USING Q-METHODOLOGY TO UNDERSTAND ENVIRONMENTAL OPPOSITION TO FRACKING

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ABSTRACT

The recent expansion in the development of unconventional sources of natural gas in the United States, specifically the Marcellus Shale-rich state of Pennsylvania, has generated policy and public controversy. The media discourse about fracking in central Westmoreland County has often been negative, based on media coverage, newspaper articles, and the development of numerous opposition groups. This study uses Q-methodology to examine emergent perspectives and sub-discourses within the fracking opposition debate in central Westmoreland County, PA. The analysis reveals four different narratives of perspectives amongst people actively involved in locally opposing fracking, labeled (1) Future Fears; (2) Local Resistor (3) Community Concerns; and (4) Distrust Stakeholders and Turn towards Renewables. The conflicts that emerge across these four extracted factors are indicative of deeper discourse within the fracking debate that signifies diversity in motivations, values, and convictions. The disparity in viewpoints point to fundamental disagreements over standard fracking processes, stakeholder decisions, and the future of fracking. Unraveling these core areas of dissent can offer tangible data upon and insights which policymakers can base future fracking campaigns.

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INTRODUCTION

The recent energy revolution to develop unconventional sources of natural gas in the United States has generated policy and public controversy. The advancement of hydraulic fracturing technology in unconventional horizontal drilling and the development of natural gas resources has expanded the United States' gas supplies (Olmstead et al., 2013). The main source of unconventional natural gas in the northeast United States is the Marcellus Shale formation that spans the states of Pennsylvania, Ohio, New York and West Virginia. The Marcellus Shale is a very fine grained, impermeable rock that has methane gas distributed throughout it. The fracking procedure injects chemicals, sediments, and water at a high pressure into the shale bed to mechanically fracture the bedrock and facilitate recovery of natural gas (Boudet et al., 2014). The purported advantages of utilizing natural gas include lower carbon dioxide emissions and less associated pollution in comparison to oil and coal, increased jobs and economic growths to local fracking areas, and the vast resources available within the United States (Davis, 2012; Bolinger, 2014; Boudet et al., 2014). However, there are local concerns of environmental contamination, health hazards, a lack of proper setback distances (the distance of fracking sites from homes, occupied buildings, water bodies, etc.), and perceived general untrustworthiness of fracking companies (Boudet et al., 2014). The state of Pennsylvania is a central player in the evolving understanding of fracking given its vast shale deposits, resource development opportunities, media coverage, and its maintenance of a consolidated and centralized natural gas policy regime, rarely susceptible to local influence (Rabe & Borick, 2013).

Fracking as a way of releasing natural gas has recently generated considerable controversy in central Westmoreland County, PA. In the past several years, fracking has spread throughout Westmoreland County, drilling permits have been issued in other Pennsylvania townships, and wells continue to be proposed throughout the area (Amico et al., 2011). The local public sentiment surrounding fracking has often been negative, judging by media's coverage of fracking activities, local newspaper articles, and the development of numerous opposition groups. In an aim to understand public opposition to fracking, this study applied Q-methodology to explore the themes and sub-discourses of fracking opposition in a region of the United States actively fighting fracking, proposed permits, and further expansion of fracking sites. The ability to improve the fracking debate beyond entrenched positions of support or opposition while unraveling the core

areas of dissent can provide local policy-makers with policy objectives and tangible data upon which to base future fracking campaigns.

LITERATURE REVIEW

Hydraulic fracturing (fracking) is a technique employed to harness previously untapped natural gas. The process couples horizontal drilling with high-pressure injection of chemicals, sediments, and water that mechanically fractures bedrock (typically shale) to facilitate the flow of gas through the fractured rock fissures (Boudet et al., 2014). Fracking is a dynamic and comprehensive process that inevitably alters the economic, environmental, social, and health fabric of local communities (Jacquet, 2012; Boudet et al., 2014). Over time, however, the practice has met public disapproval and resistance.

Typically, public support for fracking stems from associated job growth and local economic stimulation (Davis, 2012; Bolinger, 2014; Boudet et al., 2014). Fracking has created approximately 245,000 direct and indirect jobs in the state of Pennsylvania, injecting tens of billions of dollars directly and indirectly into the state's economy (Meng, 2015). Proponents also extol the virtue of harnessing natural gas, which emits less greenhouse gases into the atmosphere compared to oil and coal, and has lessened the United States' dependence on imported sources of energy (Eaton, 2013; Paredes, Komarek, & Loveridge, 2015). Natural gas is seen as a transition fuel towards a renewable energy future and low natural gas prices, supplemented by increased availability, ultimately reduce consumer costs, makes electric vehicles a viable alternative, and reduces the country's reliance on petroleum products (Ansolabehere & Konisky, 2012; Eaton, 2013; Paredes, Komarek, & Loveridge, 2015).

Conversely, public opposition for fracking typically stems from perceptions of environmental contamination, health risks, and halting of renewable energy sources (Davis, 2012; Bolinger, 2014; Boudet et al., 2014). Potential environmental impacts include water contamination from the chemical additives in fracking fluid injections, air pollution from volatile organic compounds (particularly methane) that contribute to global climate change, seismic risks, noise pollution, and soil contamination from radioactive materials in waste products fracking generates (Lampe & Stolze, 2015; Merril & Schizer, 2013). In Pennsylvania, individual fracking wells produce approximately 1,000 tons of drilling waste (ground up rock and drilling mud) that may contain salts, heavy metals, and naturally occurring radioactive materials (Merril & Schizer, 2013; Lampe & Stolze, 2015). Over the course of a well's lifetime, nearly 3.6–7.9% of shale gas production

migrates to the atmosphere through venting or leaking and 37% of the chemicals used during fracturing have been found to be volatile and airborne (Howarth, Ingraffea, & Engelder, 2011; Jackson et al., 2013; Caulton et al., 2014; Meng, 2015). Expected to account of 49% of the United States' natural gas production by 2035, fracking has thus prompted industry leaders, governments, and researchers to monitor public perception. There is a need to understand the reasons behind people's support or opposition to effectively tap the full potential of natural gas reserves, engage relevant stakeholders, and develop responsible policy (Boudet et al., 2014).

Extant literature on public opinions to fracking and environmental and energy initiatives have been covered from various perspectives, including the geographic distribution of fracking operations (Greenberg, 2009; Theodori, 2009), their impact on the environment vs. the economic benefits that can be derived from them (Theodori, 2009), comparative studies of cases (Jacquet, 2012; Stedman et al., 2012; Boudet et al., 2014; Davis & Fisk, 2014; Kriesky et al., 2014), and demographic and psychographic characteristics of people who typically support or oppose fracking (Finucane et al., 2000; Dunlap, Xiao, & McCright, 2001; Xiao & McCright, 2001; Smith, 2002; Konisky, Milyo, & Richardson, 2008; Semenza et al., 2008; Boudet et al., 2014; Davis & Fisk, 2014; Kwan, 2012; Liu, Vedlitz & Shi, 2014). Prior research has been largely empirically driven and employed two main types of methodology-public opinion polls or surveys and case studies of specific energy projects. These works have provided insights into the public's support or opposition to fracking and their level of concern, producing data on a wide range of geographic contexts, identifying barriers to public acceptance, identifying the "types" of people who support or oppose fracking, and identifying perceptions of specific impacts (e.g. water pollution, aesthetics). The findings generally indicate that public perception is complex, multi-dimensional, and influenced by cultural, contextual, geographical, socio-economic, and political factors (Ellis, Barr & Robinson, 2007).

Case studies are particularly useful for local policy objectives, to narrow the "voice" to local residents rather than relying upon national polls and to provide context to contemporary and controversial subject areas. Analyzing case studies on a cumulative topic helps point to the variant and contextual nature of environmental issues. Although one might expect public reaction to most energy projects to fall under the "not in my back yard" (NIMBY) category, geographic and economic considerations play significant roles (Jacquet, 2012; Davis & Fisk, 2014). Case studies

often relate public perceptions of energy projects across counties, in areas with divergent quantities of energy development, and in areas at varying stages of energy development (Jacquet, 2012; Stedman et al., 2012; Boudet et al., 2014; Davis & Fisk, 2014; Kriesky et al., 2014). For example, Kriesky and colleagues (2014) found that the residents of a county with substantial fracking activities were more likely to perceive fracking as an economic opportunity, were more likely to get fracking information from locals, were less likely to perceive environmental threats, and were substantially more supportive of fracking. In a survey of Pennsylvania landowners who were simultaneously experiencing the development of wind and natural gas energy sources, Jacquet (2012) found the public's attitude was more favorably disposed to wind than natural gas. Interestingly, and supporting "NIMBY" theories, survey respondents also held equally positive views toward wind and natural gas prior to the development of these energy sources in the area (Jacquet, 2012; Davis & Fisk, 2014). A number of scholars (e.g., Jacquet, 2012; Davis & Fisk, 2014; Kriesky et al., 2014), however, found mixed reactions regarding the influence of geographic location on public support or opposition.

Much of the literature regarding people's reactions and responses to energy projects has examined the public's assessment of economic stimulation vs. environmental degradation (Michaud, Carlisle, & Smith, 2008; Truelove, 2012; Boudet et al., 2014). Citizen support for natural gas fracking in the U.S. is often associated with perceptions of economic benefits, while opposition is often associated with perceptions of local environmental risks (Boudet et al., 2014). At the core of the debates about natural gas drilling are the different perceptions of the level and types of environmental risks involved in addition to the quantity of local drilling a project requires (Brasier et al., 2013; Schafft, Borlu, & Glenna, 2013; Boudet et al., 2014). In particular, Pennsylvanians differed widely on how much attention they paid to fracking; however, a plurality of residents believed that fracking produced greater benefits than costs for the state (41 to 33 percent) while simultaneously believing that fracking posed a threat to the state's water quality (Rabe & Borick, 2011). Much of the attitudinal research on fracking projects focused on communities that were actively engaged in fracking, highlighting either the support mediated by economic gains or the opposition, often mediated by NIMBY attitudes or environmental concerns. Additionally, much of the literature found no correlation between environmental knowledge and knowledge of fracking and support or opposition for fracking; however, in contrast to this finding, education or "awareness-raising" is often utilized as a strategy to garner support and overcome opposition

(Boudet et al., 2014; Davis & Fisk, 2014; Lampe & Stolz, 2015; Meng, 2015). The literature appears to be inconclusive in defining the tradeoffs between the desire for economic benefits and the acknowledgement of potential environmental contamination, purportedly due to the clouding of other factors.

