizing this risk frame as the broader, cognitively dependent structure in which the narrative is nested will facilitate the comparison of meso-level narratives around HF with micro-level HF policy images.

#### **4.5 Narratives and the Narrative Policy Framework**

Narratives may be a more precise version of a broader story frame (M. D. Jones and Song 2013). As already discussed, frames capture broader themes or story angles. Narratives however, capture deliberate decisions by storytellers (Stone 1989) that are identifiable by analyzing the structure of the story (M. D. Jones, Shanahan, and McBeth 2014). The Narrative Policy Framework (NPF) allows scholars to examine another dimension of strategic narrative construction with an analysis of the form and content. While content may vary somewhat, the narrative form is comprised of elements that are identifiable across substantive topics. Elements of narrative form include the setting, plot, characters, and the moral of the story. Integrating risk-oriented framing with a narrative framework will facilitate this study's analysis of communication construction surrounding the controversial issue of HF. The narrative setting typically relays benign facts that support other narrative components and may include relevant characters or events (M. D. Jones, Shanahan, and McBeth 2014). In the case of narratives designed to address policy issues associated with risk, the issues tend to be highly contested or controversial and are often politicized. This is the case for hydraulic fracturing in some states (Weible and Heikkila 2017a). Communications on these issues are often presented in the form of competing frames or policy images (Baumgartner et al. 2009) so frames may portray contrasting evidence.

The plot element of a narrative often defines the policy problem along with important causal factors and has a chronological or sequential storyline (M. D. Jones, Shanahan, and McBeth 2014). Building from Stone's (2012) story types, the plot may stress a trajectory of decline, frustrated progress, helplessness and control and is likely to place blame on specific actors (Deserai Anderson Crow and Berggren 2014). With regard to risk, the plot may discuss

the severity or proximity of the risk or the initiatives meant to address or mitigate the source of risk.

The characters of a policy narrative may appear as individuals, organizations, or institutions and are involved in the plot. They may be portrayed as fixing the problem/risk (hero), causing the problem/risk (villain), or a casualty of the problem/risk (victim). The moral of the story may be identifiable as the proposed solution to the problem. Narratives, particularly those surrounding highly contentious issues, may focus on the uncertainty present rather than propose a solution. In practice, policy narratives may not incorporate all narrative elements but they typically contain at least one character and another narrative element (Shanahan et al. 2013). Dominant actors often act to contain an issue or maintain the status quo while non-dominant actors may attempt to expand the scope of conflict (M. D. Jones and McBeth 2010). Within the risk domain, narratives may advocate for the concentration/diffusion of risk or policies designed to mitigate the risk using time, geography, and severity of the risk (M. D. Jones, Shanahan, and McBeth 2014; Lawlor and Crow 2018; Shanahan et al. 2013).

#### **4.6 Theoretical Expectations**

To better understand why the policy issues around HF continue to be highly contentious, this study builds on the work of Lawlor and Crow (2018), applying concepts of framing and NPF to examine structural components of communications around HF. It is assumed that meso-level communications around HF policy issues are strategically constructed to garner attention to particular aspects of the issue. This work builds on the previous chapters which analyze the cognition of policy narratives by comparing meso-level and micro-level narratives of HF. It is expected that communications surrounding HF leverage social constructions of risk (risk frames)

to produce competing policy images around HF, rendering the narrative elements cognitively significant.

*Meso-level policy narratives utilize socially constructed concepts of risk to portray HF (H<sub>1a</sub>) and the elements of risk-oriented meso-level narratives are reflected in the semantics chosen to describe HF at the micro-level (H<sub>1b</sub>).*

Applying NPF and CT, it is expected that culturally defined social constructions of reality and risk will drive narrative cognition around HF, facilitating the internalization of narrative elements that are used as cognitive artifact in order to shape overall risk perceptions associated with HF.

*H<sub>2</sub>: Cultural predispositions will guide the cognitive internalization of communications (narrative elements and risk-oriented frames) to influence individually held perceptions of utility. More specifically, it is expected that individuals with strong egalitarian worldviews will cognitively internalize HF as an environmental risk. Those with predispositions toward individualist values are expected to cognitively frame HF as an economic opportunity. Individuals with a strong affinity for hierarchism are expected to cognitively frame HF in terms of economic benefit, trusting existing institutionalized authority to manage environmental tradeoffs.*

The following sections describe the data and the analytical approaches used to test these hypotheses.

#### **4.7 Data, Analysis, and Empirical Results**

The analysis is divided into three stages and relies on two different data sets. To test whether meso-level policy narratives utilize socially constructed concepts of risk to portray HF, the first stage of the analysis examines the structural components of meso-level policy narratives associated with HF that were published between 2015-2016 in two nationally distributed

mainstream news sources. An analysis of 40 articles uses a combination of structural topic modeling and content analysis to identify frames and narrative elements used to construct the narratives.

To analyze whether elements of risk-oriented meso-level narratives are reflected in the semantics chosen to describe HF at the micro-level, the second stage of the analysis examines the structural components of individuals' descriptions of HF relying on survey data collected between 2015-2017 in the state of Arkansas to compare to those present in meso-level policy narratives. Structural topic modeling is used to extract latent narrative elements used by individuals to think about HF.

Because it is expected that cultural predispositions will guide the cognitive internalization of communications (narrative elements and risk-oriented frames) to influence individually held risk perceptions, the third and final stage of analysis OLS regression and mediation analysis using the same survey data to understand how socially constructed concepts of risk, or more specifically, culturally biased value predispositions guide the selection and cognitive internalization of certain narrative elements to influence individual perceptions of overall utility with regard to HF activities.

#### Stage 1 - Analysis of Meso-level Hydraulic Fracturing in Mainstream Media Sources

Relevant articles covering HF and published online in two mainstream media sources (Wall Street Journal (WSJ), a politically conservative leaning source for business related information, and the New York Times (NYT), a liberal-leaning newspaper)<sup>19</sup> were located with a search utilizing the keywords *hydraulic fracturing* and *fracking*. The search yielded 925 articles which

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<sup>19</sup> The WSJ and the NYT were selected in part because articles were likely to report on HF in a way that would capture national level attention (not tailored to a particular geographic audience) and be readily available to policy elites in the U.S.

were then limited by subject (U.S.-based) and by year (2015-2016) returning 40 articles (in full text, 25 articles in WSJ and 15 articles in NYT). A corpus consisting of the 40 articles contain metadata such as the publication, year, headline, and full text of the article and was preprocessed using the *quanteda* in R to prepare for analysis using structural topic modeling. Structural topic modeling (*stm* in R) (discussed in more detail in the following section) was used to extract three latent topics<sup>20</sup> from the text using the publication as a prevalence covariate.<sup>21</sup> The highest probability words in topic 1 included *gas*, *frack*, *earthquake*, and *seismic*. High frequency words in the second extracted topic included *frack*, *water*, *gas*, and *regulation*. Finally, high frequency words in the third extracted topic included *oil*, *price*, *OPEC*, and *export*. Topics 1 and 2 seem to convey aspects of an environmental risk frame while topic 3 conveys an anti-risk/economic opportunity frame. The articles were also analyzed using content analysis and provide some more resolution with regard to the narrative elements (see Table XVI).

