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Abstract:

In communities experiencing shale gas development, the local media are an important information source on potential impacts of development; their coverage generates and spreads social representations of this issue. We examine representations of natural gas development through a content analysis of six regional newspapers in the northern United States (n=1,958 articles) – two each in Ohio, New York, and Pennsylvania. Previous research showed similarities between the New York and Pennsylvania newspapers; differences emerged in nearby Ohio's coverage. In Ohio, similar percentages of articles mentioned economic impacts as in Pennsylvania and New York, but significantly fewer articles mentioned environmental or social impacts. Furthermore, valence of economic and social impacts was notably more positive in Ohio. This analysis highlights nuances inherent in regional discourse about shale gas development. In turn, these differences have implications for: (1) how politicians, journalists, activists, and researchers can better communicate about shale gas development, (2) policy/regulation of development, and (3) future research on social representations of emergent forms of energy extraction. We suggest the need, in social science research on energy development, to examine societal-level (not merely individual) influences on perceptions and to account for nuances inherent in regional variation – infrequently manifest in national sample studies.

1. Introduction:

‘Four hostile newspapers are more to be feared than a thousand bayonets.’

-- Napoléon Bonaparte

Shale gas development via high-volume slick-water horizontal hydraulic fracturing (often called simply ‘fracking’) has recently emerged as a major, controversial issue that permeates everyday conversations globally [1].¹ Notable legislation governing this form of energy extraction has been promulgated in the European Union, several European member states, Canada, and the United States. China, Russia, South Africa, Argentina, Algeria, Australia, and other nations are estimated to have extensive shale gas resources and have been considering large scale development [2]. In the United States, natural gas extracted from shale formations comprised 23% of domestically produced natural gas in 2010; by 2035, it is anticipated to contribute 49% of domestic gas production. Due to substantial shale gas development in the United States since 2007 (and recent authorisation to construct additional liquefied natural gas export capacity), the US expects by 2017 to be a net natural gas exporter [3].

As nations and sub-national entities (e.g., states and provinces responsible for policy on shale gas development) consider whether and how to engage in such development, it is useful to know what information is available to members of the public on this topic. Public perceptions and support/opposition can play a powerful role in shaping what policy options related to shale gas development emerge as viable and, indeed, whether development occurs at all. Whilst understanding content of information sources on shale gas development cannot inform us

¹ Note: We use the term ‘shale gas development’ throughout this article to refer to the set of processes and associated effects that attend this form of energy extraction/development. Whilst no term is perfect, for nuanced discussions of why to avoid use of ‘fracking’, please see [55, 65].

directly about people's specific views on development, content analysis of commonly used information sources can provide a good idea of the topics/issues people may think *about* when they consider shale gas development [4]. Furthermore, news media are recognised as an important source of information on emerging technologies, of which shale gas development is an example [5-7].

Knowledge of key information sources available to the public on the topic of shale gas development offers insight into how this issue is represented socially, in public discourse. Our research relies on social representations theory, which asserts that representations, particularly on contentious issues, emerge via public discourse and then are internalised within individuals. To the extent that representations of shale gas development are socially-derived (i.e., emerge through processes occurring at the societal-level, rather than through individual cognitions), communal information sources on this topic could be a powerful agenda setting force that shapes conversation on this issue.

Although coverage of shale gas development occurs primarily at the national level in some nations (e.g., the United Kingdom [8]), much information shared on this issue in the US is circulated at a local level. For example, a survey with 1,200 respondents from the Marcellus Shale region in NY and PA identified *local* newspapers (as distinguished from national newspapers) as the single most used source for information on this issue from among fifteen potential sources (including all major forms of mass media, Internet, and communication with family and friends). Fifty-nine percent of respondents reported reading/hearing about this topic 'often' from local newspapers [9]. A second random sample study of 6,000 residents in the Marcellus Shale region in NY and PA revealed that mass media (i.e., newspaper, television, and/or radio, but excluding Internet) was the most frequently used source for information on

shale gas development [10]. Twice as many respondents indicated that mass media provided ‘a great deal of knowledge’ on shale gas development, compared to every other information source, save ‘neighbors, friends, and relatives’.

Herein, we report and evaluate the results of a content analysis of regional newspaper coverage of shale gas development across three US states that overlay the Marcellus Shale/Utica Shale formations (New York [NY], Ohio [OH], and Pennsylvania [PA]). Through this analysis, we examine social representations (i.e., common sense, as opposed to scientific/technical, portrayals) of shale gas development. Results from the NY and PA content analyses have been reported previously [11]. This research builds upon the previous research by allowing for triangulation between the three states – revealing nuances in representations in regional discourse. Whereas the NY and PA coverage was similar in many ways, in this study we cast light on how coverage from newspapers in two moderately-sized cities in eastern OH differs in meaningful ways from coverage from two newspapers in similarly-sized cities in southern NY and two in northern PA.

Unlike many nations where shale gas development is managed predominantly at a national level and leasing of mineral rights occurs in major deals brokered between industry and the national government, regulation of shale gas development is far more localised in the US. Each state in which shale gas development occurs has different regulations, different localised discourse about the pros and cons of development, and different politics shaping these conversations [12]. Additionally, unlike many other nations, shale gas development has already occurred to a substantial extent in the US; therefore, different experiences with extant development across regions/states may shape the discourse and representations of development uniquely in each area.

1.1. Shale gas development in New York, Pennsylvania, and Ohio

Within the three bordering states in our study, shale gas development began first in Pennsylvania. The boom in leasing commenced in PA in 2006. As of January 2015, 7,788 active wells existed in PA [13]. Pennsylvania, particularly the north-eastern and south-western portions of the state, has seen the greatest amount and duration of shale gas development of any state in the north-eastern portion on the US. Much of this focus has been due to the geologic and economic viability of the resource there. The majority of the Marcellus Shale resides underneath PA. Whilst the Utica Shale, which underlies PA, NY, and OH at a greater depth than the Marcellus Shale, is also a viable shale gas play, industry focus has been on the former play at least in this first decade of development.

Local/regional opposition to shale gas development does exist in PA, but not to the extent that it is manifest in NY. Organised opposition from numerous environmental, public health, and social groups in NY contributed to NY's lengthy environmental and public health review of impacts associated with shale gas development (2009-2015) and the Governor's eventual proclamation, through his state Department of Environmental Conservation, that high volume hydraulic fracturing would not be permitted in NY [14]. Over 200,000 public comments to the Department of Environmental Conservation informed this decision. Despite the eventual ban on shale gas development in NY, much leasing of land to gas companies for potential exploration and development did occur in NY along its southern border in 2008, before high volume hydraulic fracturing was first under a de facto moratorium and then banned.

Ohio first passed legislation governing oil and gas development in 2006 [15]. From the start of unconventional shale gas development through 11 July 2015, the ODNR issued 2,018

permits horizontal wells in the Marcellus and Utica Shale formations; 1,560 wells were drilled. One notable difference between OH and NY/PA in the myriad processes associated with shale gas development is that Ohio has 202 active Class II underground injection wells, permitted by the US Environmental Protection Agency [16-17]. These wells are used for disposal of brine, flowback, and produced water that comes up the well bore during shale gas extraction. The number of class II wells in OH is far greater than the number of such active wells in NY and PA (e.g., the US EPA reports only seven active class II injection wells in PA [18]. Indeed, much of the wastewater generated in shale gas development in PA is transported to OH for disposal [19]. Virtually all of the active injection wells are located in eastern Ohio. The ODNR and independent scientific research has confirmed that these wells can be and have been responsible for induced seismic events (i.e., human-created earthquakes) [20].

Earthquakes have been increasingly prevalent in OH, particularly in north-eastern portion of the state, in the last few years since shale gas development commenced there. Particularly in the area surrounding Youngstown, OH, several 2.0 magnitude or higher (up to 4.0 magnitude) earthquakes have been recorded and linked by government scientists to disposal of wastewater from gas development [21]. The ODNR has placed restrictions on the process of hydraulic fracturing itself and the injection of wastewater into Class II underground injection wells due to these earthquakes [15].