The dominant avenue for social science research related to fracking is defining the nature of public support and opposition of fracking. These studies tend to focus on specific factors hypothesized to influence support for or opposition to of energy projects or concern for the environment in general. These variables include demographic characteristics of the affected populations, politics, geographic location of fracking sites, media use, perceived risks, issue familiarity, environmental concern, and New Ecological Paradigm (NEP) scores (Brasier et al., 2011; Devine-Wright, 2011; Poumadere, Bertoldo, & Samadi, 2011; Huijts, Molin, & Steg, 2012; Boudet et al., 2014; Davis & Fisk, 2014). Surveys to gauge public attitudes toward fracking measured general environmental concern, issue knowledge, local history of fossil fuel extraction, perceptions of governance and leasing issues, and "top of mind" associations. Scholars have also tested several predictors of perceptions, such as socio-demographic characteristics, perceived risks, geographic location, proximity to project sites, perceptions of distributive fairness, perceptions of project novelty, worldviews, political ideology, issue familiarity, media use, and public policy values pertaining to economic growth and environmental protection (Brasier et al., 2011; Devine-Wright, 2011; Poumadere, Bertoldo, & Samadi, 2011; Huijts, Molin, & Steg, 2012; Boudet et al., 2014; Davis & Fisk, 2014). Research shows that context, demographics, economics, and political characteristics affect the public's attitudes toward energy policies, fracking, and general environmental concern (Konisky, Milyo, & Richardson, 2008; Ansolabehere & Konisky, 2009; Jacquet, 2012; Brasier et al., 2013; Kriesky et al., 2013). Opposition to fracking and support for current or increased levels of regulation were found to be strongly correlated with being a member of the Democratic Party, being young and wealthy, being female, and scoring high on the NEP attitude scale (Finucane et al, 2000; Smith, 2002; Xiao & Dunlap, 2007; Konisky, Milyo, & Richardson, 2008; Semenza et al., 2008; Kwan, 2012; Boudet et al., 2014; Davis & Fisk, 2014; Liu, Vedlitz & Shi, 2014).

Often associated with the debate on measuring public perceptions of fracking is how the public, media, and the government frame energy debates. Energy projects are often framed by media and politicians according as a tradeoff between economic benefits and environmental risks. Others

extol the economic and political values of fracking (and natural gas) in comparison to nuclear, coal, oil, and renewables, and some view fracking as an energy issue rather than an environmental issue (Truelove, 2012; Davis & Fisk, 2014). A broader body of research suggests that media play a strong role in framing issues, presenting topics using overarching frameworks that serve to anchor how the public ought to understand a topic (Axsen, 2014; Luhmann, 1989; Shen, Ahern & Baker, 2014; Stephans et al., 2009). Fracking mechanics and techniques have already garnered negative attention, leading researchers to hypothesize that media framing effects in the media elicit more negative "top-of-mind" associations (Clarke et al., 2015).

Additionally, psychographic antecedents such as values, attitudes, environmental concern, and worldviews influence the public's perception of environmental issues (although little research has divulged how these factors influence support or opposition to fracking). As Devine-Wright (2011) stated, focusing on public perceptions is insightful, but does not provide information regarding the values and worldviews that shape these perceptions. Huijts, Molin, Steg (2012) focused on the role of the public's belief system and how beliefs shaped by values can affect their environmental concern, finding that individual's perceptions or beliefs about the benefits and risks of a project are typically important predictors of acceptance or opposition. Respondents with strong environmental attitudes or high NEP scores also exhibited more positive perceptions or higher perceived utility of green products (Lin & Huang, 2012; Biswas & Roy, 2015). Additionally, Ajzen et al., (2011) found that a strong association between knowledge about the environment in general and the specific behavioral category of energy conservation is not expected and that a better predictor of energy initiative attitudes stems from the theory of planned behavior (i.e., attitudes, subjective norms, and perceptions of control with respect to conserving energy).

RESEARCH JUSTIFICATION

Research appears to be lacking in what specific factors are prioritized in shaping the public's perceptions or frame the discourse of objection to fracking. According to Ellis, Barr & Robinson (2007), existing literature on public perception of another energy source, wind, tends to provide descriptive rather than explanatory information, which limits its contribution to the public policy debate. The research on public perceptions of fracking suffer from the same limitations (Jacquet, 2012; Brasier et al., 2013; Boudet et al., 2014; Davis & Fisk, 2014). Q-methodology researchers attribute the low explanatory power of past studies to a heavy reliance on positivists' methods, which, they argue, are inadequate in dealing with subjective, value-based, contentious topics such as fracking (Durning, 1999). Durning (1999) has highlighted two key consequences of the heavy reliance on the positivist approach (1) offers poor analysis of complex issues; and (2) by wielding complex quantitative methods over the insights of ordinary citizens, it tends to prioritize the knowledge of experts and researchers above more socially-derived explanations. Positivist attitudinal research that examine controversial topics seems to lack the ability to progress the debate beyond entrenched positions of support or oppose. Analysis of opposition of energy initiatives such as fracking has led to projection of monolithic notions that inadequately explains local fracking intricacies nor understands environmental issues with a holistic approach, and instead focuses on objectors as the key obstacle (Pendall 1999; Smith & Marquez 2000; Ellis, Barr & Robinson, 2007).

Research that can dissect the standard opposition opinions that tend to frame fracking disputes can offer profound insights for policy development and local governance. Cognizant of this, the present study explores the latent and embedded frames or themes underlying people's objection to fracking. As such, research that can provide a deeper theoretical framework with a valid conceptual foundation and methodological diversity instead of dependence on describing perceptions of fracking rather than explaining them, are in order (Ellis, Barr & Robinson, 2007).

Q-methodology can be employed to respond to this research gap. The use of Q-methodology to explore fracking opposition "can bridge the divide between traditional (or positivists) and post-positivists approaches to policy research (Durning 1999; Ellis, Barr & Robinson, 2007). In this study, Q-methodology will be applied to explore public opposition to fracking, in hopes to "inductively elicit individuals' understanding of a topic in a way that allows their concerns to

define the axes along which they are compared…and the analysis identifies shared and contested attitudes about a topic along these axes, thus revealing insights typically inaccessible via survey research" (Neff & Larson, 2014, p. 4). Additionally, it appears that Q-methodology has not been used for a geographic location in the preliminary stages of fracking development, whilst located within an area heavily involved in fracking (e.g., Pennsylvania).

Q-METHODOLOGY

Q-methodology was developed by psychologist and physicist William Stephenson in the 1930s and is intended to study people's own perspectives, meanings, and opinions (Previte, Pini, & Haslam-McKenzie, 2007). Q-methodology involves collecting opinion data from participants' points of view on a subjective topic. Based on the various points of view, the opinions are clustered based on similar perspectives and Q-sorts (Bartlett & DeWeese, 2014). The purpose is to uncover shared opinions or overarching themes that may assist in understanding the complexity and subjectivity of a topic (Bartlett & DeWeese, 2014). Q-methodology's systematic approach is often used to understand the complexities public perceptions about environmental issues and conservation policies and practices (Mattson et al., 2011; Previte, Pini, & Haslam-McKenzie, 2007; Rastogi et al., 2013). Q-methodology can identify and differentiate environmental attitudes for clusters of people and is well suited in studying the intricacies and distinct configurations of certain populations regarding debatable issues (Danielson, 2009; Venables et al., 2009; Pruslow & Owl, 2012). Q-methodology enables researchers to initially develop research objectives rather than hypotheses because Q-methodology is a technique "that neither tests its participants nor imposes meaning a priori; rather, the meaning and significance of generated profiles in Q-methodology are attributed a posteriori through interpretation" (Stainton, 1995, p. 185). One of its strengths is that it allows participants to define their own subjectivity and perspectives on a particular topic void of the often intended goal of generalizing to a larger population (Danielson, 2009; Bartlett & DeWeese, 2014). Unlike traditional surveys, Q-methodology reveals typologies of shared subjective perceptions and does not aim to predict the population statistics (Barlett & DeWeese, 2014).

The steps of Q-methodology include: (1) defining the concourse, (2) developing the Q-set, (3) selecting the P-set, (4) conducting the Q-sort, (5) conducting statistical analysis and presenting the results, and (6) discussion.

Defining the Concourse

The concourse is an exhaustive list of statements that describe varying perspectives on a specific topic. These statements include opinion statements and attitude complexities collected from mainstream media, relevant documents, peer reviewed literature, articles, commentaries, local

news stories, and interviews, among other sources (Previte, Pini, & Haslam-McKenzie, 2007). This broad and comprehensive collection of statements fully encompasses the range of beliefs, attitudes, worldviews, and values of the public to ensure that all potential perspectives, opinions, and themes on a topic are fully covered (Previte, Pini, & Haslam-McKenzie, 2007). Q-methodology assumes that opinions are subjective and can be shared, measured, and compared (Stainton, 1995). Next, the statements are compiled into categories based on overall themes relevant to the topic (Bartlett & DeWeese, 2014).

Developing the Q-set

Developing the Q-set entails refining the concourse into a set of statements (typically 30-50) that participants sort to describe their perspectives about a topic (Bartlett & DeWeese, 2014; Van Exel & De Graaf, 2005). The concourse statements are categorized into naturally evolving themes on the topic that are used as a framework for the study (Previte, Pini, & Haslam-McKenzie, 2007; Bartlett & DeWeese, 2014). Selecting the statements from the concourse for inclusion in the Q-set is 'more of an art than a science' (Van Exel & De Graaf, 2005). The final Q-set is determined by deleting repetitive or confusing statements while maintaining a broad representation of the topic (Barlett & DeWeese, 2014; Van Exel & De Graaf, 2005). The editing process is often completed by performing a pilot study or through random elimination (Barlett & DeWeese, 2014). The subjectivity of this process does not limit the findings, as comparative studies indicate that different sets of statements structured in different ways ultimately reach the same conclusions (Van Exel & De Graaf, 2005).