Articles in the sample were nearly evenly distributed between 2015 (48%) and 2016 (52%) with the majority of articles being published by the WSJ (60%) as compared to the NYT (40%). STM analysis of the policy narratives extracted topics that frame environmental and economic dimensions of the issue similar to previous studies and support H<sub>1a</sub>. Content analysis reveals that the articles contain socially constructed risk frames with exactly 50% of the articles framing HF as an environmental risk and 50% framing it as an economic opportunity. These risk frames operate to produce a systematic type of messaging that incorporates narrative elements where narrative elements like the setting and the plot are quite consistent when compared within

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<sup>20</sup> STM was used to extract three latent topics (as opposed to 5, 7, or any other number) based on the number of topics that emerged with earlier data analysis using manual coding.

<sup>21</sup> A prevalence covariate may be incorporated into the structural topic model when the variable is believed to affect the frequency with which a particular topic is discussed (M. Roberts, Stewart, and Tingley 2018). The prevalence covariate for this study is binary, either the WSJ or not (coded 1 or 0).

frames. When comparing narrative elements between frames however, characteristics of the setting and plot do not exhibit much overlap. Risk-oriented meso-level narratives that frame HF as an environmental risk, suggest that fracturing produces unnatural earthquakes (in 26% of environmentally framed articles) and water contamination (68%) which result in extensive investigations to understand the impacts fully (37%). The majority of these articles were set within the context of published regulatory reports (95%). The articles that position hydraulic fracturing as an economic opportunity were set contrastingly by highlighting the innovative aspect of the technology (47%) and attributing the innovation with energy independence (26%) and job creation (21%) among other benefits.

The articles analyzed in this study share many characters. All of the characters defined in economic frames are also addressed by environmental frames but treated very differently. The oil and gas industry are depicted as a hero in 53% of the economic frames while 16% depicted the industry as a victim of unnecessary litigation or unauthorized regulation in which the Department of Interior was a villain (11%). Environmental frames on the other hand, portrayed the industry as a villain (42%) with state regulators functioning as a hero (32%). Environmental narratives advocated to expand the conflict by incorporating other actors including political candidates and academics while economic narratives suggest that issues related to hydraulic fracturing be handled by the industry. Only 32% of the economic framed narratives included policy solutions which corresponded to a call to lift the ban on natural gas exports. In contrast, 89% of environmentally framed narratives advocated for some type of action including the development of national regulations on hydraulic fracturing (74%) and data collection on the impacts (11%). Economic-oriented frames portray hydraulic fracturing not as a threat to the environment but as an innovation that produces jobs, energy independence, and even clean energy. This competing



narrative assigns responsibility for lost opportunity through accusations, litigations, and unauthorized regulation to those who would view HF as risky.

### Stage 2 - Analyzing Cognition of HF through STM

To better understand how individuals rely on the structural aspects of a narrative to think about HF, this study relies on original data collected between 2015-2017 in two Internet based surveys with a focus on local energy policy issues. Given the generalized interest in public opinion and the influence of policy elites on policy narratives, the individual respondents in this study consist of both policy elites and members of the general public in Arkansas. Arkansas was chosen because it has extensive experience with HF activity but has received little previous attention in other studies. Both samples received an email inviting them to participate in an energy focused survey which included an embedded link to the survey. The policy elite sample was sent to 2,396 emails publicly available on municipal and professional websites. Of those, 788 completed some portion of the survey with 116 completing the survey. The general public sample is representative and was collected under contract with Qualtrics using professionally accepted sampling methods. The sample includes individuals who possess the resources and knowledge to influence the policy process such as members of city council, chamber of commerce members, professionals as well as members of the public residing in 50 cities across Arkansas.<sup>22</sup> After removing data with incomplete information for all of the variables used in the following analysis, the data set contains 650 respondents.

This study operationalizes individual cognition of HF by measuring respondents' recollection of cognitive images associated with HF or their 'metacognitive policy image'.

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<sup>22</sup> Arkansas' Fayetteville Shale is one of the largest shale gas formations in the U.S. and at the time of the survey, had recorded more than 4,000 active fractured wells as placed a moratorium on permanent disposal wells in designated areas (Davenport, 2015).

Conceptually, cognitive mental images represent real world experiences and are routinely expressed semantically (P. Harder 1954, 47). The expression of cognitive images are fundamental for facilitating group interactions and cooperative behavior (1954, 80) which is accomplished through the use of words which operated as formalized symbols representing an individual's "realm of reality" (P. Harder 1954, 53). Individual cognition of HF is operationalized by recording their semantic expression in response to the question posed in the survey, *when you think about fracking, what is the first image that comes to mind?* Data collection allowed respondents to input their description in an unstructured manner with no character limit. The unstructured nature of this measure is meant to avoid *a priori* researcher-specified assessments and directly record the respondents' metacognitive policy image of hydraulic fracturing.

Cognitive processing of information is restricted by bounded rationality, rendering decision making "a constructive and contingent process" where heuristics are necessary to simplify the complexities of a problem (Kahneman 2003; Kahneman, Slovic, and Tversky 1982; Kahneman and Tversky 1979; Tversky and Kahneman 1992). It is also acknowledged that this process is subject to dual system processing in which emotion or affective feelings provide an efficient cue for the judgements that follow (Damasio, Everitt, and Bishop 1996). For this reason, affect is expected to play a central role in the cognition of hydraulic fracturing narratives and is used as a prevalence covariate in the first stage of analysis detailed below. General affect or respondents' general feelings about fracturing is operationalized by asking respondents to indicate how they generally feel about fracking on a scale of one (extremely negative) to seven (extremely positive).

**Table XVI Risk Frames and Narrative Elements Associated with Hydraulic Fracturing Meso-level Narratives**

Frame	Year	Source	Setting Keywords (number of articles)	Plot (number of articles)	Characters (type; number of articles)	Policy Solution
<b>Economic</b> (20 articles)	2015 (10)	NYT (6)	Contrasting evidence (1)	Export ban frustrates economic growth (1)	Oil & gas industry (hero; 10)	Issue containment industry self-regulation (1)
	2016/17 (10)	WSJ (14)	Export ban (1)  Technological innovations (9)  Active well reductions (2)  Federal District Court rulings (1)	Energy innovation leads to: clean energy option (1) job production (4) energy independence from middle east (5) conservation of water use (1)  Innovation protects against economic recession (1)  Litigation causes unsustainable financial burden (2)  Unauthorized approval of regulations placed hardship on industry (1)	Oil & gas industry (victim; 3)  Department of the Interior (villain; 2)	Lift export ban (3)  Increase tax on imported oil/gas (1)  Issue expansion to include courts (1)
<b>Environmental</b> (20 articles)	2015 (9)	NYT (10)	State and national level reports including EPA, USGS, Texas, Oklahoma, Arkansas, New York, Colorado regulatory authorities (19)	Regulators investigate environmental impacts (7)	State regulators (hero; 6)	Expand conflict to:
	2016/17 (11)	WSJ (10)	Federal District Court rulings (1)	Hydraulic fracturing:  causes earthquakes which are unnatural (5);  impacts water resources and has national impact (13)  cause environmental impacts that affect health (1)  federal judge set stricter standards (1)  communities demand ballot initiatives but have failed to stop hydraulic fracturing (1)  EPA conclusions invalidate earlier environmental impact findings resulting in confusion about outcomes of hydraulic fracturing (1)	Oil & gas industry (villain; 8)  EPA (villain; 1)  Department of the Interior (victim; 1 and hero; 1)  Federal judge (hero; 1)  Presidential candidate hero; 1)	include academic studies that record risk (2)  include state level bans (1)  encourage national standards (14)