By many metrics the three states and six sample areas in our study are quite similar. They all contain small to moderately-sized cities surrounded by regions with a historical focus on agriculture and/or resource extraction. They have all benefited from an industrial presence that has waned in recent years; they all are struggling economically. These six cities are located in the northern portion of the geographic and cultural region known as Appalachia. They each

overlie the same two shale gas formations and are located relatively close to one another (at least by US standards) in the north-eastern portion of the nation; there are no major regional cultural differences between these areas.

Despite the manifold similarities, we expected differences in coverage of shale gas development between the OH newspapers and the NY/PA papers due to small differences in economic history, local/state politics, and the trajectory of development in OH (including wastewater injection and induced seismicity). Issues related to shale gas development in Ohio have not garnered the level of political rancour manifest in NY or the number of cases of alleged environmental contamination that have occurred in PA. Additionally, we have conducted interviews with local residents in each of these areas and have noted that discussion of economic issues and economic hardship is more pronounced in Ohio.² Whilst the regions surrounding all six newspapers are economically depressed, the unemployment rates are slightly higher in OH (Table 1). Furthermore, poverty rates are higher in one OH region (Table 1). The unemployment rates only vary by a few percentage points between the OH metropolitan areas and the metropolitan areas in NY and PA; yet, the rates in Canton and Youngstown (OH) are 17% and 21% higher than the rate in Williamsport (PA), the area with the next highest unemployment rate.

Table 1: Unemployment and poverty rates in MSAs surrounding each newspaper^a

MSA	Unemployment rate ^b	Poverty rate ^b
Canton, Ohio	10.5%	15.0%
Youngstown, Ohio	10.9%	17.5%
Binghamton, New York	8.7%	15.7%

² Interviews in northern PA and southern NY included 25 individual interviews with journalists and residents heavily engaged in discourse on shale gas development; in eastern Ohio we interviewed 12 residents actively opposing or supporting shale gas development in their communities. These findings will be published subsequently.

Elmira, New York	7.3%	15.7%
Scranton, Pennsylvania	8.2%	14.6%
Williamsport, Pennsylvania	9.0%	14.2%

^a MSAs are Metropolitan Statistical Areas, a geographic reporting unit used by the US Census Bureau

^b Unemployment rate and poverty rate are measured by the 2013 American Community Survey 5-year estimates; poverty rate is operationalised as the percent of individuals whose income in the last 12 months was below the poverty level (averaged across data from 2008-2013).

In terms of differences across newspapers, specifically, we anticipated that:

- 1) The ratio of attention to economic impacts compared with environmental impacts would be higher in OH newspapers than in NY or PA newspapers,
- 2) Articles citing negatively valenced impacts would be less common in OH newspapers, whilst positively valenced impacts would be more common in OH articles, and
- 3) Whilst differences in categories of impacts (e.g., percent of articles citing environmental impacts) and valence of impacts would emerge between the states, we predicted there would be few differences across states in the most common impacts mentioned *within* categories (i.e., environmental, economic, and social). One difference we did expect was increased attention to earthquakes in Ohio.

It is precisely because of the close similarity between shale gas development and socio-cultural background in each of these three states that we undertook this comparison. If substantial differences in social representations of development can emerge in these relatively similar regions, this sheds light on which representations of shale gas development should not be assumed to remain consistent across areas – even ostensibly similar areas – exposed to (or potentially exposed to) development [22]. These findings in turn have implications for communicators tailoring messaging on this topic and for policy makers shaping regulation to the needs and desires of local/regional populations. If systematic differences in coverage emerge

between regions, this suggests a need for more research on public perceptions of energy development to account for the potential influence of societal-level – and not solely individual-level – factors shaping perceptions of emergent energy technologies and their effects.

Because of the diffuse coverage across similar regions, because local information may be *the* major source of information for residents in shale gas regions in the US, and because substantial divergence exists across states in shale gas regulation in the US (e.g., New York has banned any high-volume hydraulic fracturing whilst Ohio is currently actively promoting it), we focus on comparison within a single nation for our research. Whilst cross-national research on social representations of shale gas development would certainly be useful, comparative research within nations in which representations may vary notably across regions is also needed. In terms of implications for policy and communication, comparative work that highlights similarities and differences in social representations within the same nation could be more useful in some ways than comparisons across nations, due to the cultural baseline across which to compare the similarities and differences. Within the same nation, cultural divergence might be less of a confounding factor for interpreting differences in representations.

In this vein, the following research speaks to some key debates in the energy studies and social science field highlighted by Sovacool [23]. It sheds light on approaches to designing comparative studies by revealing value in selecting quite similar, rather than divergent or extreme cases, but still using longitudinal data to demonstrate reliable similarities and differences across regions. The research also presents a way of measuring social discourse (through mass media coverage and the voices reflected therein) about whether ‘a certain energy system harm(s) the environment, degrade(s) the social structure of local communities’ [23, p. 24]. Because our content analysis chronicles the primary benefits and concerns about shale gas

development mentioned in regional mass media coverage, it paints a picture of key environmental, economic, and social concerns and externalities (positive and negative) related to this energy production approach in those areas.

1.2. Regional newspapers in our analysis

We selected the *Youngstown Vindicator* (Youngstown, Mahoning County, OH) and the *Canton Repository* (Canton, Stark County, OH) as the two newspapers for our analysis of social representations in Ohio. Both newspapers are located in regional population centres in the area of eastern Ohio most affected by shale gas development. The *Youngstown Vindicator* has a daily circulation of 62,100 (87,000 on Sundays) [24]; Youngstown itself had a population of 53,873 as of the 2010 US Census. The *Canton Repository* has a daily circulation of 56,789 (69,638 on Sundays); Canton had a population of 55,206 in 2010.³

Since Youngstown's establishment in 1820, industrial activity has fuelled development, population growth, and the economy there. Between the 1920's and 1960's, Youngstown was an important industrial hub, however the US steel industry fell into decline in the 1970's, causing an economic depression in Youngstown. In the wake of steel plant shutdowns, the community lost an estimated 40,000 manufacturing jobs, 400 satellite businesses, \$414 million in personal income, and between 33-75% of school tax revenues [25]. This area of Ohio, included within the US's 'rust belt', awaits economic recovery.

³ We focus on the Ohio newspapers here as the NY and PA sources are discussed elsewhere [11]. The total daily circulation (M-F) for the NY and PA newspapers is: *Binghamton Press and Sun-Bulletin* – 34,111; *Elmira Star-Gazette* – 15,181; *Scranton Times-Tribune* – 47,663; *Williamsport Sun-Gazette* – 22,795 [24]. The 2010 populations of the NY and PA cities were: Binghamton – 37,938, Elmira – 22,646, Scranton – 60,624, Williamsport – 23,024.

Similar to Youngstown, Canton has had a long history with industry. Given its location, it started as a major manufacturing centre as railroads started to be built across the United States. Today, industry is still a major part of the economy, however Canton has significant health care and agricultural sectors as well. In recent years, the downtown areas of Youngstown and Canton have experienced increased economic investment in terms of new local businesses and increased employment. Whilst many of the newspaper articles we coded have attributed this resurgence in local economy to shale gas development and related industries (e.g., manufacturing and services for gas extraction and pipeline construction), people opposed to shale gas development in this area that we have interviewed have offered competing explanations (e.g., a new casino outside of Youngstown).

2. Social representations: The role of societal-level discourse

Serge Moscovici, who developed the concept of social representations (hereafter ‘SR’) and coined the term in 1961, has described SR broadly as a ‘series of propositions which enable things or persons to be classified, their characters described, their feelings and actions explained’ [26, p. 152]. SR exist as an alternative to and often as an outgrowth of scientific thought and discourse. They are complex ideas, processes, and objects translated into common sense that is accessible and applicable in everyday life [27]. The role of the SR researcher, according to Clémence [28, p. 83], ‘is to study common sense knowledge about abstract objects or theories.’ We contend this applies well to the recently emergent and complex set of technical processes associated with shale gas development. The fact that social actors create and mould SR is also essential; as noted by Billig [29, p. 42]: ‘It is a central theme of the social representationists that

psychological states are *socially produced*’ (emphasis added). They emerge from discourse in the public sphere [30].