Selecting the P-set

The P-set refers to the study's set of participants. Studies that employ Q-methodology require a limited number of respondents; the P-set is typically smaller than the Q-set (Van Exel & De Graaf, 2005). The standard sampling procedure in Q-methodology is to gather perspectives considered to have distinctive, influential, and dominant points of view (Venables et al., 2009). Q-methodology participant selection is not random, but rather, the researcher purposively seeks out specific clusters of participants whose knowledge about the topic is comprehensive, enabling insights and subjectivities of the topic from people who may have the most impact and are theoretically relevant to the topic (Van Exel & De Graaf, 2005; Danielson, 2009). Q-methodology emphasizes individual subjectivity of specific populations, rather than pre-defined demographic characteristics typical of

traditional surveys. Traditional positivists sampling techniques aim to generalize from the sample set to certain larger populations. This is not relevant to Q-methodology because the process is more akin to the purposeful or strategic sampling characteristic of qualitative research (Stenner & Marshall, 1995). The number of participants associated with a factor is of less importance than who these participants are (Van Exel & De Graaf, 2005).

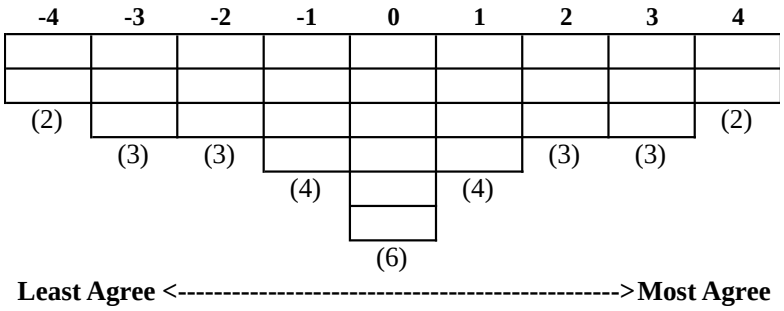
Conducting the Q-sort

The completed Q-set statements are provided to participants on flash cards, or in an online format, as "hypothetical" cards, each containing one statement (Brown, 1993; Van Exel & De Graaf, 2005). For an online sort, an emailed link can be sent that directs the participant to the study's webpage (Barlett & DeWeese, 2014). The participant is instructed to read through all the statements carefully and to roughly sort the statements according to a prompt from the researcher into three piles-agree, disagree, or no strong opinion-according to a prompt from the researcher (Brown, 1993; Van Exel & De Graaf, 2005). This initial sort into the three categories allows the participant to become accustomed to the sorting methodology and form an impression of the content and range of statements (Brown, 1993; Van Exel & De Graaf, 2005). At completion of the initial sort, the iterative process continues and the participants are instructed to sort the same statements, relevant to the same provided prompt, across a continuum ranging from most agree to most disagree across a quasi-normal distribution (Brown, 1993; Van Exel & De Graaf, 2005), similar to that shown in Figure 1.

Figure 1 depicts a conceptual sample of a Q-sort quasi-normal distribution with a total of 30 items. There is room for two statements rated the highest (+4) and two statements rated lowest (-4). The distribution must be completed fully to match the number of statements from the Q-set (Barlett & DeWeese, 2014). The researcher chooses the structure of the quasi-normal distribution based on the number of statements and the extent to which the topic is deemed controversial (Brown, 1993; Van Exel & De Graaf, 2005). Especially salient and impactful topics require a flatter distribution structure to provide room for pointed opinions (Brown, 1993; Van Exel & De Graaf, 2005). This process allows participants to compare each statement with one another and base their sorting of the statements on personal experience (Barlett & DeWeese, 2014). The Q-set remains accessible to the participants who have the freedom to move items during the sorting process, until they are satisfied with their decision, and conclude their sort, or submit their sort online (Barlett &

DeWeese, 2014). The Q-sort is often followed by an interview to discuss why the participant chose to place certain statements at the extreme ends of the spectrum (Brown, 1993; Van Exel & De Graaf, 2005). Although Q-methodology studies are often conducted in face-to-face settings, research shows the results of online and mailed studies were highly congruent with in-person interviews (Brown, 1993; Van Exel & De Graaf, 2005).

Figure 1. Example of a typical Q-sort quasi-normal distribution with the number of statements allowed (number in parentheses) within each score classification (number at the top).



Results and Statistical Analysis

Q-methodology requires the conduct of a factor analysis to measure the attitudinal patterns related to a topic (Barlett & DeWeese, 2014). Typically, Q-methodology factor analysis uses either the Centroid or Principal Component Analysis (PCA) method (Barlet & DeWeese, 2014). Several software programs are available specifically tailored to Q-methodology analysis; thus, only a brief explanation of the procedure that it entails will be provided (Barlett & DeWeese, 2014).

First, the correlation matrix of all completed Q-sorts is calculated to represent the level of agreement and disagreement between all individual sorts (Van Exel & De Graaf, 2005). The correlations between Q-sorts does not represent significant data, because Q-methodology is not concerned about how closely individual participants correlate, but rather the group in its entirety. This correlation matrix is analyzed in an attempt to identify factors or natural groupings of Q-sorts due to their similarity or dissimilarity with one another (Van Exel & De Graaf, 2005). Factor extraction unearths existing relationships between sorters, and sorters with similar viewpoints will maintain high correlations and share the same factor (Barlett & DeWeese, 2014). The number of factors for a study is dependent upon the variability in the Q-sorts and the inclusion and exclusion

variables utilized by the researcher, such as eigenvalues, percent variability, and number of Q-sorts loaded per factor (Barlett & DeWeese, 2014; Van Exel & De Graaf, 2005). It is recommended to "take along more than the number of factors that is anticipated in the next step of the analysis–factor rotation–to preserve as much of the variance as possible" (Van Exel & De Graaf, 2005, p. 8).

The extracted factors are then rotated to arrive at a final set of factors (Van Exel & De Graaf, 2005). The rotation maximizes the correlation of each Q-sort with a particular factor (O'Leary, Riskin, & Wobbrock, 2013). Factor rotation is performed either objectively (varimax) or theoretically (hand) (Barlett & DeWeese, 2014). Rotating the factors allows the researcher to examine the data from varying perspectives (Barlett & DeWeese, 2014). According to Van Exel & De Graaf (2005), "rotation does not affect the consistency in sentiment throughout individual Q-sorts or the relationships between Q-sorts; it only shifts the perspective from which they are observed" (p. 9). After rotation, a factor loading is determined for each Q-sort (a process called "flagging"), expressing the extent to which each Q-sort is associated with each factor (Barlett & DeWeese, 2014; Van Exel & De Graaf, 2005). The final factors represent the weighted average Q-sort of clusters of individuals with points of views highly correlated with each other (Van Exel & De Graaf, 2005). The factors produced thus represent groupings of participants with similar patterns of sorting, and the loading of participants on a given factor indicates their level of agreement (Thomas & Watson, 2002).

Some Q-sorts contribute more to defining a factor than others; thus, they have a higher "loading" on that factor (O'Leary, Riskin, & Wobbrock, 2013). The correlation of each Q-sort with a specific factor is given by the factor loadings that range from -1 to +1 (O'Leary, Riskin, & Wobbrock, 2013). Factor loadings of each Q-sort are used to determine Z-scores and the factor scores for each statement in the Q-set (Van Exel & De Graaf, 2005; O'Leary, Riskin, & Wobbrock, 2013). Z-scores are the normalized weighted average statement score of participants that define a specific factor (i.e., relative to zero representing the "neutral" position in the Q-sort procedure) (Van Exel & De Graaf, 2005; O'Leary, Riskin, & Wobbrock, 2013). Based on the Z-scores, Q-statements can be attributed to the original quasi-normal distribution (factor score), resulting in an idealized Q-sort of each final factor (Van Exel & De Graaf, 2005). This idealized Q-sort represents how a hypothetical participant with 100% loading on a specific factor would have sorted her/his

statements in the Q-sort (Van Exel & De Graaf, 2005). The idealized Q-sort for each factor provides a rich source of information regarding the tensions, contradictions, and convictions within and between factors (O'Leary, Riskin, & Wobbrock, 2013).

The Z-scores for each idealized Q-sort are compared statistically (difference scores) to reveal distinguishing and consensual statements between factors at significance levels of $p < .01$ and $p < .05$ (O'Leary, Riskin, & Wobbrock, 2013). A statement is said to be distinguishing for a factor if it ranks in a position that is significantly different from where other factors ranked it (Van Exel & De Graaf, 2005).

Discussion

The qualitative and interpretive element of Q-methodology involves the construction of idealized accounts that represent the viewpoint expressed by each factor. Typically, the extreme end statements of the idealized sort produce a description of each factor's point of view. The consensus and distinctive statements aid in highlighting the differences and similarities between factors, and the reasons participants gave for sorting statements on the extreme ends of the distribution aids in generating a narrative description of the dominant viewpoints represented by the factors (Van Exel & De Graaf, 2005). However, emphasis must be placed on a holistic and thorough interpretation of the factors, and the final product should account for the entire configuration captured by the factors (Watts & Stenner, 2005). The interrelationships of the statements within each factor drive the holistic interpretation as individual statements in the idealized factor configuration have been placed at a ranking for a reason (Watts & Stenner, 2005). A crib sheet system for each factor will aid in achieving holistic interpretation with the ability to identify statements of potential importance in each factor ranked towards the center of the distribution (Watts & Stenner, 2005). The crib sheet method isolates polarizing statements *relative* to other factors and other statements within a factor, and is not meant to isolate the statements for singular attention (Watts & Stenner, 2005). The interpretation of a singular statement is only significant due to its placement relative to other statements and other factors (Watts & Stenner, 2005). The relevant statements are purposely ordered by Q-sorts within each factor to create a specific account of the factor's point of view (Watts & Stenner, 2005). The narrative description summarizes the major points revealed through the statements to produce a bird's eye view of the different accounts produced through the sorting process (Stainton-Rogers, Havey, & Ash, 1989).