**Table XVII Variables and Measures for Analyzing Cognition of HF**

<b>Variable</b>	<b>Measure</b>
Metacognitive Policy Image of Hydraulic Fracturing	When you think about fracking, what is the first image that comes to mind? (Open-response)
Affect	Indicate how you generally feel about fracking. (1=Extremely Negative to 7=Extremely Positive)

Again, structural topic modeling (STM) is applied in an R statistical environment to extract latent topics from unstructured text. This method has been used in various applications across disciplines (M. Roberts, Stewart, and Tingley 2018). Structural topic models (STM) incorporate other covariates in order to estimate meaningful variation present in the frequency with which a topic is discussed (topical prevalence) (2018). Structural topic models use an unsupervised learning approach within a machine learning scheme to infer topics for each individual response based on the distribution of words represented by a semantic theme (K) using a mixed-membership model.<sup>23</sup> The calculation of topical distribution (content and prevalence) incorporated affect. The distribution of words in a given response across the extracted latent topics may reported. In this study, the distribution is used as a dependent variable in the third stage of analysis. Again, three topics were selected based on earlier preliminary data analysis (Moyer and Song 2016d) using “Spectral” initialization and a maximum of 500 iterations. Topical inference results summarize meaningful topics through the calculation of prioritized words (those words that have the highest frequency of use for a given topic as calculated in various ways)<sup>24</sup> and are analyzed for frames, narrative structure and content.

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<sup>23</sup> Mixed membership models assign a topic to each word in a document resulting in one document defined as a vector of proportions that represent the fraction of words within each document that belong to an inferred topic.

<sup>24</sup> FREX weights words based on overall frequency and exclusivity to the topic. Lift weights words by giving a greater weight to words that appear less frequently in other topics. Score divides the log frequency of the word in primary topic by the log frequency of the word in other topics (M. Roberts, Stewart, and Tingley 2018).

To better understand how the communications themselves might influence how individuals think about HF, this stage compares the structural components of communications present in individual-level descriptions of HF with that of meso-level narratives. The analysis STM to generate a word co-occurrence matrix over three topics (K=3) Words with the highest probability of occurring in each latent topic are displayed in Table XVIII. Topic 1, based on the frequency and on the weighting of words (indicated by Lift and Score) includes: *water, pollut, earthquake, ground*. Topic 2's most probable words include: *energi, job, cheap, and ground*. The most frequent words for Topic 3 are *rock, oil, inject, and frack*. An analysis of high probability keywords and representative responses in individual descriptions of HF reveal similarities in topics 1 and 2. These topics share the risk frames identified in meso-level narratives. HF is not only framed as an environmental threat (to water and via earthquakes) but also as an economic opportunity for cheap energy, jobs, and energy independence. Topic 3 however, does not reflect a risk theme. Responses such as “fracking rock” or “drilling for oil” seem to describe the technical aspects of HF. With regard to narrative form, individual descriptions do not convey characters, nor do they introduce any policy solutions. What can only be described as a partial plot is evident. It can be inferred from environmentally framed descriptions, that HF causes earthquakes and water pollution mirroring plots found in 32.5% of the articles representing meso-level narratives. Similarly, economically framed descriptions seem to suggest clean energy, job production, and energy independence, a plot found in 12.5% of the meso-level narratives. Topic 3 contained a narrative structure best described as unquestioned facts that are reasonably characterized as elements of the setting. While Topic 3 contains valuable information, it holds less theoretical interest for this paper. For this reason, the remainder of the study will focus on Topics 1 and 2.

**Table XVIII Comparison of Topics Extracted from Meso-level Hydraulic Fracturing Policy Narratives with Individual Level Descriptions of HF**

		<b>Environmental</b>		<b>Economic</b>
		<b>Topic 1</b>	<b>Topic 2</b>	<b>Topic 3</b>
<b>Highest probability of use based on frequency of use</b>	<b>Nationally Distributed Newspaper Articles</b>	<i>gas, frack, earthquak, seismic</i>	<i>frack, water, gas, regulation</i>	<i>oil, price, OPEC, export</i>
		<b>Topic 1</b>		<b>Topic 2</b>
	<b>Individual Descriptions of HF</b>	<i>water, pollut, earthquak, ground</i>		<i>energi, job, cheap, independ</i>
	<b>Representative Responses</b>	<i>Diminishing water levels. Polluted ground water. Earthquakes and polluted ground water.</i>		<i>Energy independence. Cheaper energy for the U.S. Jobs and energy self-sufficiency.</i>
<b>Percentage of high probability words shared by meso-level narrative topics and metacognitive policy image topics</b>	<b>Individual Descriptions of HF</b>	25%	25%	0%

Using risk-oriented frames and NPF, this study finds some support for H<sub>1b</sub>. The analysis found similarities between these responses and meso-level narratives associated with HF. Frames that reflect socially constructed (and competing) concepts of risk were found in both meso-level narratives and respondents' metacognitive images. With regard to narrative form, metacognitive images reflect part of a larger plot embedded in meso-level narratives that position HF as an innovation, an opportunity to grow the U.S. economy, and chance to achieve energy independence from the middle east (beginning) but which is ultimately constrained (middle) resulting in unsustainable financial burdens for the industry and for the nation (end). Metacognitive policy images also reflect a larger plot in meso-level narratives that describe HF responsible for contaminated or poisoned water and earthquake damage. This analysis provides evidence to suggest that micro-level mental policy images used to think about HF rely on socially constructed concepts of risk to orient the issue and retain some elements of a larger plot. This suggests that culturally shared value predispositions guide selection of narrative elements. In the case of HF, communications that frame the issue in ways that are congruent with individuals' sensitivity to socially constructed concepts of risk are cognitively retained and used to describe the policy issue. The final stage of analysis examines the relationships between value predispositions, risk-oriented narrative elements, and perceptions of utility.

### Stage 3 - Examining Value Predispositions, Risk-Oriented Narratives, and Risk Perceptions

The final stage of analysis uses the distribution of HF descriptions corresponding to the extracted topic of HF as environmental risk (topic 1) and HF as an economic opportunity (topic 2) for each response as a dependent variable. Individuals' worldviews or predispositions toward culturally biased values function as a primary independent variable in this study and are operationalized using cultural theory (CT). Three survey questions correspond to each of the four cultural

worldviews (i.e., egalitarianism, individualism, hierarchism, and fatalism) for a total of twelve culturally nuanced statements (provided in random order in the survey) rated one to seven. One indicates that the respondent strongly disagrees and seven indicates strong agreement. Factor analysis (with the *varimax* rotation method) of the twelve CT measures reveal four latent factors corresponding to the four distinctive dimensions of the cultural worldviews. Consistently high factor loadings exist among each of the three related CT measures (i.e., factor loading greater than 0.5), loading low on remaining unrelated factors. Based upon this factor structure, factor scores for each of four latent dimensions (representing each of four cultural orientations) were calculated and are used as an index for measuring each cultural orientation. Cronbach's  $\alpha$  scores for the three survey items (constituting each CT index) range from 0.69 to 0.72 indicating that the related survey measures are reasonably reliable. Previous studies have indicated that identification with a political party is more stable than political values and may therefore be used to process information and form judgements on political or policy related matters (Goren 2005). For this reason, respondents' identification with a political party is considered a control variable in this study. Respondents are asked to indicate which political party they most identify among Democratic, Republican, or Independent. Measures were recoded to capture respondents' primary identification with the Democratic party (coded 1) or not (coded 0) or with the Republican party (coded 1) or not (coded 0).