Wagner and Hayes [27, p. 310] highlight the relative import of social (as opposed to individual) processes in fostering SR when they assert that SR emerge via ‘the translation of sociostructural and cultural conditions into individual dispositions.’ The types, content, and frequency of public discourse and communication on a topic powerfully influence the structure of the SR that emerge from the production process [31]. The importance of communication in the public sphere to emergence of SR illustrates the potential relevance of mass media coverage – a major form of public information sharing – to SR about shale gas development.

Historical, cultural, and social processes contribute to the generation of SR via two primary processes: anchoring and objectification [26, 27, 32]. Both processes make the unfamiliar familiar. Anchoring occurs when a community is exposed to a novel concept, process, or object (e.g., shale gas development). We write ‘community’, and not ‘members of a community’, because SR theory postulates that anchoring occurs primarily at the societal level, via shared social understandings. Through public discourse, the item is linked (anchored) to other concepts, processes, or objects already well understood in the community, which the community considers to be similar or related to the novel item. In this sense, the representation is truly a ‘re-presentation’, a presentation once again, but in a modified form, of both the scientific physical reality that is the object/process, as well as of the previously held representations of similar objects/processes that the public integrated with the new knowledge [26].

The process of anchoring in SR theory is similar to the anchoring and adjustment heuristic, as detailed in psychological literature on heuristic processing [33], except that the

anchoring in SR theory occurs primarily via social influences and processes (as opposed to almost exclusively individual ones) – due to communal discourse, social structure, institutional actions, and a shared history and culture. Once the anchor has been set, objectification occurs, in which a community associates images and descriptive language with the object of the SR. The societal level at which anchoring and objectification occur intimates a potentially powerful role for news media in fostering SR. Indeed, much research on SR relies on content analysis of news media coverage as a key source for understanding emergence of SR [34-35]. SR theory has also been used recently in Europe to study controversial environmental issues [36-37] and energy development explicitly [8, 38-40].

2.1. Social representations in newspaper coverage

We sought to develop an initial understanding of SR of shale gas development through a content analysis of regional newspaper coverage on this topic. If the newspaper coverage predominantly reflects public discourse, it could help spread emerging anchors for SR. If newspapers report findings and perspectives novel to local discourse about gas development, the coverage itself could be the public forum in which potential anchors are debated and selected. Newspaper coverage likely plays both of these roles simultaneously, to some extent. In addition to anchoring, newspaper coverage – through frequently repeated language and/or vivid imagery – can play a role in objectifying shale gas development.

In our content analysis, we coded predominantly for mention of impacts associated with shale gas development and valence of those impacts. Impacts are key content for potential anchors for SR. Because SR focus on what is discussed, but also on how it is discussed (i.e., the

words used to describe the content), valenced language is important to the operationalisation of SR in mass media coverage.

To the extent that unique representations do emerge in coverage of shale gas development across regions, this supports the need to include societal-level variables in models that seek to explain public views on shale gas development. Research on perceptions of shale gas development often seems to assume that perceptions are individually formed and held (e.g., through use of demographic variables and personal characteristics such as political leaning as key predictors of perceptions [10, 41-50]). Social representations theory suggests that if regional discourse can vary considerably, it might also shape individual perceptions of development at regional scales. One rationale for undertaking this content analysis is to move beyond solely individual influences on public perceptions of development and to also gauge *social* influences.

Because SR theory dictates that anchors are based on interpersonal discourse within communities, social structure, a shared history, and culture, it follows that SR about shale gas development would emerge differently in diverse communities engaged with this issue. Nevertheless, little research on SR of energy issues has taken a comparative approach. There is, however, precedence in other SR-focused content analyses for such a comparative approach across regions [51-52].

3. Methods:

This study builds off of previous content analytic research on representations of shale gas development in regional newspapers in New York and Pennsylvania. Because the methods for the NY and PA analysis are reported elsewhere [11], we speak primarily to the methods for the Ohio content analysis here. As highlighted by Krippendorff [4, p. 2], ‘Content analysts examine

data, printed matter, images, or sounds—texts—in order to understand what they mean to people, what they enable or prevent, and what the information conveyed by them does’. Whilst such analysis cannot establish how people will eventually think or feel about shale gas development, it can reveal a good deal about the types of representations available to local residents. It speaks to the ‘agenda setting’ role of mass media [53-54].

3.1. Sample selection

We analysed social representations in articles from the two regional newspapers in the areas most affected by shale gas development in Ohio – the eastern Ohio cities of Canton and Youngstown (see Table 2). Our sample frame included articles mentioning any of the following words/phrases: ‘shale gas’, ‘hydraulic fracturing’, ‘Utica Shale’, ‘Marcellus Shale’, or ‘fracking’. Searching for articles with these words allowed us to capture most articles focused on shale gas development whilst excluding additional articles on natural gas, but extraneous to shale gas drilling, extraction, and associated effects.

Our sample frame extended from 1 January 2009 (a date prior to the first article in either paper mentioning any of our search terms) to 31 December 2014. For the *Youngstown Vindicator*, we coded the entire census of articles from our sample frame (n=402); due to a much larger sample frame from the *Canton Repository*, we included every third article chronologically from the sample frame in our final sample (n=329). We used the Access World News search engine to obtain the full-text of articles in our samples.

The Ohio newspaper samples mostly overlap chronologically with the NY and PA samples, which ranged from 1 January 2007 (a date prior to mention of this issue in those four

newspapers) to 31 December 2012. Across all six newspapers we coded and analysed 1,958 articles.

Table 2: NY, OH, and PA regional newspaper articles about shale gas development, 2007-2014*

	<i>Canton Repository</i> (OH)	<i>Youngstown Vindicator</i> (OH)	<i>Binghamton Press and Sun-Bulletin</i> (NY)	<i>Elmira Star-Gazette</i> (NY)	<i>Scranton Times-Tribune</i> (PA)	<i>Williamsport Sun-Gazette</i> (PA)	TOTAL
2007	---	---	---	---	---	1	1
2008	---	---	33	15	19	19	86
2009	1	1	60	66	33	46	207
2010	9	6	91	87	112	112	417
2011	75	62	62	65	102	114	480
2012	78	166	44	17	57	72	434
2013	79	103	---	---	---	---	182
2014	87	64	---	---	---	---	151
TOTAL	329	402	290	250	323	364	1,958

* The number of articles listed here is the number we coded in the content analysis. For the all samples save Youngstown, the sample frame generated was three times larger.

As small regional newspapers, several of the articles in our sample were written by a limited number of journalists. For example, two authors (Tom Wilber and Jon Campbell) wrote 46% of the articles in our sample from the Binghamton Press and Sun-Bulletin (NY). Indeed, because Gannett Company owns both the Binghamton and Elmira newspapers, these same two journalists wrote 28% of the coverage in our Elmira Star-Gazette sample.⁴ For a discussion of how the norms and experiences of the journalists writing for these papers and the PA newspapers in our sample influences coverage, please see [11].

⁴ The other newspapers are owned by: *Scranton Times-Tribune* – Times-Shamrock Communications, *Williamsport Sun-Gazette* – Ogden Newspapers, Inc., *Canton Repository* – Gate House Media, Inc., *Youngstown Vindicator* – The Vindicator Printing Company.