METHODS

Defining the Concourse

In the present study, defining the concourse began with a thorough literature and local media coverage review of fracking, fracking opposition, and environmental attitudes and opinions related to fracking. The concourse statements were collected from a range of sources, including local blogs, newspaper articles and comments sections, op-eds, government statements, press releases, and research articles. An extensive review of the discourse surrounding public opposition to fracking generally denoted six themes indicative of the public's fracking opposition. The themes included (1) environmental hazards; (2) health; (3) economic/local considerations; (4) NIMBY attitude/property rights; (5) fossil fuel/climate change perceptions; and (6) trust in stakeholders/government. Development of the concourse concluded when the varying perspectives and themes to fracking opposition were exhaustively covered, aided by faculty consultation. Some statements were modified for clarity and/or brevity, to form complete sentences, to remove colorful language, and to effect other improvements. However, the goal was to maintain as much opinion statement originality as possible. For example, the statement "Drill cuttings coming up are highly radioactive and cancer rates have tripled in drilling areas" was altered to "Waste coming from fracking sites are highly radioactive and cancer rates have tripled in fracking areas". The final concourse was composed of 108 statements from 32 different sources (see Appendix A).

Q-set

To develop the Q-set, each concourse statement was thematically coded into the six overarching themes, based on a reasonable assessment and interpretation of each statement. For example, the statement "Fracking operations may result in increased erosion, altered chemical cycling, and reduced water levels" was coded under the "environmental hazards" theme. Duplicate and confusing statements were initially eliminated from the concourse. A mock study was conducted with six University of Illinois undergraduate environmental science students. The students were briefed on the research and the methodology. Then, the students were provided with a list of 60 statements and were tasked with providing both oral and written feedback on statement clarity, breadth of coverage on the topic of fracking opposition, and whether they felt the statements were all "sortable" to the provided research prompt. After providing statement feedback, the students conducted a mock Q-sort of 30 statements to assess the method, the sorting task, and the ease or

confusion with the provided prompt and directions. A second statement elimination process resulted from student and professor feedback. Finally, statements were randomly eliminated from each theme to maintain equal statement counts within each theme for a Q-set total of 30 statements. The final Q-set was independently checked to ensure balance, breadth, and applicability to fracking opposition. Appendix B lists the final Q-set statements.

P-set

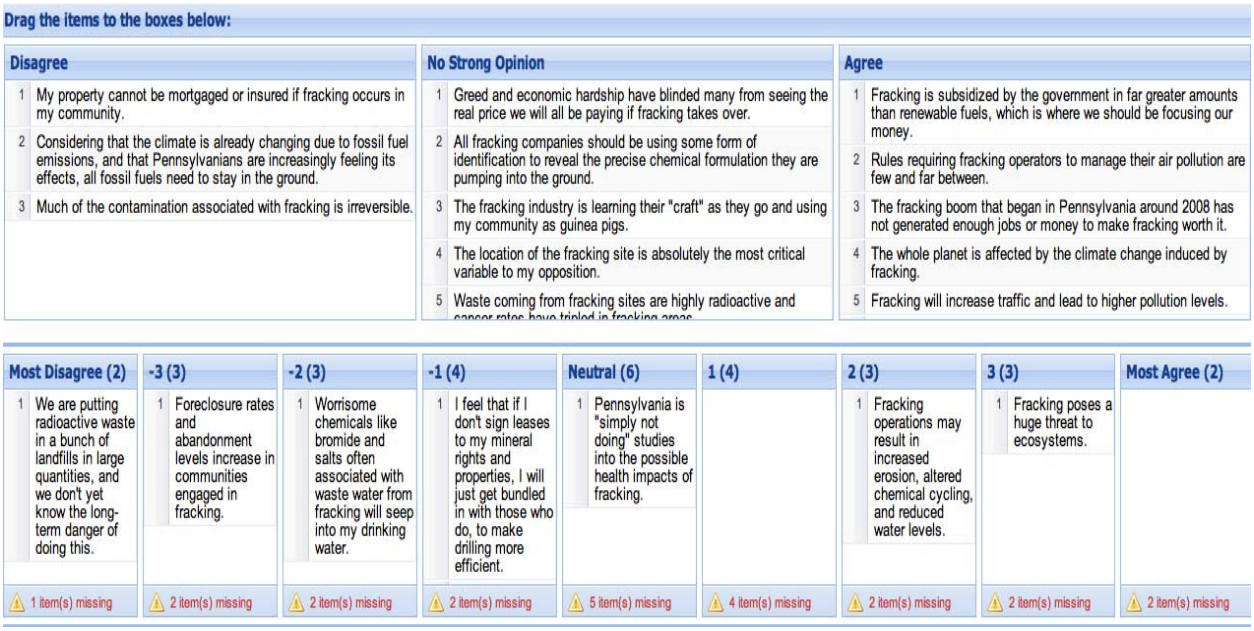
The selected participant requirements were being 18 years of age or older and active involvement in fracking opposition movements. Active involvement was defined by participation in fracking opposition meetings or membership in a fracking opposition group. A range of stakeholder interests were represented by including protest organizations, health officials, environmentalists, citizens, and residents of both affected and unaffected regions. In this study, 23 participants produced usable completed Q-sorts and six produced partial or incomplete Q-sorts that were unusable. The 23 completed Q-sorts came from seven males and 16 females with an average age of 47 years. All participants were white.

Q-sort

Participants were invited via an emailed website link to complete the Q-sort online. The Q-sorts were administered via a free online program called Q-Sortware (Pruneddu, 2012) that simulates physical Q-methodology "flash card" settings using a drag-and-drop interface. Before beginning the Q-sort, the participants were provided the following general directions: "There are two parts to this study, which together should take no more than 30 minutes to complete. In the first part (Initial Sort), you will be asked to do a general sort of statements by placing them in one of three categories: Agree, Disagree, or No Strong Opinion. In the second part (Main Sort), you will sort the statements across a continuum of nine categories from Most Agree to Most Disagree." On the screen with the Q-statements, specific instructions read as follows: "Please read each statement carefully and drag into one of three boxes (Agree, Disagree, or No Strong Opinion) based on their importance to your opposition to fracking. There are 30 statements that can be placed in any box. If you want to change or move a statement to a different box, you can drag it from one box to another. Just to be clear, we are interested in your point of view; therefore, there are no right or wrong answers." In the Initial Sort, the randomized statements were projected on the computer screen individually (i.e., not a list of 30), and only after dragging the projected statement into one

of the three boxes did another statement appear. Statements remained visible after being categorized and can be re-sorted and dragged to different boxes if the participant so desired. This Initial Sort allowed the participants to compare each statement with one another, become familiar with the content of the statements, and gain understanding of the sorting process. After completion of the initial sort into the three categories of Agree, Disagree, and No Strong Opinion, the same statements were sorted along a scale ranging from –4 to +4 (the Main Sort), with a fixed number of statements allowed in each category. Participants were directed to: "Please sort the same statements from your Initial sort into the nine boxes that range from Most Disagree to Most Agree based on their importance to your opposition to fracking." Figure 2 displays a screen shot of the online Q-sort quasi-normal distribution resulting from the Main Sort.

Figure 2. A screen shot of an example of the online Q-sort quasi-normal distribution. The statements in the three boxes at the top (Disagree, No Strong Opinion, and Agree), resulting from the Initial Sort, are dragged into the nine boxes below. The number in parentheses at the top of the nine boxes indicates the statement quantity allowance per box.



In a forced distribution such as the example Q-sort shown in Figure 2, only a certain number of statements can be dragged into each box and that number can be found in red at the bottom of each box and in parentheses at the top of each box. If too many items are dragged into a box, a red message will show that too many statements were entered. A statement thus needs to be removed from that box and dragged into a different box. Participants cannot continue to the next page of

the sort until all nine boxes are filled with the correct number of statements and a green checkmark is showing at the bottom. After completing the final Q-sort, participants were asked basic demographic information, including gender, age, ethnicity, and occupation. Such qualitative data are used to better understand the points of view that define each factor (after analysis). Although Q-sorts are often followed by interviews to discuss why participants chose to place certain statements at the extreme ends of the spectrum, the online sorting mode precludes face-to-face interviews. Instead, participants were asked to "Explain why you most agreed with your top 2 statements" and "Explain why you most disagreed with your bottom 2 statements." Finally, using a Likert scale from 1-5 (1=lowest knowledge and lowest opposition and 5=highest knowledge and highest opposition), participants ranked their relative level of personal opposition to fracking and their level of knowledge about the fracking issue.

RESULTS

The online statistical program, PQMethod (Schmolck, 2002) was used to input and analyze the data. After inputting the 23 Q-sorts, the Centroid method was utilized to discover patterns within the data set and identify underlying variables. The Centroid method is the preferred factor analysis method for Q-methodology (Brown, 1993). In the PQMethod, the Centroid method yields seven factors. Determining which factors are kept for rotation and interpretation depends upon the variability in the Q-sorts and the researcher's inclusion and exclusion criteria. For a factor to be included in this study, three criteria were used, (1) the Kaiser Criterion, with eigenvalue >1.0 (eigenvalues are the sum of squared loadings for each factor and represent the variance each factor accounts for); (2) the variance explained criterion, with summed variance >50%; and (3) more than two Q-sorts load significantly (at .05) on a factor. Three of the seven initial factors identified by the Centroid method did not satisfy these criteria.

The remaining four factors were rotated using the Varimax method in the PQMethod program to arrive at the final representation of factors. Rotation is the process of manipulating the reference axes to make the data structure clearer (Zabala & Pascual, 2016). Varimax rotation is strictly mathematical and provides an orthogonal solution that allows each sort to exhibit the highest degree of association with only one factor (Watts & Stenner, 2005). After rotation, factor loading was conducted by the PQMethod program to objectively identify the Q-sorts that significantly loaded on a particular factor.