Trust has also been identified as an important mediating variable in the relationship between individuals' value predispositions and attitudes toward hydraulic fracturing (Tumlison & Song, 2019) so trust is included as a control variable in this analysis. While various forms of



**Table XIX Chapter 4 Variables and Measures**

<b>Variable</b>	<b>Measure</b>
Benefit Perceptions Fracking provides a benefit to my community in the following categories:	A stable and reliable energy supply
	Energy independence
	New economic opportunities
	An increase in local tax revenue and improvement for public services
	A reduction in air pollution and water use compared with other fossil fuels (e.g. coal)
Risk Perceptions Fracking poses a risk to my community in the following ways:	Air pollution
	Overuse of water
	Contamination of ground water by chemicals used in the process
	Exposure of citizens to toxic chemicals
	Earthquakes
	Disposal of “fracking waste”
Benefit-Risk Index	Index using average of above 11 items (0=Not beneficial at all to 10=Extreme risk) ( $\alpha=0.72$ )
Egalitarianism	Society works best if power is shared equally. (1=Strongly disagree to 7=Strongly agree)
	It is our responsibility to reduce differences in income between the rich and the poor. (1=Strongly disagree to 7=Strongly agree)
	What society needs is a fairness revolution to make the distribution of goods more equal. (1=Strongly disagree to 7=Strongly agree)
Egalitarianism index	Index using factor score of above three items ( $\alpha= 0.81$ )
Individualism	We are all better off when we compete as individuals. (1=Strongly disagree to 7=Strongly agree)
	Even the disadvantaged should have to make their own way in the world.(1=Strongly disagree to 7=Strongly agree)
	Even if some people are at a disadvantage, it is best for society to let people succeed or fail on their own. (1=Strongly disagree to 7=Strongly agree)
Individualism index	Index using factor score of above three items ( $\alpha=0.70$ )
Hierarchism	Society is in trouble because people do not obey those in authority. (1=Strongly disagree to 7=Strongly agree)
	The best way to get ahead in life is to do what you are told to do to the best of your abilities. (1=Strongly disagree to 7=Strongly agree)
	Society would be much better off if we imposed strict and swift punishment on those who break the rules. (1=Strongly disagree to 7=Strongly agree)
Hierarchism index	Index using factor score of above three items ( $\alpha=0.69$ )

**Table XIX (Cont.)**

Fatalism	For the most part, succeeding in life is a matter of chance. (1=Strongly disagree to 7=Strongly agree)
	No matter how hard we try, the course of our lives is largely determined by forces beyond our control. (1=Strongly disagree to 7=Strongly agree)
	Most of the important things that take place in life happen by random chance. (1=Strongly disagree to 7=Strongly agree)
Fatalism index	Index using factor score of above three items ( $\alpha=0.76$ )
Trust	How much would you trust mainstream new media for providing reliable information about fracking processes and operations? (0=No trust whatsoever to 10=Complete trust)
Political Party Identification	1=Democrat; 0=Others (Republican or Independent) 1=Republican; 0=Others (Democrat or Independent)
Race	1=Non-Hispanic White
Gender	1=Male
Age	Age in years
Education	Level of education (1=Elementary through some high school to 7=Doctorate (of any type))
Income	Total estimated annual household income (1=less than \$20,000 to 9=\$300,000 or more)
Year	1=2017; 0=2015

trust (trust in government or particular advocacy groups) are arguably relevant, given the emphasis of analysis and data used in this study, trust is measured by asking respondents to rate the level of trust they have in mainstream news media as a reliable source of information about hydraulic fracturing processes and operations on a scale of zero to ten with zero representing no trust whatsoever and ten indicating complete trust.

Demographic characteristics of respondents used in this study include race (coded 1 for Non-Hispanic Whites and 0, otherwise), gender (coded 1 for Male and 0, otherwise), age (age in years), education (a 7-point scale with higher rating representing higher education level) and annual household income (1 to 9-point scale ranging from less than \$20,000 to \$300,000 or more) and serve as control variables. Responses received in the 2016/17 release of the survey were coded 1 and those received in the 2015 release of the survey were coded 0. The variables used in this stage of analysis are displayed in Table XIX.

### *Descriptive Statistics*

The average policy elite is white (87.1%), male, (52.3%) and approximately 49 years old with a college education and a median annual household income of between \$35,000-\$50,000 (see Table XX and XXI).

### *Analysis*

OLS regression analysis provides an estimation of the relationships between the primary independent variable of value predispositions, narrative cognition, and perceptions of utility which serve as the dependent variable. Regression results are displayed in Table XXII. Model 1 estimates the effects of control variables. Males (-0.767, p-value<0.05) and those most likely to identify as Republican (-0.694, p-value<0.05) tend to perceive HF as a benefit. Those who report high levels of trust in mainstream media (+0.079, p-value<0.05) indicate that HF is risky. Model 2 incorporates the primary variable and results indicate that egalitarians perceive HF as risky (+0.504, p-value<0.05) while individualists (-0.410, p-value<0.05) and, to a lesser extent, hierarchs (-0.251, p-value<0.05) are likely to view HF as beneficial. The final model incorporates the effect that narrative cognition has on judgement toward HF indicating that using environmental narrative elements to think about HF result in perceptions of risk (+2.456, p-value<0.05). Theory and the analytical results of regression are consistent with expectations of H<sub>2</sub> suggesting that a causal relationship exists between these three variables. Mediation analysis is now applied to further test H<sub>2</sub>.

Theoretical frameworks such as the Advocacy Coalition Framework and GGCT, value predispositions hold causal priority therefore, value predispositions are the primary independent variable. To better understand how risk-oriented narratives are cognitively used to shape perceptions, the dependent variable in this analysis is utility perceptions associated with HF.

**Table XX Chapter 4 Descriptive Statistics**

<b>Variable</b>	<b><i>n</i></b>	<b>Mean</b>	<b>St. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<b>Benefit-Risk Index</b>	650	5.21	1.92	0.00	10.00
<b>Egalitarianism</b>	650	0.00	0.98	-2.45	2.30
<b>Individualism</b>	650	-0.01	0.97	-2.86	2.60
<b>Hierarchism</b>	650	0.00	1.01	-2.58	2.49
<b>Fatalism</b>	650	0.00	0.98	-2.16	2.76
<b>Trust</b>	650	3.94	2.70	0.00	10.00
<b>Age</b>	650	48.94	16.00	18.00	88.00
<b>Education</b>	650	3.68	1.44	1.00	7.00
<b>Income</b>	650	3.60	1.81	1.00	9.00
<b>Affect</b>	650	3.55	1.71	1.00	7.00

**Table XXI Chapter 4 Frequency Table**

<b>Variable</b>	<b><i>n</i></b>	<b>Category (%)</b>		
<b>Race</b>	650	Non-White (12.9%)	White (87.1%)	
<b>Gender</b>	650	Female (47.7%)	Male (52.3%)	
<b>Political Party Identification</b>	650	Democrat (34.2%)	Republican (33.2%)	Other (32.6%)