Figure 1: Home cities of the six regional newspapers

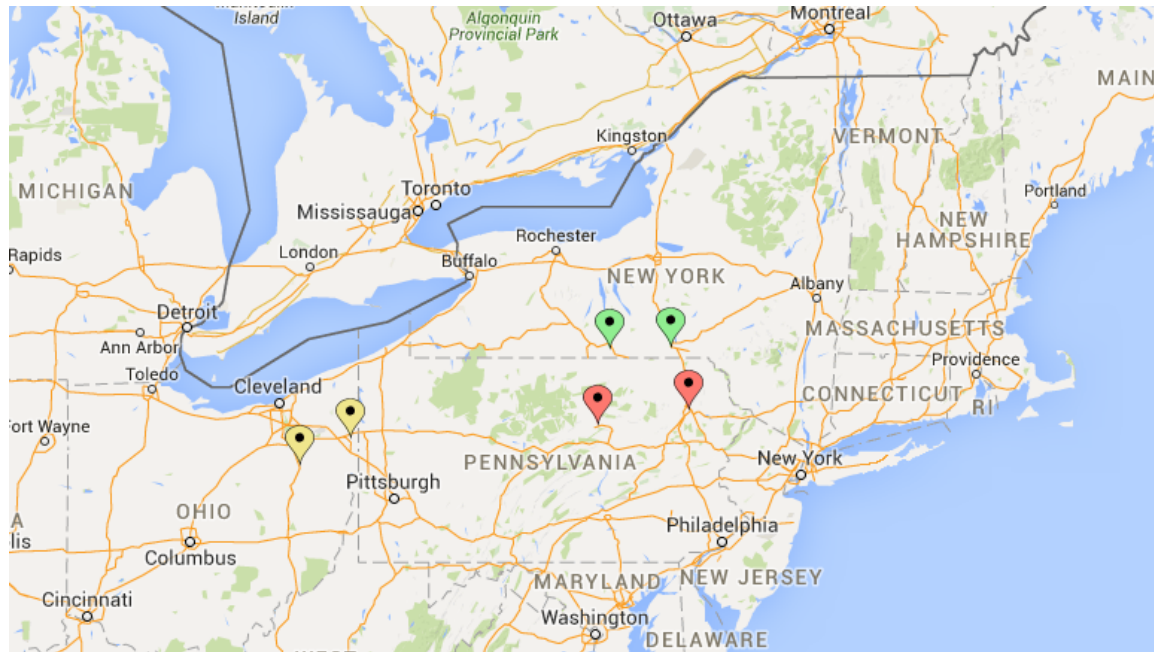
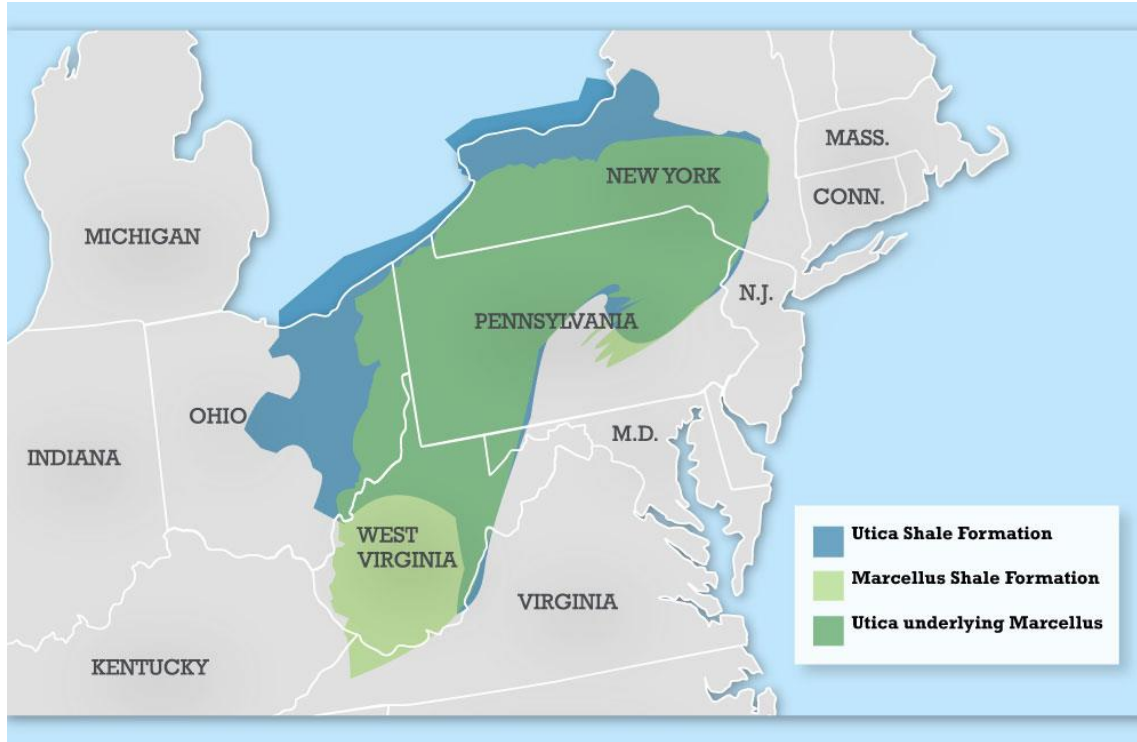


Figure 2: Extent of Marcellus and Utica Shale formations



Note: map retrieved from Marcellus Shale Coalition (<http://marcelluscoalition.org/pa-map/>)

3.2. Coding

We replicated the coding scheme used in Evensen and colleagues' analysis [11] to allow for direct comparison between the results of our OH content analysis and the research in NY and PA. The primary items for which we coded were: (1) presence/absence of references to specific impacts associated with development and (2) valence of those impacts. We chose these foci due to the attention given to impacts and valence in policy and academic discourse on shale gas development, and for comparability across regions. For example, because issues of regulation and political debates vary markedly across states, a regional comparison of such topics may be of limited value.

We coded for impacts by recording presence/absence of a host of environmental, economic, or social effects of development in each article (Table 3). These effects were chosen for the original (NY and PA) analysis on the basis of effects we expected to see discussed – from a review of scientific and public perceptions literature regarding shale gas development impacts. We refined the codes iteratively when we noticed items for which we should be coding but did not include initially. We re-coded each previously-coded article for new codes when they emerged.

Table 3: Impact for which we coded (impacts of shale gas development)

<p><u>Environmental impacts:</u> (1) effects on drinking water, (2) effects on lakes, (3) effects on streams/rivers, (4) other references to water quality that are too vague to fit the previous categories, (5) impacts due to wastewater, (6) effects on water supply (e.g., volume of water used), (7) problems related to methane migration/escape, (8) effects on air quality, (9) effects on greenhouse gas emissions, (10) production of clean energy by increasing gas available, (11) concerns about naturally occurring radioactive materials, (12) production of solid waste (e.g., rock cuttings, sludge), (13) effects on soil quality, (14) effects on wildlife health, (15) effects on wildlife habitat, (16) effects on fish and other aquatic animals, (17) effects on forests, (18) non-specific environmental effects (i.e., gas development affects the environment, but no specific effect is stated)</p>
<p><u>Economic impacts:</u> (1) effects on jobs (including availability, wages paid, job training, etc.), (2) financial aspects of royalties, (3) financial aspects of leases, (4) effects on tax revenue, (5) effects on local business, (6) effects on taxpayer costs, (7) production of cheap energy, (8) effects on property values, (9) effects on price of rental property, (10) effects on tourism, (11) financial aspects of mineral rights, (12) costs related to water treatment, (13) non-specific economic effects (i.e., gas development affects the economy, but no specific effect is stated)</p>
<p><u>Social impacts:</u> (1) effects on traffic, (2) condition of roads/ bridges, (3) effects on community infrastructure beyond roads and bridges (4) effects on community character or rural way of life, (5) effects on municipal and/or emergency services, (6) effects on local aesthetics/beauty, (7) effects on amount of noise, (8) effects related to light pollution, (9) issues related to dust, (10) effects on housing availability, (11) effects on parking (availability, need for, etc.), (12) effects on US energy independence/security,</p>

(13) effects on **crime** rate, (14) effects on driving and pedestrian **safety**, (15) issues related to the **distribution of gains** earned, (16) effects on **public health**, (17) **non-specific** social effects (i.e., gas development affects local communities, but no specific effect is stated)

After impacts, we coded for the valence (positive, negative, neutral, or mixed [positive and negative]) of each *category* of impact (i.e., independent valences for environmental, economic, and social impacts). We labelled an impact category positive if the journalist and any persons/organisations cited in the article specifically identified all impacts in a given category as good (e.g., through words such as: beneficial, increased opportunity, promising, boon, etc.). We labelled the valence negative for categories in which all impacts in an article were identified as bad (e.g., words such as: risk, harmful, disaster, concern, destroy, etc.). Neutral valence was assigned to categories where there was no mention of a good or bad outcome associated with any impact in that category; the impact(s) were merely mentioned (e.g., ‘wastewater is created when wells are hydraulically fractured’). To be positive, negative, or neutral, all impacts mentioned in a given category in an article needed to be of the same valence. Categories were labelled as having mixed valence if the same impact was listed as positive and negative in the same article (e.g., either by different sources or as a pro/con discussion), or if some impacts in that category were represented as positive and others were represented as negative (e.g., positive effects on greenhouse gas emissions but negative effects on local air quality would generate a mixed environmental valence).