The extracted four factors represent four distinct groups of like-minded fracking dissenters in central Westmoreland County and account for 58% of the total cumulative variance. Twenty Q-sorts loaded significantly on one of the factors (see bottom of Table 1), three Q-sorts were unclassifiable (i.e., without any significant loading), and no Q-sort loaded on more than one factor. Table 1 depicts the 20 Q-sorts loading on each factor, expressed by the correlation to each idealized factor. The correlation coefficients (factor loadings) illustrate the extent to which the Q-sorts are typical of each factor. For example, Q-sort 9's factor loading of 0.7873 indicates that it occupies a position 78% of the way up the positive pole of Factor 1.

Table 1. Defining sorts loaded on each factor.

	1 Correlation (sort #)	**2** Correlation (sort #)	**3** Correlation (sort #)	**4** Correlation (sort #)
	0.4522 (7)	0.7643 (1)	0.5051 (2)	0.7068 (8)
	0.7873 (9)	0.8023 (3)	-0.6468 (19)	0.6682 (10)
	0.7781 (11)	0.7119 (4)		0.7492 (12)
	0.7551 (14)	0.5219 (16)		0.6699 (13)
	0.5960 (17)			0.6642 (15)
	0.6425 (22)			0.6677 (20)
	0.5933 (23)			0.5710 (21)
No. loadings	7	4	2	7

Each factor is representative of a composite and idealized Q-sort, attributing Q-statements to the original quasi-normal distribution. Table 2 shows the statement scores for each statement across all four factors, demonstrating the diversity and range of statement rankings. For example, statement 13 is ranked on the extreme ends of the rating spectrum: for Factor 2 (+4) and for Factor 1 (-4)

Because of an error in collecting the responses to the two Likert scale questions, “What is your relative level of personal opposition to fracking?” and “How knowledgeable to do you feel about fracking as an issue?”; these two items were excluded from the analysis. The error was due to a technical issue in the downloading capacity of the online program.

Table 2. Statement scores for all four factors.

No	Statement	1	2	3	4
1	My property cannot be mortgaged or insured if fracking occurs in my community.	0	-3	-3	-3
2	Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.	4	-3	4	1
3	Much of the contamination associated with fracking is irreversible.	4	1	3	0
4	We are putting radioactive waste in a bunch of landfills in large quantities, and we don't yet know the long-term danger of doing this.	3	2	1	1
5	Foreclosure rates and abandonment levels increase in communities engaged in fracking.	0	-1	-1	-1
6	Greed and economic hardship have blinded many from seeing the real price we will all be paying if fracking takes over.	3	1	-2	4
7	All fracking companies should be using some form of identification to reveal the precise chemical formulation they are pumping into the ground.	2	2	0	3
8	Worrisome chemicals like bromide and salts often associated with waste water from fracking will seep into my drinking water.	2	0	-2	0
9	People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.	3	4	1	4
10	I feel that if I don’t sign leases to my mineral rights and properties, I will just get bundled in with those who do, to make drilling more efficient.	0	-1	-3	-3
11	Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.	2	-1	2	-1
12	The fracking industry is learning their “craft” as they go and using my community as guinea pigs.	1	0	-2	2
13	The location of the fracking site is absolutely the most critical variable to my opposition.	-4	4	0	-4
14	Waste coming from fracking sites are highly radioactive and cancer rates have tripled in fracking areas.	0	3	0	-2
15	Crime and social disagreement between residents will become worse if fracking enters my community.	-1	1	3	-3
16	The consistently high levels of fracking investment in political contributions and lobbying should worry all Pennsylvanians.	1	0	-3	2
17	Fracking is subsidized by the government in far greater amounts than renewable fuels, which is where we should be focusing our money.	0	-2	0	1
18	Rules requiring fracking operators to manage their air pollution are few and far between.	0	2	1	0
19	Fracking poses a huge threat to ecosystems.	1	-1	-1	3
20	Fracking operations may result in increased erosion, altered chemical cycling, and reduced water levels.	-1	0	-1	1
21	The fracking boom that began in Pennsylvania around 2008 has not generated enough jobs or money to make fracking worth it.	-2	-4	-1	0
22	The whole planet is affected by the climate change induced by fracking.	1	-2	-4	2
23	Fracking will increase traffic and lead to higher pollution levels.	-1	0	1	0
24	Fracking can't be made sustainable; it's an unsustainable energy source.	-2	-2	0	3
25	Fracking operations should be confined to industrial or already built up areas, like near power stations.	-4	3	4	-2
26	I am very fearful that nearby fracking will erode the value of my property.	-3	0	0	-1
27	I don’t trust the fracking companies; they tried to have me sign a legal liability release.	-2	-3	-4	-4
28	The real solution is to ditch fossil fuels entirely.	-3	-4	3	-1
29	People living or working near active fracking wells may be exposed to certain pollutants at higher levels than the Environmental Protection Agency considers safe for lifetime exposure.	-1	3	2	0
30	I am worried about the community impacts of fracking and the increased local demand for housing and medical care.	-3	1	2	-2

DISCUSSION

Crib sheets were composed for all four factors (and the negative correlation of bipolar Factor 3) to guide a comprehensive and holistic interpretation of each factor (Appendix C). The crib sheet method enable researchers to identify statements of potential importance in each factor that are ranked towards the center of the distribution (see middle sections of items ranked higher and lower than other factors) and isolates polarizing statements *relative* to other factors and other statements within a factor. In the following factor descriptions, Q-statements are referred to in parentheses, (e.g. s 20), statements marked with an asterisk (*) are significant at $p < .01$, and statements marked with a number or pound sign (#) are significant at $p < .05$. Embedded within the factor descriptions are quotes from the factor advocates (participants who loaded on a factor) about why they personally sorted statements in a certain order.

Factor discussions are presented in order of least to greatest study variance.

Factor 4: Distrust Stakeholders and Turn toward Renewables

Demographic summary: Factor 4 explains 7% of the study variance and has an eigenvalue of 1.58. Seven participants loaded significantly on this factor, four are women and three are men. All seven are white. Ages range from 26 to 66, with a mean of 48 years.

Factor 4 is represented by a resolutely anti-fracking sentiment, framed by a deep distrust for the fracking industry and a desire to counter global climate and environmental contamination with a campaign for renewable energy sources. Factor 4 believes that fracking as an energy source is unsustainable (s 24) and is contributing to climate change and environmental degradation (s 22#; s 2#; s 19*; s 20*). Factor 4 rated environmental degradation and concern for climate change statements (s 19*; s 20*; s 22#) higher than any other factor. Similar to Factors 1 and 3, the location of fracking sites were irrelevant to those who fall under this factor (s 13; s 25*). As one advocate explained, “location does not minimize the overall impact fracking has on the environment and climate change” and another insisted that “fracking should not be confined to any area on the planet.” In this sense, compared to Factor 2 (NIMBY), Factor 4 sees natural gas from fracking as less than a bridge fuel because “the methane emissions more than negate the fact that gas burns cleaner than coal.” However, an understanding that fossil fuels cannot be immediately avoided (s 28#) was ranked higher than expected. A strong desire (more than all other factors) to promote

renewable energy sources was evident (s 17). Fracking investments and subsidies from governments are stifling investment in renewables. According to one advocate, "Renewables would reduce the need for dirty fossil fuels." The desire to transition to renewables is exacerbated by a deep distrust for the fracking industry, with a belief that greed is blinding stakeholders from the real effects of fracking (s 6). One advocate explained, the fracking industry is "externalizing the environmental costs to the public while enriching the few." Factor 4 expresses wariness over corruption in industry and government (s 16), a level of skepticism over industry's intentions (s 12), and a negative opinion of fracking companies' public emissions identification tactics (s 7). As one advocate stressed, "Companies need to be held responsible for their actions." With the exception of s 9, Factor 4 expresses less local concern with health, property, legal, or community impacts (s 14#, s 4, s 27, s 15*, s 1, s 10, s 5) and a more general focus on global consequences, a desire to tackle climate change, a distrust in energy stakeholders, and a strong call to mobilize renewables.

Factor 3: Community Concerns

Demographic summary: Factor 3 explains 7% of the study variance and has an eigenvalue of 1.58. Two participants loaded significantly on this factor, both are women and white. Ages range from 34 to 42, with a mean of 38 years.

Factor 3 contains Q-sort loadings with positive and negative correlations and is defined as a bipolar factor with "exemplar Q-sorts positioned near to both their poles" (Watts & Stenner, 2005). A second narrative of the negative pole viewpoint is achieved through interpretation of a factor array that is the mirror image of the positive viewpoint (Watts & Stenner, 2005). For example, in Factor 3 (+), statements 2 and 25 have a ranking of +4 and for Factor 3 (-), those statements would inversely have a ranking of -4. The whole array is simply turned back-to-front manually and interpreted a second time (Watts & Stenner, 2005). The essence of a bipolar factor is two distinct but connected viewpoints (Watts & Stenner, 2005). Considering Factor 3(-) was manually analyzed, no statistically significant statements were calculated.