**Table XXII Regression Analysis Results**

<b>Variable</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
<b>Internalization of Environmental Narrative</b>			<b>2.456*</b> (0.551)
<b>Internalization of Economic Narrative</b>			<b>-2.433*</b> (0.313)
<b>Egalitarian</b>		<b>0.504*</b> (0.080)	<b>0.242*</b> (0.066)
<b>Individualism</b>		<b>-0.410*</b> (0.072)	-0.104 (0.061)
<b>Hierarchism</b>		<b>-0.251*</b> (0.073)	<b>-0.156*</b> (0.059)
<b>Fatalism</b>		-0.012 (0.077)	-0.083 (0.062)
<b>Trust in Mainstream Media</b>	<b>0.079*</b> (0.028)	0.046 (0.028)	0.040 (0.022)
<b>Republican</b>	<b>-0.694*</b> (0.179)	-0.291 (0.178)	-0.214 (0.143)
<b>Democrat</b>	0.059 (0.185)	0.329 (0.178)	0.301 (0.143)
<b>Age</b>	0.004 (0.004)	0.008 (0.004)	0.005 (0.004)
<b>Gender (Male)</b>	<b>-0.767*</b> (0.150)	<b>-0.737*</b> (0.143)	<b>-0.431*</b> (0.116)
<b>Race (White)</b>	-0.109 (0.228)	-0.084 (0.217)	-0.267 (0.176)
<b>Education</b>	0.008 (0.057)	-0.006 (0.056)	-0.004 (0.045)
<b>Income</b>	0.020 (0.046)	0.063 (0.045)	0.024 (0.036)
<b>Intercept</b>	<b>5.340*</b> (0.360)	<b>5.088*</b> (0.355)	<b>5.288*</b> (0.487)
<b><i>n</i></b>	650	650	650
<b>Adjusted R<sup>2</sup></b>	0.077	0.174	0.465
<b>F statistic</b>	7.779	12.350	41.210

Cognitive internalization of narrative elements is conceptualized as the mediator. Causal mediation analysis as outlined by Preacher and Hayes (2004) and Hayes (2013) is used to test  $H_2$  by examining whether value predispositions guide the cognitive internalization of risk-oriented narrative elements to guide individual perceptions of HF while still controlling for other factors like demographics, political party identification, and trust in the media. The analysis was done using the *mediation* package in R. The statistical models utilize a standardized linear regression fit with ordinary least squares (OLS) (Hayes 2013; Tingley et al. 2014).

The regression coefficients representing the *total* effect of X on Y are shown in column  $c(X \rightarrow Y)$  and mirror results in Table XXII Model 2. Mediation analysis estimates the relationship between value predispositions (shown in column X) and the risk-oriented narrative elements used to think about HF (shown in column M; i.e., metacognitive policy images) on perceptions of utility (Y). Coefficients shown in column  $a(X \rightarrow M)$  represent the effect of value predispositions on the cognitive selection of risk-oriented narrative elements and the coefficients shown in column  $b(M \rightarrow Y)$  represent the effect of the narrative elements used to describe HF on indicated perceived utility. Finally, the extent to which an individual's cognitive internalization of narrative elements (M) account for the overall influence of worldviews (X) on the benefit-risk perceptions of HF (Y) or the *indirect* effect of X on Y (or  $ab$ ).

Analytical results of mediation displayed in Table XXIII indicate that egalitarians are more likely to think of HF using by cognitively internalizing an environmental risk frame (+0.053,  $p$ -value<0.05) over an economic opportunity (-0.054,  $p$ -value<0.05). Individualists are more likely to hold a competing view of HF by using a narrative frame highlighting economic (+0.067,  $p$ -value<0.05) over environmental (-0.058,  $p$ -value<0.05) impacts. Hierarchs (+0.023,

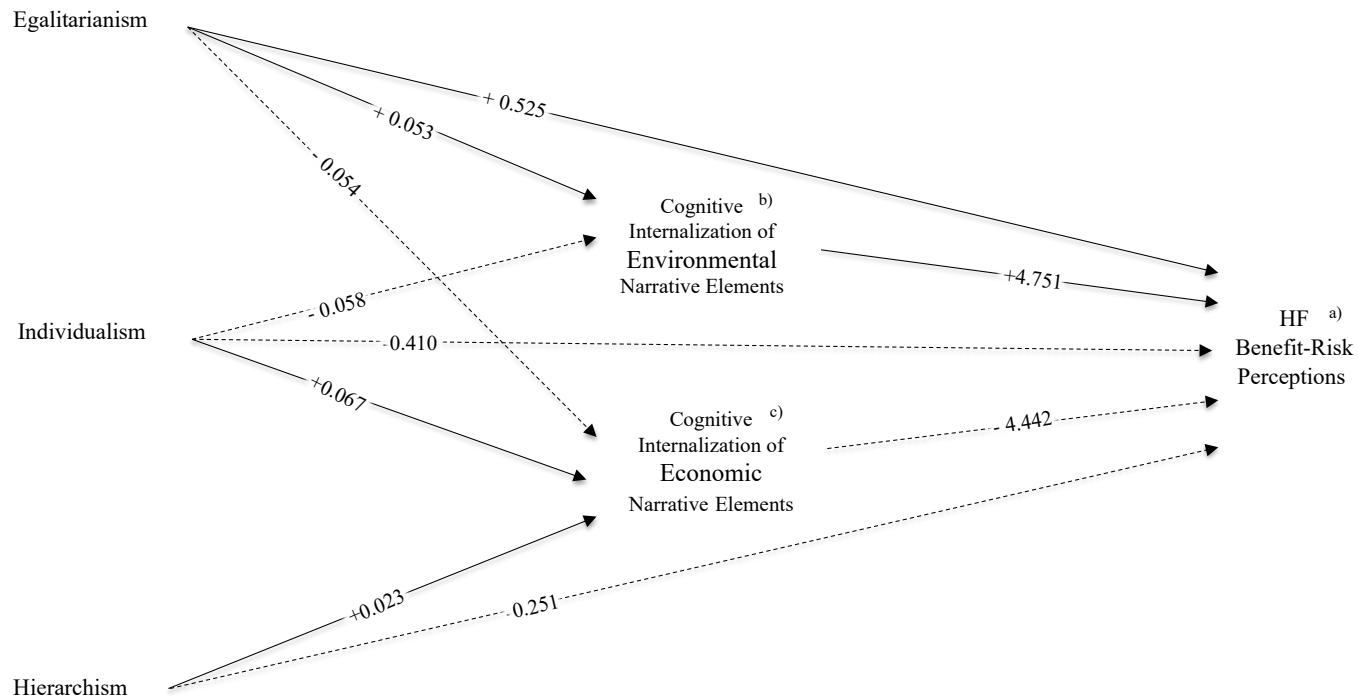
p-value<0.05) are likely to think about HF in terms of economic opportunity while fatalists (-0.020 p-value<0.05) are opposed to thinking about HF in terms of environmental impacts.