Three independent coders were trained and coded portions of the Ohio samples. One of these coders also duplicated the coding for a portion of the articles coded by the other two coders (for a reliability check). Furthermore, a fourth independent coder duplicate-coded additional articles by all three coders. In total, approximately 8% of the total sample (60 articles; 30 from

each newspaper) were duplicate-coded for reliability analysis. For impacts and valence, we compared all codes to determine level of agreement between the lead coder and the reliability coder. All 18 environmental impacts, 13 economic impacts, 17 social impacts, and 4 valences for which we coded exhibited at least 90% agreement and had a Cohen's kappa score for inter-coder reliability of 0.8 or above.⁵ The coders jointly reviewed all cases of disagreement to determine the appropriate code.

4. Results:

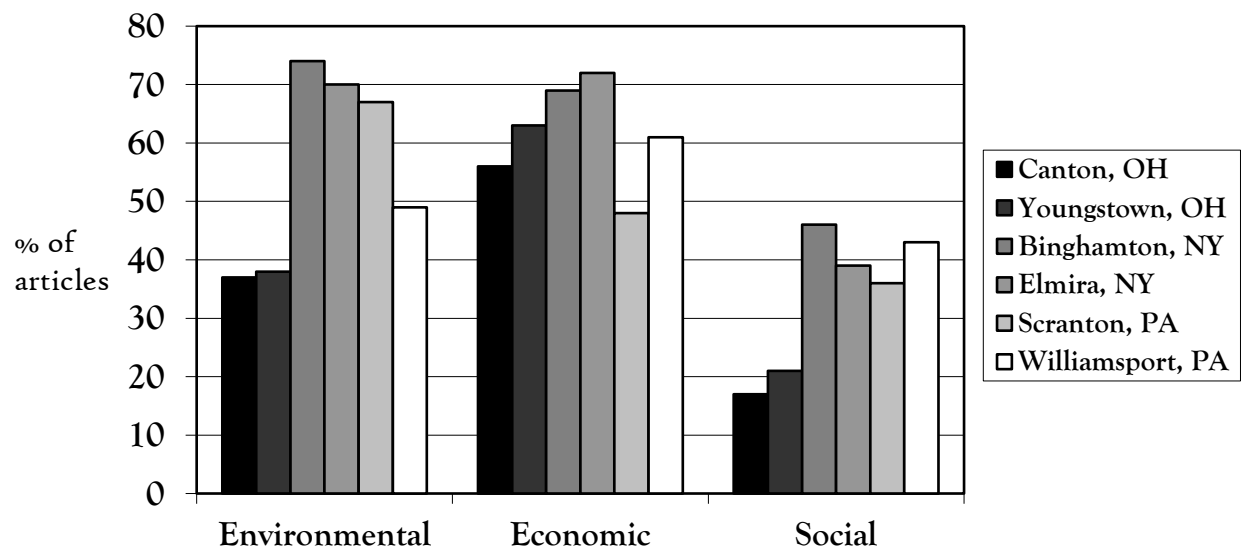
Here we examine the social representations of shale gas development, compared across newspapers. We investigate differences by comparing the papers across impact categories (environmental, economic, and social), across specific impacts mentioned within the articles, and across valence of articles. We rely on frequency statistics and generalised linear models with pairwise comparisons to highlight the most common representations of impacts and identify statistically significant differences in representations across newspapers. We use the same approaches to characterise differences in valence of each impact category across newspapers. Because the NY and PA findings are reported elsewhere [11], we focus predominantly on the OH results and comparison of the OH with NY and PA results.

Across the data set holistically, more articles contained economic impacts than environmental or social impacts (Figure 3). Whilst 61% of articles across all six newspapers referenced at least one economic impact, 54% of articles mentioned at least one environmental impact, and only 33% cited a social impact.

⁵ Across the NY and PA samples, each code exhibited at least 90% agreement and a Cohen's kappa of 0.9 or above.

Both OH newspapers had significantly fewer articles that mentioned environmental impacts compared with all four NY and PA papers.⁶ Another metric for assessing the relative prevalence of environmental versus economic impacts in each newspaper is the ratio of articles that mentioned environmental impacts to the articles that mentioned economic impacts. Those ratios are as follows: Canton (OH) = 0.66, Youngstown = 0.60, Binghamton = 1.07, Elmira = 0.97, Scranton = 1.40, and Williamsport = 0.80.

Figure 3: Representations of categories of impacts, by newspaper



*Note: In this figure and all subsequent figures of this style, each newspaper is denoted by a greyscale bar. Newspapers from left to right in each set of bars are listed from top to bottom in the legend.

With respect to economic impacts, the only statistically significant differences between the OH newspapers and the NY and PA papers were: (1) the Canton newspaper included a lower

⁶ Statistical significance in this section, unless otherwise noted, has been calculated via generalized linear models with a binomial probability distribution and logit link function, with Bonferroni corrections for multiple pairwise comparisons. Significance level is $p < 0.05$.

percentage of articles citing at least one economic impact than both NY newspapers and (2) the Youngstown paper included a higher percentage of articles mentioning at least one economic impact compared to the Scranton newspaper. Both Ohio newspapers mentioned social impacts in a significantly lower percentage of articles compared to all NY and PA newspapers. None of the NY or PA newspapers differed significantly from each other on the percentage of articles referencing at least one social impact.

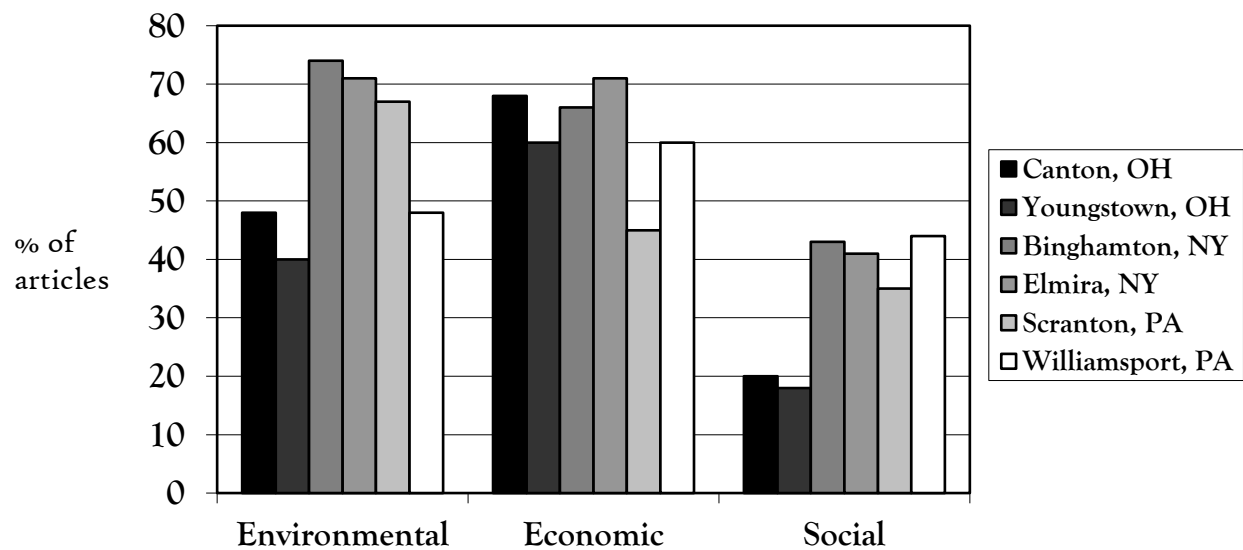
We must note that the above findings compare the full NY/PA sample (articles from 2007-2012) with the full OH sample (articles from 2009-2014). In each case, this captures articles from the start of coverage until six years later. We find this comparison appropriate in that it follows the development of social representations of shale gas development in each state for equal periods of time, beginning with a slow start to coverage, then including a wide proliferation in coverage, and finally capturing the slight decline in coverage in later years (see again Table 2). To only include the same years of coverage could artificially skew the data in that development in OH began a few years after development in northern PA; therefore, comparing 2010 in all three states, for example, would include coverage of a fairly well-settled, burgeoning industry in PA, whilst it would reflect an incipient industry in the earliest stages of production and public awareness in OH. Recall that these are regional newspapers that report heavily on local (as opposed to national) issues with respect to shale gas development.