Factor 3 (+):

Factor 3 (+) is represented by pointed concerns for community and societal effects directly attributed to fracking, as compared to indirectly for Factor 3 (-). The discourse (+) believes

fracking is a purely industrial process (s 25); however, the location of wells are not of pressing concern to this factor (s 13*) because of a desire to completely eradicate fracking and fossil fuel consumption (s 2; s 28*). Even with a goal to eliminate all fossil fuels, specific fracking opposition is grounded in concerns about negative communal and social effects in fracking communities (more than any other factor), such as crime and social disagreement between and among residents (s 15), an increased demand for housing and medical care (s 30), and an increase in local traffic and subsequent pollution levels (s 23). Within the broader discourse of community and social effects, advocates (+) are decidedly less worried about a financial disruption (unlike Factor 3 (-)) by people abandoning the community (s 5) or loss of home insurance or home worth (s 1). Factor 3 (+) is unyielding in understanding that people maintain some personal power over their land and against the legal pressures fracking companies exert in Pennsylvania (s 10; s 27). Factor 3 (+) demonstrates knowledge of Pennsylvania-specific legality, as one advocate explained "PA doesn't have forced pooling of the Marcellus" and "I don't own mineral rights and I wouldn't sign a lease even if I did." Unlike all other factors, the discourse (+) believes stakeholders are not blind to the real impacts of fracking because of greed; however, there is still a sense that fracking "will continue as long as there is money to be made." The more communal and social concern of Factor 3 (+) is evidenced by a lesser degree of concern about health and environmental impacts (s 4; s 9#; s 7; s 8#; s 19). In direct opposition to Factor 3 (-), Factor 3 (+) is more apathetic and places less emphasis on trustworthiness and potential corruption of politicians and the fracking industry (s 16*; s 7; s 12). As Factor 3 (+) appears to oppose fracking due to the direct fracking impacts of the process on the community, Factor 3 (-) appears to oppose fracking due to more indirect fracking and financial impacts, particularly those stemming from stakeholder corruption.

Factor 3 (-):

Fracking 3 (-) is represented by pointed concerns about community and societal effects indirectly attributed to fracking, and more directly attributed to distrust in decision makers. The discourse (-) is acutely concerned with fracking-induced climate change (s 22) and the desire to completely eradicate fracking everywhere (s 25). One advocate (-) explained, "I believe that fracking is dangerous in any environment…if an area is zoned for industrial use, it's [sic] environment has already been gravely altered." Similar to Factor 3 (+), specific fracking opposition originates from negative communal and social effects on fracking communities; however, in comparison to Factor

3 (+), which emphasizes community solidarity opposition, Factor 3 (-) emphasizes personal worry about property rights and a keen distrust in industry stakeholders. Factor 3 (-) believes more than any other factor that the fracking boom has not brought an economic or job boost to Pennsylvania (s 21). As such, there appears to be more of a financial concern, compared to Factor 3 (+), with the transient nature of the fracking industry, its ability to disrupt local communities, and the potential emergence of fracking in local communities. The discourse harbors concerns about potential foreclosures, home insurances collapses, and property and mineral rights (s 5; s 1; s 10; s 27). This discourse retains a potent worry that property or mineral rights could be stolen from residents (s 27; s 10). This financial and personal concern originates from a deep distrust of politicians and industry stakeholders (s 27; s 10). Advocates (-) believe the fracking industry is too immature to "test out" fracking standards on local communities (s 12) and vehemently opposes campaign contributions and corresponding favors (s 16). The financial and trustworthy concern of Factor 3 (-) is evidenced (similar to Factor 3 (+)) by a lesser degree of concern for health and environmental impacts (s 4; s 9; s 23; s 29).

Factor 2: Local Resistor

Demographic summary: Factor 2 explains 12% of the study variance and has an eigenvalue of 2.58. Four participants loaded significantly on this factor; three women and one man. All four are white. Ages range from 43 to 54, with a mean of 47 years.

Factor 2 is represented by a distinctly NIMBY attitude resolutely against fracking due to well locations (s 13*). Advocates are "not against drilling in remote areas", but demand that fracking be confined to areas already zoned to guard against hazards (s 25). Fracking can be a thriving and sustainable energy choice (s 24) and advocates even believe that Pennsylvania's recent fracking boom has been successful for the local economy and job growth (s 21). As a defined NIMBY dissenter, there is an understanding that all fossil fuels cannot be entirely abolished (s 2*; s 28*). As such, Factor 2 does not represent a staunch campaign for renewable energy sources (s 17*), nor is it worried about climate change triggered by fossil fuel consumption (s 22). Factor 2 represents a very personal desire to "remove fracking from residential communities", due to health concerns, such as fear for cancer, birth defects, and the "unseen" pollutants emitted from fracking sites (s 9; s 14; s 29). The discourse acknowledges that Pennsylvania is conducting studies measuring the health impacts of fracking (s 11); however, advocates of this factor think that the fracking

companies are not truthfully disclosing their techniques and the chemicals they use (s 7; s 18) and that "elected officials are not listening or heeding the advice of medical professionals." Greed is blinding representatives (s 6*) "at the expense of the communities health and welfare", an advocate of this factor stressed. As a representation of a passionate and often first-hand opposition to fracking, the discourse places little emphasis on concern for environmental, social, or property effects (s 5; s 19; s1). Factor 2 appears to embody the position of fracking opposition advocates who are embroiled in personal and currently active "backyard" controversies. According to one advocate, "I live in a residential community and have experienced effects of fracking…I am concerned about the risks to me and my family", and another advocate explained "I built my home only to have frackers barge into my community and set up a well pad literally in my front yard."

Factor 1: Future Fears

Demographic summary: Factor 1 explains 32% of the study variance and has an eigenvalue of 7.47. Seven participants loaded significantly on this factor; four women and three men. All seven are white. Ages range from 23 to 72, with a mean of 50 years.

Factor 1 is represented by a more general attitude opposed to fracking with the greatest importance placed on fears for the future of climate change, and future health calamities from current fracking practices. Factor 1 explains 32% of the study variance (much more than any other factor); therefore, a more general dissent is expected. Similar to Factors 3 and 4, the location of the fracking sites was irrelevant in this factor's opposition to fracking (s 13; s 25*) because of a belief that contamination due to fracking and the contribution of fracking to climate change will be irreversible in the future (s 3; s 8#; s 22#). One advocate worries, "we are getting to the point of no return on climate change" while another explained that "what we visually see does not reveal what is occurring below the surface…we are all connected and on one planet, what we do or what is done on the other side of the world affects ALL OF US!" However, environmental concern did not extend to statements on erosion, altered chemical cycles, traffic and subsequent pollution, or ecosystem decline (s 20; s 23*; s 29#). As an advocate explained, "Yes, immediate exposure to physical sound, lights, and dangers in addition to chemicals is a critical problem…however…as the pipes and concrete deteriorate over time, we will be exposed to air, water, and land contamination for an undetermined amount of time in the future." Although Factor 1 opposes fracking, it appears to suffer from an internal conflict with future energy choices. The desire to

eliminate fossil fuels as the solution to current fracking apprehensions or climate change contributions is not ranked as high as would be expected for this factor (s 28#). The discourse even acknowledges that fracking could eventually be made sustainable (s 24). This internal conflict can be explained by future-oriented reservations and a fear of the unknown about the relatively new fracking technology. One advocate explained that, "decisions are being made that only deal with the current energy needs and short term profits…These decisions should also consider the long-term energy needs, profits, and consequence of what we really need, which is not just energy…Energy is required for today's lifestyle, but is not being pursued in a way that does not degrade the rest of the standard of living." As such, Factor 1 placed the greatest value on the long-term health impacts of radioactive waste (s 4#), groundwater contamination (s 18#), cancer and birth defects (s 9), a lack of health impact studies (s 11), and a succinct fear that today's greedy practices come at the expense of sacrificing the future (s 6). One advocate explained, "just because we can't necessarily see the damages, we do not know what is going on under the surface and the repercussions of our actions" and epitomized the future fears explaining "there is no way to calculate how a baby raised on this exposure will be affected throughout there [sic] life."

CONCLUSION

Fracking is a nationally controversial energy issue that is poignantly relevant to the Marcellus Shale-rich state of Pennsylvania. Q-methodology was implemented to explore the themes and sub-discourses of opposition to fracking in an effort to elevate the level of the fracking debate beyond entrenched positions of support or oppose. Understanding the distinguishing reasons behind the opposition to fracking within central Westmoreland County can assist local governments and policy-makers in determining specific policy objectives and empirical data upon which to base future fracking campaigns. Knowing the subjective attributes of the community on fracking opposition aid all parties with future collaboration and identifying potential areas for successful negotiation. Q-methodology aids in analyzing the types of attitudes, values, convictions, and beliefs that combine with well-defined fracking viewpoints or sub-discourses (i.e. factors). The results of this Q-methodology study can be useful for facilitating methods of settling disputes. For example, fracking companies attempting to zone areas for fracking can alleviate local concerns by focusing their campaign on the tangible opposition sentiments inherent to the community. Similarly, fracking opposition groups can narrow their efforts to oppose fracking legislation by prioritizing their arguments and protests with factor-specific narratives, rather than the entrenched anti-fracking viewpoint. This entrenched viewpoint is typical of traditional positivist's research and contributes to the impasse in understanding the public's deeper perceptions of environmental issues (Ellis, Barr, & Robinson, 2007). Local government decision makers can incorporate the sentiments of their constituents by developing clauses in fracking companies' contracts that consolidate the factors' viewpoints and assuage strong concerns of the community. The factors that emerged in this study reinforce the need for government to provide transparent and open dialogue on fracking.

The conflicts that emerge across the four extracted factors are indicative of deeper discourse within the fracking debate and signify diversity in motivations and worries behind the fracking opposition. The disparity across factors indicate fundamental disagreement over core fracking processes, stakeholder decisions, and the future of fracking. Perhaps most evident to this disparity is the absence of statistically significant consensus statements, revealing a lack of a common foundation to build a fracking management strategy. The factor's values in conflict suggest the inability for a successful institutional response. The four factors and the differences between them

represent how future controversial and environmental conflicts will emerge in public dialogue. Q-methodology's clustering of similar beliefs has significant advantages in the current context of fracking policy by identifying dominant groups who define opposition priorities.