**Table XXIII Mediation Analysis Results**

X	M	Y	c(X→Y)	a(X→M)	SE(a)	b(M→Y)	SE(b)	ab	SE(ab)
Egalitarianism	Environmental Crisis	Benefit-Risk Perceptions	0.525*	0.053*	0.009	4.751*	0.268	0.252*	0.045
Individualism			-0.410*	-0.058*	0.009	4.751*	0.268	-0.276*	0.046
Hierarchism			-0.251*	-0.016	0.009	4.751*	0.268	-0.076	0.043
Fatalism			-0.065	-0.020*	0.009	4.751*	0.268	-0.095*	0.043
Egalitarianism	Economic Opportunity		0.525*	-0.054*	0.010	-4.441*	0.249	0.240*	0.046
Individualism			-0.410*	0.067*	0.009	-4.441*	0.249	-0.297*	0.043
Hierarchism			-0.251*	0.023*	0.009	-4.441*	0.249	-0.102*	0.040
Fatalism			-0.065	0.018	0.010	-4.441*	0.249	-0.080*	0.045

**Note:** \*p<0.05; In the first table row, X, represents the primary independent variable, M the mediator variable, and Y the dependent variable. The arrow represents a causal relationship between the two variables. The letters c, a, and b represent the coefficients estimated using OLS regression. SE denotes the standard effort of the coefficient estimation. The Indirect effect is calculated by multiplying a and b (Preacher & Hayes 2004, Hayes 2013).





**Note:** Only significant paths are shown. All paths are statistically significant at  $p < 0.05$  levels. Solid lines indicate positive relationships between variables while dashed lines indicate negative relationships. ADE coefficients shown here have been averaged. All regression coefficients indicated are standardized. Control variables are not reported here but were included in the regression analysis (a) Full Model  $R^2=0.465$   $DOF=639$ ; b) Internalization of Env  $R^2=0.138$   $DOF=637$ ; c) Internalization of Econ  $R^2=0.151$   $DOF=637$ ).

**Figure 2 Value Predispositions, Narrative Cognition, and Benefit-Risk Perceptions.**

Results represented by the *b* coefficient indicate that as environmental risk-oriented narratives increasingly dominate an individuals' cognition of HF, the more likely they are to indicate the multi-dimensional aspects of risk (+4.751, p-value<0.05). Cognition dominated by economic-oriented narratives are more likely to result in an awareness of the benefits associated with HF (-4.441, p-value<0.05). This conclusion makes intuitive sense however, it is of theoretical interest to determine how instrumental value predispositions are in shaping these perceptions of HF. Egalitarian values drive individuals to cognitively internalize narrative elements embedded within a 'HF is an environmental risk' frame and influences the formation of risk perceptions (+0.252, p-value<0.05). Individualist (-0.276, p-value<0.05) and, to a lesser extent, hierarch values (-0.076, p-value<0.05) drive perceptions of benefit through the cognitive internalization of narrative elements embedded within a 'HF is an economic opportunity' frame.

#### **4.8 Conclusion**

This study set out to define how the construction of narratives around HF are cognitively processed and ultimately impact perceptions of utility. Following recent studies by Lawlor and Crow (2018) this work applied framing theory and NPF in an effort to define characteristics of communications around HF at the meso and micro level. Using socially constructed risk frames and elements of narrative form, analytical results indicate similarities in the composition of meso-level narratives with individuals' mental images (cognition) of HF as reflected in the semantics chosen to describe HF. Broader risk frames are present in both however, the results suggest that individual cognition of HF internalizes narrative elements that resemble a partial plot. In this case, other elements that were evident in meso-level narratives, like the characters and moral of the story, were not used. This finding has important theoretical implications. It supports NPF suppositions that narratives function as cognitive artifact at the micro level while

at the same time, implicating a synergism between risk-oriented frames and narratives that deserves more attention. It is worth noting that the characters present in meso-level narratives, were consistent across risk frames (all of the characters in economic frames were also present in environmental frames) which reiterates that characters play an essential role in communicative strategies. Are characters perhaps collectively developed at the meso-level? The lack of character elements in micro-level narratives may suggest that the core of the plot or the outcome (end of the story) is a key element for the construction/reconstruction of a narrative at the micro-level particularly for risk-framed issues.

It is accepted knowledge that communications around controversial issues are strategically constructed. This research begins to close the gap of understanding as to why. Previous work suggests that narratives around HF rely on motivated reasoning (Zanocco, Song, and Jones 2018) and the analytical results of this work indicate that the controversial nature of policy debates around HF and corresponding communications are fueled by competing worldviews. Egalitarians are sensitized to environmental threats, particularly when the threat can be traced back to a strong institutionalized group like the oil and gas industry. This explains narratives that identify the “unnatural” effects of HF and question the conclusions of environmental impact studies conducted by the government. Individualists on the other hand, are predisposed to see risk as opportunity and are not interested in any sort of institutional interference in realizing the opportunity identified. This explains narratives that villainize the government for environmental regulation, a baseless cause since individualists’ view nature as resilient. Hierarchs are also predisposed to see HF as an opportunity but under the condition that there is some institutional regulation in place. This explains narratives that position the oil and gas industry and the government as adequately monitoring the impacts of HF.

These worldviews or value predispositions, in part through the selection and internalization of narrative elements, are foundational to the formation of perceptions around the issue. These findings have practical implications as well. Narratives constructed to support a particular view of this issue are likely to be more successful if they utilize framing and story plots that may be viewed as congruent with existing worldviews.

In conclusion, this study concludes that communications around the highly controversial issue of HF is shaped by individuals' socially influenced conceptualizations of reality. It shapes what information is cognitively retained to think about this issue and to project perceptions of the risks or benefits HF is responsible for. The results of this study are consistent with findings in other research. Evidence of environmental vs. economic framing of the issue has been reported in the media (Boudet et al. 2014; Sarge et al. 2015) and in more complete narratives at the coalition level (Heikkila, Weible, and Pierce 2014). This study follows a recent move to abandon broadly defined risk by identifying particular frames of risk, using them to better understand narrative construction. Communications that employ risk-oriented policy narratives likely function to simplify the cognitive effort needed to think about controversial issues. The bounded rationality of the individual combined with dual process cognition suggests that mental images play an essential role in cognitive processing particularly when assessing risk (Slovic et al. 2004). Using socially constructed concepts of risk to frame policy issues creates a cognitive environment of mutually exclusive options. Risk creates a sense of urgency and introduces time pressure that affects judgments due to the dual processing nature of human cognition and automatically situates the issue as either a benefits or a risk which would be consistent with findings by Finucane et al. (2000).

From a methodological perspective, a distinguishing feature of this study is its use of the open-ended survey question combined with computer-assisted text analysis. Open-ended survey questions provide an advantage of providing a more direct view of respondents' thoughts by allowing them to structure the response with less researcher-imposed constraints (Iyengar 1996). However, it is not without limitations. A lack of response or short responses may result from this approach and as noted, this may have important implications for the conclusions drawn from this study. Regardless, this approach provides a novel measure and relevant insights (Geer 1991, 360) with results that are most valuable when combined with other relevant studies. An extension of this approach, applying unsupervised machine learning techniques to the analysis of text data, renders large scale text analysis more feasible. In concluding this discussion, it is important to acknowledge that there are limitations to this research. It is not clear from this study that respondents had read any or even a selection of the nationally published articles used in this analysis. It is also unclear how essential complete narratives might be to the cognition of controversial issues like hydraulic fracturing or how individuals with different knowledge and sophistication levels might process risk-oriented narratives differently. These limitations represent opportunities for future research and experimental research designs offer a great deal of promise in this area.