To further assess the appropriateness of using the full samples (as opposed to restricting the samples to the same years), we examined coverage of environmental, economic, and social impacts from 2009-2012 only – the years from which we have data for each newspaper. The overall frequency of impacts mentioned was: economic – 61%, environmental – 58%, social – 35%. This compares closely with the percentages from the full sample: 61%, 54%, and 33%.

Figure 4 shows the percentage of coverage referencing each type of impact in each newspaper from 2009-2012. The percentages parallel closely the data from the full sample; even more importantly, the statistically significant differences are similar to those in the full sample. Both OH newspapers contain significantly less coverage of environmental impacts compared to all NY and PA newspapers, save Williamsport; they contain more articles that cover economic impacts than Scranton but do not differ from the other three newspapers; finally, a significantly smaller percentage of Ohio articles cite social impacts, compared with all four NY and PA newspapers.

Because the findings from the 2009-2012 sample diverge only minimally from those of the full sample, and because the different years of coverage in the various states allow for the same periods in the trajectory of development to be captured in the three states, we focus on the full article sample in the remainder of this results section.

Figure 4: Representations of categories of impacts, by newspaper (2009-2012 *only*)



Returning to our results from the full article samples, the reduced focus on environmental and social impacts manifest in OH newspapers held when examining the *average number of impacts* mentioned per article in each category (in addition to presence/absence of at least one impact per article). Both OH newspapers had significantly lower average counts of environmental and social impacts cited per article compared with all four NY and PA newspapers (Table 4).⁷ This stark differentiation between the OH newspapers and the NY/PA newspapers was not evident for average number of economic impacts mentioned per article (Table 4).

Table 4: Average number of impacts mentioned per article in each category, across newspapers

Newspaper	Environmental impacts	Economic impacts	Social impacts
Canton, OH	0.63 ^a	0.99 ^{a,b}	0.24 ^a
Youngstown, OH	0.64 ^a	1.10 ^{a,b}	0.31 ^a
Binghamton, NY	1.48 ^b	1.18 ^b	0.77 ^b
Elmira, NY	1.45 ^b	1.21 ^b	0.70 ^b
Scranton, PA	1.28 ^b	0.74 ^c	0.50 ^c
Williamsport, PA	0.91 ^c	0.94 ^{a,c}	0.68 ^b

The numbers in each column represent the average number of impacts mentioned in each newspaper article across all articles in the sample from each newspaper.

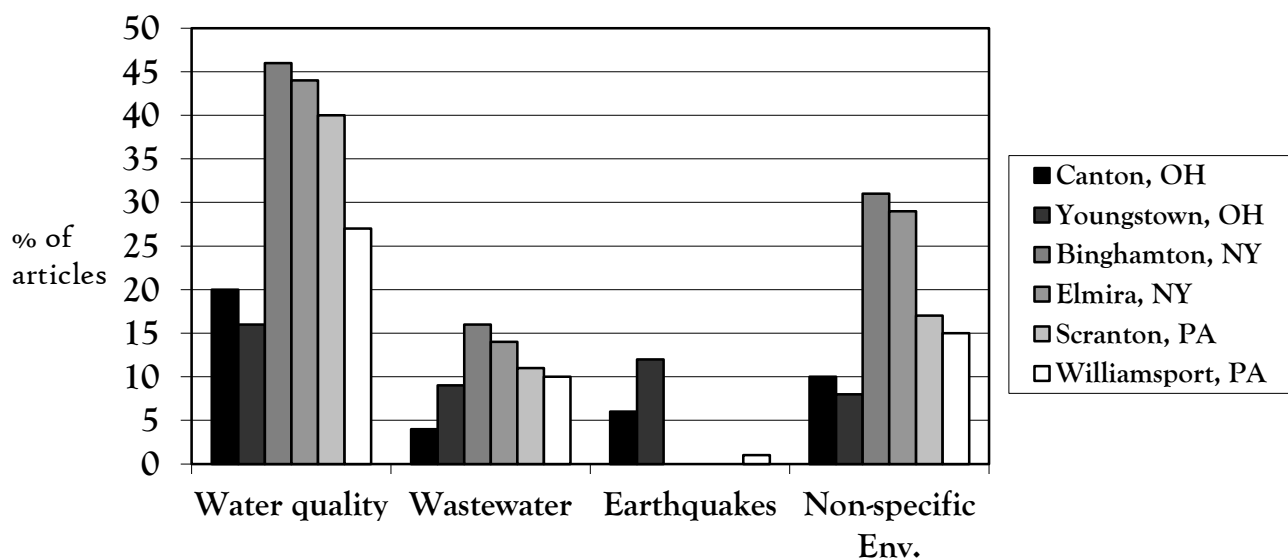
Superscript letters following the numbers denote which newspapers differ from each other with statistical significance. The same letter by two newspapers within a given category indicates that those newspapers do *not* differ significantly ($p < 0.05$, with Bonferroni corrections for multiple pairwise comparisons).

4.1. Environmental Impacts

⁷ We computed statistical significance for all the tests related to count data (i.e., average number of impacts mentioned per article) with generalized linear models with a Poisson probability distribution and a log link function (with Bonferroni corrections for multiple pairwise comparisons). Significance level is $p < 0.05$.

When environmental impacts were mentioned, a few impacts dominated coverage. The only environmental impacts mentioned in more than 10% of the coverage in *any* newspaper were: (1) water quality (in this code we combined references to effects on drinking water, surface waters [e.g., streams, lakes, and rivers], and non-descript references to ‘water quality’ broadly), (2) wastewater, (3) earthquakes, and (4) non-specific ‘environmental’ impacts (Figure 5). Across each of these impacts, with the notable exception of earthquakes, both OH newspapers contained a lower percentage of articles mentioning the impact than all four NY and PA papers.⁸ Whilst substantial differences across newspapers arose in the frequency with which articles referenced specific environmental impacts, water quality impacts were the single most discussed environmental impact in each newspaper.