This study has generated insights about the origins and the nature of voices that are opposed to fracking. Unlike traditional surveys, Q-methodology was successful in exposing the latent dispositions within a group with broader agreement (i.e. fracking opposition). The discrepancies disclosed nuanced views, rather than a general unidimensional attitude in fracking opposition. This study focused on the perspectives of those specifically opposed to fracking because, "the less complicated nature of objection has come to implicitly and explicitly mold the dominant policy responses, with the result being unsuccessful" (Ellis, Barr & Robinson, 2007, p. 540). Ellis, Barr, & Robinson (2007) note that a fundamental shift in environmental research questions and frames applied to the human dimension of policy issues is necessary to optimize the utility of Q-methodology in creating successful public policy. Applicable policy approaches will demonstrate different impacts given the variation in interests across the four factors. For example, policy leading to rural-specific fracking in Westmoreland County will likely alleviate the concerns for Factor 2. Increased education on regional fracking politics and the absence of forced pooling in Pennsylvania may temper the opposition of Factor 3 (-). Nevertheless, anything short of sustainable and renewable energy policy will continue to frustrate and provoke dissension from Factor 4. However contentious the fracking discourse is, and acknowledgement that opposition will continue, a necessary shift in local governments' methods to mediate concern between fracking companies and residents is apparent. The findings of the present study will hopefully contribute to the wider transition in the paradigms identified by Durning (1999) governing policy and settling disputes.

STUDY LIMITATIONS AND SUGGESTIONS FOR FUTURE WORK

Q-methodology factors and results are not generalizable to a larger population; rather, inherent to properties of the method, they are generalizable to a population of statements (O'Leary, Riskin, & Wobbrock, 2013). The statements are generalizable because they are a comprehensive collection of viewpoints representative of a particular topic (in this case, fracking). Due to the forced distribution and pre-determined statements, limitations are fundamentally placed on participant's responses; participants can only "tell a story" with the statements they are provided. Often interviews or focus group discussions can aid in determining the breadth of themes and statements regarding the topic. To reduce this limitation, researchers must be meticulous in developing a comprehensive and representative Q-set. Similar to other surveys, Q-methodology relies on the cooperation and honest responses of participants. Unlike studies that elicit data using Likert-type scales, the number of uncertain responses is limited by the forced distribution in the Q-methodology; however, there remains a risk that participants may sort statements based on how they think the researcher wants them sorted (Cross, 2005).

The inherently subjective and sometimes ambiguous nature of the opinion Q-statements requires researchers to be scrupulous in statement inclusion, analysis, and interpretation. Subjectivity is inevitably involved in interpretation due to the philosophy of Q-methodology, introducing bias. Thus it is incumbent upon researchers to fully explain how they interpreted the resulting factors.

Q-methodology is often criticized because the Q-sorting process is time-consuming and the atypical survey process requires extensive instructions (Watts & Stenner, 2005). The mental effort needed to complete a Q-sort can affect validity if participants' lack of comprehension leads to misrepresentation (Watts & Stenner, 2005). Furthermore, the online format does not offer the opportunity for face-to-face contact, which would allow for instantaneous responses to questions or further explanations as needed. For example, several participants requested further clarification on study intent and software usage via email. In the end, six participants chose not to complete the survey due to potential misunderstandings of the purpose of the concourse, frustration with the online interface, or desiring additional clarification of the study's intent. Despite this constraint, research findings show that the results of online and mailed inquiries were highly congruent with those resulting from in-person interviews (Brown, 1993; Van Exel & De Graaf, 2005). The benefits of the online format include convenience for both the participants and researchers, the ability of

participants to spend as much time as desired on the Q-sort, and the likelihood of more truthful responses due to anonymity.

Future studies may extend the present research by exploring the types of information sources of those who oppose fracking in an effort to better understand the types of sources and influences inherent to people's opposition to fracking. A similar research approach can be used with both pro- and anti-fracking samples to formulate a standard for comparison and reveal prevalent sentiments of support and opposition. Similar research could be conducted comparing townships or counties going through different phases of fracking development, to potentially gauge the progression of attitudinal differences over the evolution of fracking projects. Although little variation in attitude across geographic locations across a region (i.e. western Pennsylvania), is expected, further work could explore wider distributions. Additionally, future studies could assess the extent of opposition to fracking with different methods that would be more generalizable to fracking towns throughout the country.

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Appendix A: Concourse Sources

1. http://myinforms.com/en/a/16463941-allegheny-co8217s-eastern-suburbs-brace-for-fracking/
2. http://pittsburgh.cbslocal.com/2015/09/14/churchill-fracking/
3. http://pittsburgh.cbslocal.com/2014/09/25/deal-approved-to-allow-drilling-in-2-beaver-co-parks/
4. http://triblive.com/neighborhoods/yourallekiskivalley/yourallekiskivalleymore/8937723-74/allegheny-river-drinking#axzz3mVwGJkMW
5. http://triblive.com/news/allegheny/9056168-74/hills-penn-churchill#axzz3mVwGJkMW
6. http://triblive.com/business/headlines/8619983-74/drilling-industry-shale#axzz3fdsr89U1
7. http://triblive.com/business/headlines/8619983-74/drilling-industry-shale#axzz3fdsr89U1; Comments Section
8. http://triblive.com/news/fayette/7916380-74/county-drilling-rules#axzz3mVwGJkMW
9. http://triblive.com/news/westmoreland/7789449-74/township-ordinance-ligonier#axzz3mVwGJkMW
10. http://triblive.com/news/allegheny/7549957-74/wastewater-disposal-shale#axzz3mVwGJkMW
11. http://triblive.com/neighborhoods/yourligonier/7350676-74/township-ordinance-korns#axzz3mVwGJkMW
12. http://westmorelandmarcellus.blogspot.com
13. http://www.post-gazette.com/opinion/letters/2015/04/28/Frackers-talk-a-good-game-in-TV-ads-but-let-s-look-at-reality/stories/201504280084
14. http://www.post-gazette.com/opinion/letters/2015/04/28/Frackers-talk-a-good-game-in-TV-ads-but-let-s-look-at-reality/stories/201504280084; Comments Section
15. http://www.huffingtonpost.com/2014/07/12/pennsylvania-fracking-former-health-secretary_n_5580980.html
16. http://www.huffingtonpost.com/2014/03/31/forced-gas-drilling-law-pennsylvania_n_5062914.html
17. http://www.huffingtonpost.com/2013/10/07/anti-fracking-activists_n_4058056.html
18. http://www.huffingtonpost.com/lynne-peeples/artists-against-fracking-new-york_b_2611237.html
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20. http://www.csuohio.edu/class/sites/csuohio.edu.class/files/media/economics/documents/Sumell%20-%20abstract.pdf
21. http://marcellusdrilling.com/2013/08/nimby-town-to-provide-water-for-fracking-at-pittsburgh-airport/
22. http://www.energyfromshale.org/americas-communities/pennsylvania
23. https://stateimpact.npr.org/pennsylvania/2015/04/02/pipelines-the-new-battleground-over-fracking/
24. https://stateimpact.npr.org/pennsylvania/2015/04/02/pipelines-the-new-battleground-over-fracking/;Comments Section
25. http://www.gracelinks.org/191/natural-gas-fracking-introduction
26. http://www.theenergycollective.com/simonlomax/413776/votes-show-strong-support-colorado-energy-rejection-anti-fracking-activism; Comments Section
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28. http://www.pbs.org/pov/theovernighters/interview.php
29. http://www.post-gazette.com/frontpage/2015/02/10/Colorado-anti-fracking-activists-import-N-Y-strategies/stories/201502100189
30. http://www.denverpost.com/business/ci_28955667/davita-expanding-denver-headquarters-anchor-new-skyscraper?source=infinite
31. http://summitcountyvoice.com/2014/08/02/study-warns-of-widespread-fracking-ecosystem-impacts/
32. http://www.ncbi.nlm.nih.gov/pubmed/25044053

Appendix B: Concourse Statements

1. My property cannot be mortgaged or insured if fracking occurs in my community.
2. Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.
3. Much of the contamination associated with fracking is irreversible.
4. We are putting radioactive waste in a bunch of landfills in large quantities, and we don't yet know the long-term danger of doing this.
5. Foreclosure rates and abandonment levels increase in communities engaged in fracking.
6. Greed and economic hardship have blinded many from seeing the real price we will all be paying if fracking takes over.
7. All fracking companies should be using some form of identification to reveal the precise chemical formulation they are pumping into the ground.
8. Worrisome chemicals like bromide and salts often associated with waste water from fracking will seep into my drinking water.
9. People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.
10. I feel that if I don't sign leases to my mineral rights and properties, I will just get bundled in with those who do, to make drilling more efficient.
11. Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.
12. The fracking industry is learning their "craft" as they go and using my community as guinea pigs.
13. The location of the fracking site is absolutely the most critical variable to my opposition.
14. Waste coming from fracking sites are highly radioactive and cancer rates have tripled in fracking areas.
15. Crime and social disagreement between residents will become worse if fracking enters my community.
16. The consistently high levels of fracking investment in political contributions and lobbying should worry all Pennsylvanians.
17. Fracking is subsidized by the government in far greater amounts than renewable fuels, which is where we should be focusing our money.
18. Rules requiring fracking operators to manage their air pollution are few and far between.
19. Fracking poses a huge threat to ecosystems.
20. Fracking operations may result in increased erosion, altered chemical cycling, and reduced water levels.
21. The fracking boom that began in Pennsylvania around 2008 has not generated enough jobs or money to make fracking worth it.
22. The whole planet is affected by the climate change induced by fracking.
23. Fracking will increase traffic and lead to higher pollution levels.
24. Fracking can't be made sustainable; it's an unsustainable energy source.
25. Fracking operations should be confined to industrial or already built up areas, like near power stations.
26. I am very fearful that nearby fracking will erode the value of my property.
27. I don't trust the fracking companies; they tried to have me sign a legal liability release.
28. The real solution is to ditch fossil fuels entirely.
29. People living or working near active fracking wells may be exposed to certain pollutants at higher levels than the Environmental Protection Agency considers safe for lifetime exposure.
30. I am worried about the community impacts of fracking and the increased local demand for housing and medical care.