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## **Chapter 5. Conclusion**

Although HF is hailed as one of the most important technologies of the century, prolonged contentious policy debates have buttressed the development of inconsistent and inefficient policies. Competing policy narratives position the issue as either a threat to the environment or, as an opportunity to realize economic gain (Heikkila, Weible, and Pierce 2014; Weible, Heikkila, and Carter 2017) however, important dimensions of this issue are much more complex. For example, HF activities have increased the availability of natural gas, identified as a “bridge fuel” because it emits half of the carbon dioxide per unit of energy than coal (EIA 2017). Ongoing policy debates around HF frustrate successful short-term strategies to address climate change.

This dissertation set out to examine policy elites’ cognition around this controversial policy issue and explain how policy narratives are used to think about HF. Founded in policy process theories, this dissertation work also provides some insight into why the communications around this issue devolve into competing and often mutually exclusive narratives that position HF as either an environmental risk or economic benefit. Previous research on the public’s perceptions of HF have found that demographics (H. S. Boudet et al. 2018; Davis and Fisk 2014), identification with politically oriented ideologies, proximity to HF (H. S. Boudet et al. 2018), framing of the issue (H. Boudet et al. 2014a; Heikkila, Weible, and Pierce 2014; Sarge et al. 2015) and images associated with the issue (Sarge et al. 2015, 66) are likely to impact attitudes and support for HF. Public perceptions on this issue are relevant however, given the highly technical nature of unconventional fuel extraction, actors with advanced scientific and technical information are likely to play a key role in policy changes that extend from existing policy debates (Jenkins-Smith, Nohrstedt, et al. 2014). Building on a substantial body of research in public opinion toward HF, this work provides a unique perspective by focusing on policy elite

attitudes and cognition. The results provide insight into the cognition of policy narratives that have broader implications for a range of substantive policy areas including energy, environment, economic, national security, and foreign policy.

Do policy elites cognitively internalize elements of broader (meso-level) policy narratives on HF and if so, what factors drive the cognitive selection of certain narrative elements? The analytical results of this research suggest that policy elites cognitively select narrative elements that are present in meso-level narratives. With regard to the environmental dimensions of HF, they often use exact wording found in meso-level narratives to describe HF. Their assessment of the overall utility of HF correlates with aspects of the narrative elements they use to think about HF. For example, policy elites who cognitively internalize aspects of environmental narratives also tend to view the risks of HF as outweighing any benefits. Conversely, policy elites who acknowledge that benefits outweigh the risks tend to cognitively internalize economic narrative elements. Consistent with previous research, both gender and political party identification were also found to shape narrative cognition. The influence of gender is attributable to the “white male effect” of risk perception, reflecting identity-protective cognition (Kahan et al. 2007; McCright and Dunlap 2012). Political party identification was also found to shape narrative cognition. Partisan cues are likely to shape policy preferences, particularly among ideologues however, moderates tend to rely on their cultural views (Jackson 2014). The findings of this study identify socially constructed worldviews or value predispositions fundamental drivers of narrative cognition. This is probably best explained by motivated reasoning where narrative content in meso-level narratives are cognitively selected by policy elites relying on heuristics to simplify cognitive processing. It is the narrative elements that remain congruent with pre-existing values or worldviews that are cognitively selected and stored to use in future judgments. These findings

are consistent with the Jones and Song's (2014) study which found that worldviews were used to structure policy narratives dealing with climate change.

Cognitive sophistication or political knowledge is implicated in the formation of politically oriented beliefs (Carpini and Keeter 1997) so it is important to understand how cognitive sophistication factors into narrative cognition. This study finds that the effect of worldviews on narrative cognition is particularly strong for policy elites. In the context of other research finding that high levels of political knowledge lead to policy support in ways that are consistent with culturally-biased worldviews (Jorgensen, Song, and Jones 2017), the results of this study suggest that the persuasiveness of policy narratives are somehow dependent on relationship between worldviews and political sophistication. For those with higher levels of cognitive sophistication, their values are likely to have a stronger effect on what aspects of a narrative will be retained to think about HF. For issues where technical understanding is key to understanding causality, technocratic decision-making is critical to achieving the justification needed to adopt proposed policy options (Habermas 1973). Policy decision-making that relies on those with higher levels of cognitive sophistication may conjure assumptions of rationality and objectivity when in fact, personally held worldviews are more likely to shape their understanding and communication on the policy issue. The degree of reliance on expertise in policymaking has the potential to equip technocracy with unchecked power, further threatening democratic systems of policymaking (Jenkins-Smith, 1990) via knowledge and information asymmetry as a tactic used stabilize self-serving power structures (Foucault, 1973) and erodes the ideal that democracy is a safeguard against tyranny. Therefore, public exclusion from policy deliberations run the risk of supporting a technocratic tyranny (Jenkins-Smith, 1990).

Does narrative cognition ultimately impact how HF is assessed with regard to the benefits and risks? The analytical results of this work indicate that the controversial nature of policy debates around HF and corresponding communications are fueled by competing worldviews. Individuals with egalitarian tendencies are sensitized to environmental threats, particularly when the threat can be traced back to a strong institutionalized group like the oil and gas industry. This explains narratives that identify the “unnatural” effects of HF and question the conclusions of environmental impact studies conducted by the government. Individualists on the other hand, are predisposed to see risk as opportunity and are not interested in any sort of institutional interference in realizing the opportunity identified. This explains narratives that villainize the government for environmental regulation, a baseless cause since individualists’ view nature as resilient. Hierarchs are also predisposed to see HF as an opportunity but under the condition that there is some institutional regulation in place. This explains narratives that position the oil and gas industry and the government as adequately monitoring the impacts of HF. Individually held worldviews are foundational to how individuals assess the benefits and risks of HF. Individual understanding of policy issues like HF rely on worldviews. Social constructions of risk and beliefs about the world guide narrative cognition. The internalization of narrative elements function as cognitive artifact which likely facilitates the structure of new information and may function as a cognitive seed from which individuals may grow a more complete narrative.

Practically speaking, this knowledge suggests that communications around controversial issues would do well to consider multiple perspectives on the issue that flow from varying worldviews. This is particularly true for communications that employ risk frames as this may support cognitive tendencies to use heuristics and motivated reasoning to assess the issue. Risk-oriented narratives create a sense of urgency, introduces time pressure, and subject to dual

processing, frames the issue in such a way that options are either beneficial or risky (Finucane et al. 2000). This type of policy communication may function to perpetuate controversy rather than encourage healthy deliberation or efficiently lead to policy solutions. It is also important to acknowledge that attitudes, within the context of political behavior, are moderated by individual self-interests (Young et al. 1987). While beyond the scope of this body of work, research that examines how policy elites' attitudes track political actions is worth of future attention.