Figure 5: Representations of leading environmental impacts, by newspaper

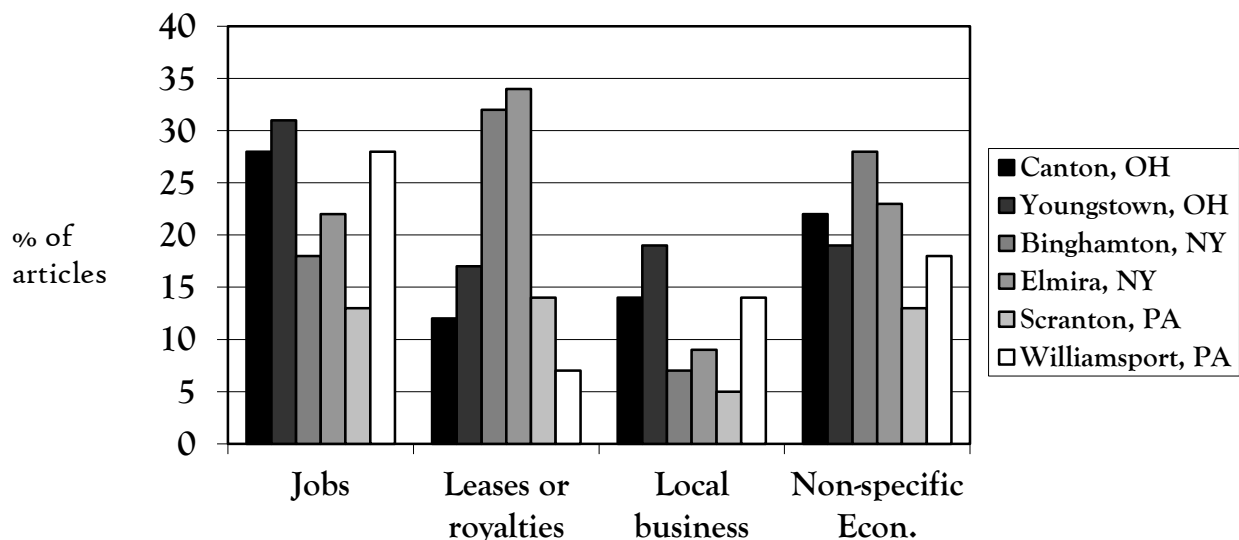


⁸ For water quality, Youngstown differed significantly from all NY and PA newspapers; Canton differed from all four save Williamsport. For non-specific environmental impacts, Youngstown differed significantly from all NY and PA newspapers; Canton differed from the NY papers. For earthquakes, both Ohio newspapers differed significantly from every NY and PA paper.

4.2. Economic Impacts

The only economic impacts mentioned in more than 10% of the coverage in any newspaper were: (1) jobs, (2) leases and royalties, (3) local business, and (4) non-specific ‘economic’ impacts (Figure 6). The differences between the OH newspapers and the other newspapers were more mixed for economic impacts compared with environmental impacts. For jobs and local business, the OH newspapers contained a greater percentage of articles referencing these impacts compared to all four other papers.⁹ For leases/royalties and non-specific economic impacts, the OH newspapers fell to neither extreme in terms of percent of articles referencing these impacts. As with environmental impacts, despite differences across newspapers in the frequency with which articles cited impacts, the dominant economic impacts mentioned were stable across newspapers, being either jobs or leases/royalties for each newspaper.

Figure 6: Representations of leading economic impacts, by newspaper



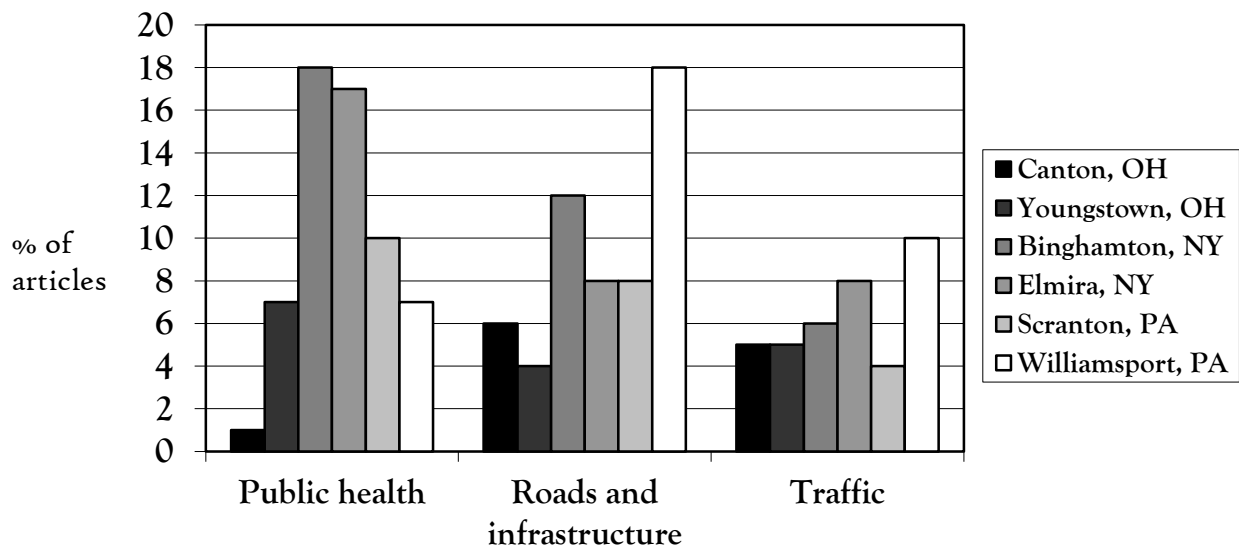
⁹ For jobs, both Ohio papers differed significantly from Binghamton and Scranton; for local business, Youngstown differed significantly from Binghamton, Elmira, and Scranton, whilst Canton differed only from Scranton.

4.3. Social Impacts

Very few social impacts were mentioned in any newspaper with notable frequency.

Across the six newspapers, the most commonly mentioned social impact (i.e., roads and related infrastructure) occurred at a rate less than half of the most common economic impact (jobs), and less than a third of the most common environmental impact (water quality). The only two impacts mentioned in more than 10% of the coverage from any newspaper were (1) public health and (2) roads and related infrastructure (e.g., bridges). Mention of impacts related to traffic was the third most common across the full sample. For each of these impacts, the OH newspapers either had the lowest percentage of articles citing the impact or were very close to the lowest.¹⁰

Figure 7: Representations of leading social impacts, by newspaper



¹⁰ For public health, Canton differed from all four NY and PA papers, whereas Youngstown differed from the two NY papers; for roads and infrastructure, Canton differed from only Williamsport, whereas Youngstown differed from Binghamton and Williamsport; for traffic, neither OH newspaper differed significantly from any other paper.

4.4. Valence of impact categories

Here we report the distribution of valence within each *category* of impacts (i.e., environmental, economic, social) within each newspaper. When reporting on differences in valence, we only compare the sub-sample of articles from each paper that included impacts within that category (e.g., from the Youngstown sample of 402 articles, only 144 mentioned environmental impacts, 244 mentioned economic impacts, and 82 mentioned social impacts; therefore, the following data is based on those sample sizes, not the full 402).