Appendix C: Crib Sheets

Appendix C Key: * = p <.01 # = p <.05 (statistical significance)

Factor 1	#	Statement	Rank
Most (+4)	2	Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.	+4
	3	Much of the contamination associated with fracking is irreversible.	+4
Items ranked higher than other factors	4#	We are putting radioactive waste in a bunch of landfills in large quantities, and we don't yet know the long-term danger of doing this.	+3
	8#	Worrisome chemicals like bromide and salts often associated with waste water from fracking will seep into my drinking water.	+2
	11	Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.	+2
	5	Foreclosure rates and abandonment levels increase in communities engaged in fracking.	0
	1*	My property cannot be mortgaged or insured if fracking occurs in my community.	0
	10	I feel that if I don't sign leases to my mineral rights and properties, I will just get bundled in with those who do, to make drilling more efficient.	0
	27	I don't trust the fracking companies; they tried to have me sign a legal liability release.	-2
Items ranked lower than other factors	18	Rules requiring fracking operators to manage their air pollution are few and far between.	0
	20	Fracking operations may result in increased erosion, altered chemical cycling, and reduced water levels.	-1
	23*	Fracking will increase traffic and lead to higher pollution levels.	-1
	29#	People living or working near active fracking wells may be exposed to certain pollutants at higher levels than the Environmental Protection Agency considers safe for lifetime exposure.	-1
	24	Fracking can't be made sustainable; it's an unsustainable energy source.	-2
	26	I am very fearful that nearby fracking will erode the value of my property.	-3
	30	I am worried about the community impacts of fracking and the increased local demand for housing and medical care.	-3
Least (-4)	13	The location of the fracking site is absolutely the most critical variable to my opposition.	-4
	25*	Fracking operations should be confined to industrial or already built up areas, like near power stations.	-4
Other distinguishing statements	22#	The whole planet is affected by the climate change induced by fracking.	+1
	15*	Crime and social disagreement between residents will become worse if fracking enters my community.	-1
	28#	The real solution is to ditch fossil fuels entirely.	-3
	9	People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.	+3
	6	Greed and economic hardship have blinded many from seeing the real price we will all be paying if fracking takes over.	+3

Appendix C: Crib Sheets cont.

Factor 2	#	Statement	Rank
Most (+4)	9	People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.	+4
	13*	The location of the fracking site is absolutely the most critical variable to my opposition.	+4
Items ranked higher than other factors	14	Waste coming from fracking sites are highly radioactive and cancer rates have tripled in fracking areas.	+3
	29	People living or working near active fracking wells may be exposed to certain pollutants at higher levels than the Environmental Protection Agency considers safe for lifetime exposure.	+3
	18	Rules requiring fracking operators to manage their air pollution are few and far between.	+2
	26	I am very fearful that nearby fracking will erode the value of my property.	0
Items ranked lower than other factors	5	Foreclosure rates and abandonment levels increase in communities engaged in fracking.	-1
	11	Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.	-1
	19	Fracking poses a huge threat to ecosystems.	-1
	17*	Fracking is subsidized by the government in far greater amounts than renewable fuels, which is where we should be focusing our money.	-2
	24	Fracking can't be made sustainable; it's an unsustainable energy source.	-2
	1	My property cannot be mortgaged or insured if fracking occurs in my community.	-3
	2*	Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.	-3
Least (-4)	21	The fracking boom that began in Pennsylvania around 2008 has not generated enough jobs or money to make fracking worth it.	-4
	28*	The real solution is to ditch fossil fuels entirely.	-4
Other distinguishing statements	6*	Greed and economic hardship have blinded many from seeing the real price we will all be paying if fracking takes over.	+1
	25	Fracking operations should be confined to industrial or already built up areas, like near power stations.	+3
	22	The whole planet is affected by the climate change induced by fracking.	-2
	7	All fracking companies should be using some form of identification to reveal the precise chemical formulation they are pumping into the ground.	+2

Appendix C: Crib Sheets cont.

Factor 3 (+)	#	Statement	Rank
Most (+4)	2	Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.	+4
	25	Fracking operations should be confined to industrial or already built up areas, like near power stations.	+4
Items ranked higher than other factors	15	Crime and social disagreement between residents will become worse if fracking enters my community.	+3
	28*	The real solution is to ditch fossil fuels entirely.	+3
	11	Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.	+2
	30	I am worried about the community impacts of fracking and the increased local demand for housing and medical care.	+2
	23	Fracking will increase traffic and lead to higher pollution levels.	+1
	26	I am very fearful that nearby fracking will erode the value of my property.	0
Items ranked lower than other factors	4	We are putting radioactive waste in a bunch of landfills in large quantities, and we don't yet know the long-term danger of doing this.	+1
	9#	People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.	+1
	7	All fracking companies should be using some form of identification to reveal the precise chemical formulation they are pumping into the ground.	0
	5	Foreclosure rates and abandonment levels increase in communities engaged in fracking.	-1
	6*	Greed and economic hardship have blinded many from seeing the real price we will all be paying if fracking takes over.	-2
	8#	Worrisome chemicals like bromide and salts often associated with waste water from fracking will seep into my drinking water.	-2
	12#	The fracking industry is learning their “craft” as they go and using my community as guinea pigs.	-2
	1	My property cannot be mortgaged or insured if fracking occurs in my community.	-3
	10	I feel that if I don’t sign leases to my mineral rights and properties, I will just get bundled in with those who do, to make drilling more efficient.	-3
	16*	The consistently high levels of fracking investment in political contributions and lobbying should worry all Pennsylvanians.	-3
	19	Fracking poses a huge threat to ecosystems.	-3
Least (-4)	22	The whole planet is affected by the climate change induced by fracking.	-4
	27	I don’t trust the fracking companies; they tried to have me sign a legal liability release.	-4
Other distinguishing statements	24#	Fracking can't be made sustainable; it's an unsustainable energy source.	0
	13*	The location of the fracking site is absolutely the most critical variable to my opposition.	0
	3	Much of the contamination associated with fracking is irreversible.	+3

Appendix C: Crib Sheets cont.

Factor 3 (-)	#	Statement	Rank
Most (+4)	22	The whole planet is affected by the climate change induced by fracking.	+4
	27	I don't trust the fracking companies; they tried to have me sign a legal liability release.	+4
Items ranked higher than other factors	1	My property cannot be mortgaged or insured if fracking occurs in my community.	+3
	10	I feel that if I don't sign leases to my mineral rights and properties, I will just get bundled in with those who do, to make drilling more efficient.	+3
	16	The consistently high levels of fracking investment in political contributions and lobbying should worry all Pennsylvanians.	+3
	8	Worrisome chemicals like bromide and salts often associated with waste water from fracking will seep into my drinking water.	+2
	12	The fracking industry is learning their "craft" as they go and using my community as guinea pigs.	+2
	5	Foreclosure rates and abandonment levels increase in communities engaged in fracking.	+1
	20	Fracking operations may result in increased erosion, altered chemical cycling, and reduced water levels.	+1
	21	The fracking boom that began in Pennsylvania around 2008 has not generated enough jobs or money to make fracking worth it.	+1
Items ranked lower than other factors	3	Much of the contamination associated with fracking is irreversible.	-3
	15	Crime and social disagreement between residents will become worse if fracking enters my community.	-3
	11	Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.	-2
	29	People living or working near active fracking wells may be exposed to certain pollutants at higher levels than the Environmental Protection Agency considers safe for lifetime exposure.	-2
	4	We are putting radioactive waste in a bunch of landfills in large quantities, and we don't yet know the long-term danger of doing this.	-1
	9	People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.	-1
	18	Rules requiring fracking operators to manage their air pollution are few and far between.	-1
	23	Fracking will increase traffic and lead to higher pollution levels.	-1
	7	All fracking companies should be using some form of identification to reveal the precise chemical formulation they are pumping into the ground.	0
Least (-4)	2	Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.	-4
	25	Fracking operations should be confined to industrial or already built up areas, like near power stations.	-4

Appendix C: Crib Sheets cont.

Factor 4	#	Statement	Rank
Most (+4)	6	Greed and economic hardship have blinded many from seeing the real price we will all be paying if fracking takes over.	+4
	9	People who live near fracking are at increased risk of health problems ranging from birth defects to cancer.	+4
Items ranked higher than other factors	7	All fracking companies should be using some form of identification to reveal the precise chemical formulation they are pumping into the ground.	+3
	19*	Fracking poses a huge threat to ecosystems.	+3
	24#	Fracking can't be made sustainable; it's an unsustainable energy source.	+3
	12	The fracking industry is learning their “craft” as they go and using my community as guinea pigs.	+2
	16	The consistently high levels of fracking investment in political contributions and lobbying should worry all Pennsylvanians.	+2
	22#	The whole planet is affected by the climate change induced by fracking.	+2
	17	Fracking is subsidized by the government in far greater amounts than renewable fuels, which is where we should be focusing our money.	+1
	20#	Fracking operations may result in increased erosion, altered chemical cycling, and reduced water levels.	+1
	21	The fracking boom that began in Pennsylvania around 2008 has not generated enough jobs or money to make fracking worth it.	0
Items ranked lower than other factors	4	We are putting radioactive waste in a bunch of landfills in large quantities, and we don't yet know the long-term danger of doing this.	+1
	3	Much of the contamination associated with fracking is irreversible.	0
	18	Rules requiring fracking operators to manage their air pollution are few and far between.	0
	5	Foreclosure rates and abandonment levels increase in communities engaged in fracking.	-1
	11	Pennsylvania is "simply not doing" studies into the possible health impacts of fracking.	-1
	14#	Waste coming from fracking sites are highly radioactive and cancer rates have tripled in fracking areas.	-2
	1	My property cannot be mortgaged or insured if fracking occurs in my community.	-3
	10	I feel that if I don’t sign leases to my mineral rights and properties, I will just get bundled in with those who do, to make drilling more efficient.	-3
	15*	Crime and social disagreement between residents will become worse if fracking enters my community.	-3
Least (-4)	13	The location of the fracking site is absolutely the most critical variable to my opposition.	-4
	27	I don’t trust the fracking companies; they tried to have me sign a legal liability release.	-4
Other distinguishing statements	2#	Considering that the climate is already changing due to fossil fuel emissions, and that Pennsylvanians are increasingly feeling its effects, all fossil fuels need to stay in the ground.	+1