From a methodological perspective, the use of unsupervised machine learning techniques used in this study to generate topics, render this approach a feasible method for examining attitudes on a much larger scale and demonstrates how this approach can be used beyond a simply exploratory method to support theoretical development

Taking a broader philosophical perspective, policy communications are undeniably essential to democratic governance. Traditionally, political communication is conceived of as a tool for building consensus and is viewed as essential to democratic processes. A pragmatic view of democracy conceives of the arrangement as a collective regulation of the shared consequences belonging to society (Dewey and Rogers 2012). This regulation is accomplished through the appointment of leaders who are willing to represent the public's interest and set "conditions of agreement" that will liberate and realize the full potential of the individuals represented (2012, 54–55). It is a lofty ideal that was conceived of as a protection for society against tyranny, but self-governance demands effort. It is reliant on a culture that encourages group inquiry, participation, and cooperation and it is realized when, "free social inquiry is indissolubly wedded to the art of full and moving communication," (2012, 184). In other words, deliberation is the foundation of democratic governance. Within that context, this research takes a closer look at communications around a particularly controversial policy issue where prolonged disagreements

and deliberations over how to define or address this policy issue could stand to improve. Debates over HF have produced inconsistent and inefficient policies that arguably fail to fully maximize economic opportunity or minimize the total environmental impact of unconventional fuel extraction. For this particular issue, the deliberations surfacing as intense policy debates have played out on a public (social media) stage and have become a target for foreign agents who see it as an opportunity for manipulation (U.S. House 2018). Once hailed as a hallmark and strength of democratic governance, the process of deliberation may prove to be a vulnerability, subject to exploitation on a global communication platform. In this context, deliberation could paradoxically become the weak link in democratic design.

Deliberative processes are ideally pursued by society to address and deal with conflict. In a democracy, consensus is necessary for deciding how conflict will be resolved but consensus routinely suffers from a scarcity of resources, a lack of understanding, moral disagreement, or limited generosity (Gutmann and Thompson 1999). The communications around such an issue must necessarily address and overcome these barriers and so, deliberation is the process of articulating the reasoning behind conditions of agreement (Jolls, Sunstein, and Thaler 1998) so that all of those interested may determine whether the reasons are self-serving, uninformed, morally destitute, or oriented toward achieving a greater good (Cohen 1989). The results of this study provide evidence to suggest that the communications, deliberations, conflict, and conditions of agreement are subject to individually held beliefs or worldviews and may be particularly sensitive to cognitive biases, especially under conditions of uncertainty.

In the interest of improving how society structures conditions of agreement to address important policy issues, the results of this study offer some policy relevant insight through research that intersects cognition, communication, and risk. Using a pragmatic lens, the type of



rhetoric that contributes meaningfully to the democratic process involves more than just passive thinking. Deep inquiry and deliberation give way to an acceptance or rejection of certain beliefs, forming a mental model that represents reality and eschews what is “true” for what is “reasonably probable” (Dewey 1997, 4; Jackson and Clark 2014). Pragmatically speaking, the importance of deliberative processes is to solve a problem. Communicative actions that accomplish this will likely find success with the identification of common principles and justification that renders solutions acceptable to others (Habermas 1984). This makes intuitive sense for anyone who has tried to persuade another but practically speaking, it is the identification of common principles that pose a significant challenge. Without some generalizable and reliable measure of principles with which to gauge commonality, as scholars we are unable to scientifically investigate and contribute any insight into the mechanics of deliberation or communication in the context of policy decision making. Determining to whom common principles must apply for consensus to be gained is equally challenging.

Philosophers and political theorists have written extensively on democratic processes, focusing on the structure and relationships of political power, but again, a pragmatic lens provides an alternative perspective to consider. Democracy enables society to solve real problems by collectively addressing complex issues that have widespread consequences (Dewey and Rogers 2012). A focus on problem solving shifts attention to the fact that societies are increasingly reliant on technical solutions to address issues; a shift that has arguably led to technocratic policymaking. Some argue that the public is incapable of comprehending the complexity surrounding many policy issues rendering technocratic policymaking essential (Fischer 1995; Wilson 1941) but there are larger implications to this approach. In addition to merely crafting policy solutions grounded upon rigorous analysis with robust science and data,

expert-based policy decisions also function to legitimize one choice over another, making technocratization critical to achieving the justification needed to adopt proposed policy options (Habermas 1973). This level of reliance on expertise in policymaking has the potential to equip technocracy with unchecked power, ultimately threatening democratic systems of policymaking (Jenkins-Smith, 1990).

At the crux of this debate is the assumption that scientific and technical expertise rely on purely rational and objective analytical procedures to develop policy solutions (Jenkins-Smith, 1990; Weimer, 2005) when, in reality, technocracy may favor the formation of expert-driven bureaucratic structures that control the flow of information used to inform policymakers' decisions (Jenkins-Smith, 1990). More often than not, this is accomplished through the use of highly sophisticated communications that may exclude public participation and divert attention from public interests (Habermas, 1973; Pateman, 1970; Barber, 1984). A technocratic system that maintains control of knowledge or key policy information arguably contributes to the problem of knowledge and information asymmetry, and that may be utilized to stabilize self-serving power structures and insulate experts and technocrats from political oversight (Foucault, 1973). A technocratic bureaucracy of power is even seen by some as a challenge to political power where "every advance made in the techniques of enquiry, administration, and organization itself reduces the power and the role of politics" (Ellul, Wilkinson, & Merton, 1964: 259). Advocates of democratic and participatory policymaking processes argue that exposure of the process to the power of argumentation and democratic debate is a safeguard against a technocratic tyranny (Jenkins-Smith, 1990). They claim that exclusion of public participation in policy deliberation may incite the adoption of policy choices that neglect public values (Hawkesworth, 1988), though some scholars argue that broader participation is not an ideal solution, in that policy

decisions made with public participation still tend to favor individual self-interests rather than a larger public interest (Fischer 1995).

If one subscribes to the pragmatic view of democracy and agrees that consensus is worth pursuing for purposes of solving societies most complex problems, then understanding how policy communications function in this process is essential, not only for members of the general public, but for those who hold the potential to engage in the policymaking process by way of resources or advanced knowledge. Given the pragmatic concerns mentioned, any advancement of this pursuit requires deeper knowledge of mechanisms involved in communications around conflict, particularly those areas of contention that are the most controversial.

Specific theoretical contributions of this work include a deeper understanding of how policy narratives are used to think about controversial policy issues and the foundational role that beliefs or worldviews play in the process. This work offers some insight into how individuals' cognitive and cultural biases impact policy learning and ultimately, how this supports the building of advocacy coalitions and the advancement of beliefs through policy over time. This could be applied to better understand how secondary beliefs might be compromised over deep core or even policy core beliefs (Jenkins-Smith et al. 2014). More specifically, this understanding demonstrates processes at the individual level that support belief driven organization around an issue that is supported through value laden communications that may rely on socially constructed definitions of risk to frame specific narratives that justify preferred solutions. This study finds evidence to suggest that elements of a narrative plot are retained as cognitive artifact and used to think about policy issues when needed. It is possible that characters in strategically crafted narratives are selected through gaining consensus and are likely context-specific, but more research is needed to explicate the relationship between narrative elements at

the individual level. Finally, this study demonstrates how GGCT is useful, not only for operationalizing risk-oriented issue frames but for strategically crafting persuasive narratives around policy issues.

It is important to acknowledge that application of the research findings presented here have the potential to impact the public discourse environment, but extreme caution should be taken moving forward. The contributions mentioned could be applied with a goal of reaching consensus for the sake of advancing Dewey's ideal community but without conditions of agreement that support the potentiality of a global community, the deliberations themselves are subject to manipulation in such a way as to render communicative actions unproductive.

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