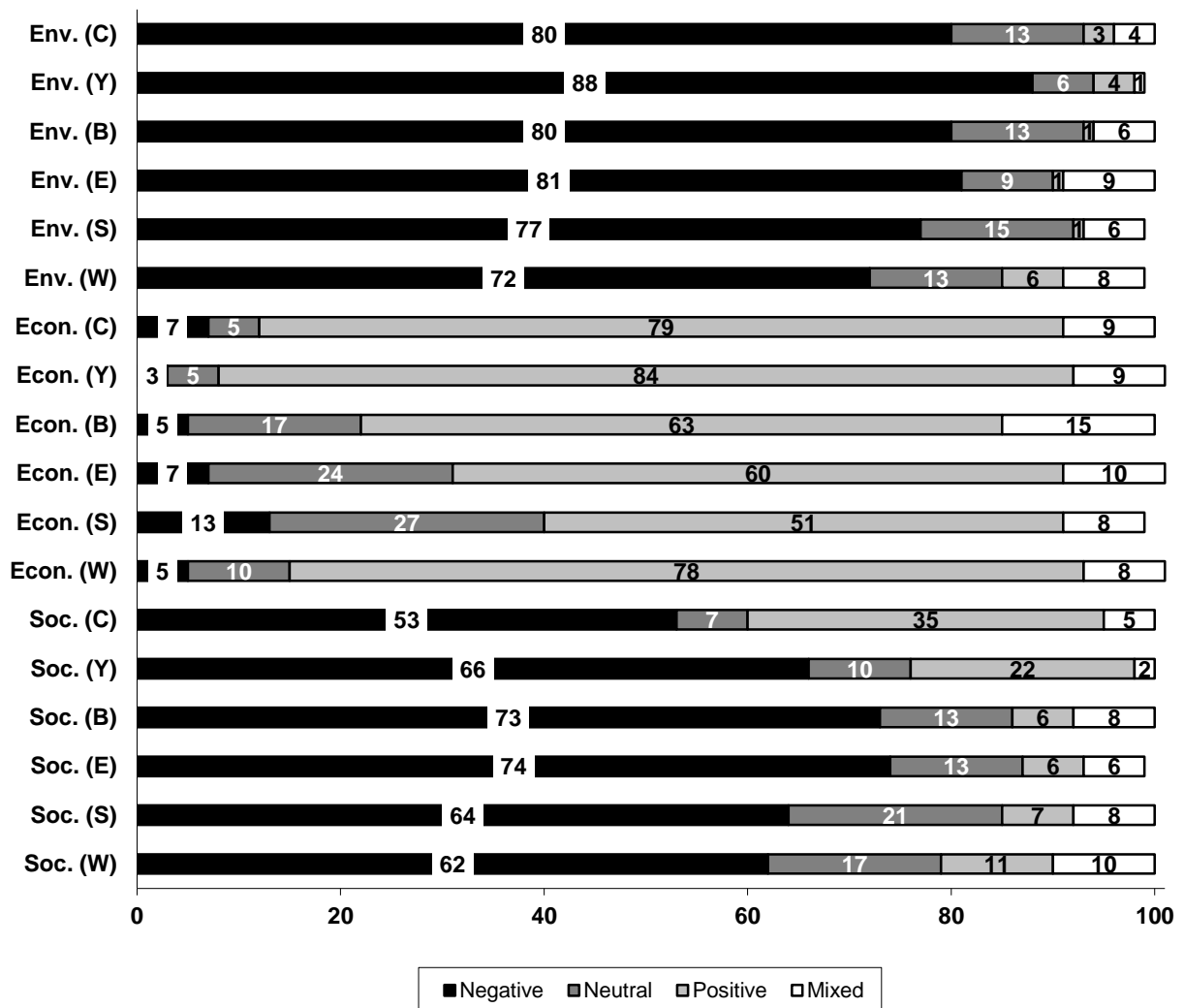
Unsurprisingly, most of the articles mentioning environmental impacts, across all newspapers, assigned a negative valence to environmental impacts. The percentage of negatively valenced articles ranged from 72% (Williamsport) to 88% (Youngstown).¹¹ The majority of articles referencing economic impacts at each newspaper assigned a positive valence to those impacts; nevertheless, greater variation in valence was manifest for economic impacts (between 51-84% positive valence), compared with environmental impacts. The OH newspapers displayed the highest percentages of articles with positively valenced economic impacts (Figure 8).¹² Finally, the majority of articles from each newspaper that cited social impacts attributed negative valence to those impacts. Whilst there was some variation in percentage of articles with *negatively* valenced social impacts (53-74%), none of these differences were statistically significant. There were, however, significant differences in the percentage of articles with

¹¹ The only statistically significant difference between newspapers on percentage of articles with negative environmental valence was between Youngstown and Williamsport.

¹² Both OH newspapers differed significantly from the Binghamton, Elmira, and Scranton newspapers on percentage of articles with positive economic valence.

positively valenced social impacts; both OH newspapers had the greatest percentage of such articles.¹³

Figure 8: Valence of impacts



Env. = Environmental, Econ. = Economic, Soc. = Social

C = Canton (OH), Y = Youngstown (OH), B = Binghamton (NY), E = Elmira (NY), S = Scranton (PA), and W = Williamsport (PA)

*The numbers and sizes of the bars indicate the percentage of articles from each newspaper sample that manifested each valence. The total 100% for each bar is based on the number of articles that *mentioned* at least one impact in that category (i.e., environmental, economic, or social) for that newspaper sample.

¹³ Canton differed with statistical significance from all four NY and PA newspapers on the percentage of articles with positively valenced social impacts; Youngstown differed significantly from the two NY newspapers.

5. Discussion

A key finding is that both regional Ohio newspapers contained a significantly lower percentage of articles mentioning environmental and social impacts, and lower average number of impacts per article, than the NY and PA newspapers. These are the two categories of impacts that typically appear with negative valence. The Ohio samples also included a higher percentage of articles with positively-valenced economic impacts and positively-valenced social impacts when compared to the NY and PA newspapers. In total, this intimates that regional newspaper coverage in eastern Ohio is more positive about shale gas development than regional coverage in southern New York or northern Pennsylvania.

Whilst substantial differences did exist between the OH newspapers compared with the NY and PA newspapers, in some respects the six sources revealed considerable consistency. Perhaps the most notable similarity is that the impacts mentioned most frequently within each category deviated little across newspapers. Effects on water quality, jobs, and roads/infrastructure were leading impacts, regardless of geographic location. For policy makers, this pattern offers some assurance that whilst magnitude of focus on specific impacts and impact categories might shift regionally, the foremost discussed impacts could remain more reliable. Such knowledge may help when tailoring policy to either respond to constituent concerns or when explaining the necessity of policy that is, perhaps, ancillary to common representations.

In seeking to explain the similarities and differences across newspapers, we have identified several plausible rationales. We note, however, that data from our content analysis only speak to the degree of variation; speculation about rationales for the differences cannot be gleaned from the content analytic data itself. First, as mentioned in the introduction, the area of

eastern OH surrounding Canton and Youngstown is in worse condition economically than the areas in NY and PA where the other four newspapers are located. In economically depressed areas, more attention likely would be afforded in coverage to positive economic impacts (and potentially to the positive social impacts that this influx of wealth could also engender) than to negative environmental or social impacts. We do not know, however, whether the coverage in Canton and Youngstown is reflecting ‘anchors’ for social representations that have already been established in public discourse, or whether it is potentially offering new ‘anchors’ for the public to consider related to shale gas development. It could serve both functions simultaneously.

If the OH newspaper coverage is both reflecting current local social representations of shale gas development and generating a new form of discourse that can then shape emergent social representations further, local political discourse could affect coverage. Each of the six newspapers included a number of articles that referenced key conversations about shale gas development in state politics (and often quoted politicians and appointed state executive agency leaders). Governor Kasich’s administration (Ohio) has been very openly supportive of shale gas development, compared to Governor Cuomo’s administration (New York) that has been equivocal or sceptical (and that has now banned high volume hydraulic fracturing). Former Governor Corbett’s administration (Pennsylvania) was also supportive of shale gas development, but may have received more push-back against proposed regulations from other politicians and the general citizenry in Pennsylvania than has been the case in Ohio (e.g., a PA supreme court judgment ruled against Governor Corbett’s administration, which sought to prevent local municipalities from regulating development). Ohio Governor Kasich’s strong support for shale gas development was represented well in the regional newspaper coverage in our sample. The Governor is quite popular in the state, winning re-election in 2014 and receiving a majority vote

in the counties of Mahoning (Youngstown; 54% for Kasich to 43% for the chief opponent) and Stark (Canton; 67% to 30%).

Differences in the experiences associated with shale gas development in each state also likely had an impact on coverage. In Pennsylvania, a major controversy over possible contamination of drinking water from shale gas wells in the township of Dimock drew much attention locally in town meetings, government documents, and protests from 2009 onward. The New York newspapers are also located close to this township. Other cases of water contamination (e.g., streams and other surface waters) have garnered scrutiny in north-eastern PA. Whilst alleged water contamination has certainly occurred in Ohio, a lack of major alleged contamination events may have contributed to less coverage of environmental impacts there (recall, a large percentage of references to environmental impacts in each paper were attributable to discussion of effects on water quality).

On the other hand, in Ohio there are numerous injection wells for disposal of wastewater associated with shale gas development. High pressure injection of wastewater into deep, porous rock formations for long-term disposal has been confirmed to cause earthquakes by academic research [20], the Ohio Department of Natural Resources [15], and the US Geological Survey [21]. Attention to earthquakes was much more pronounced in the Ohio newspapers. This is just one example of how differences in the development process affect reporting. The diminished attention to public health impacts in Ohio, which could be attributable to a lack of the intense political discussion on this topic in NY or the presence of high profile drinking water contamination cases in PA, is another such example.

Differences in timing could also contribute to variance in coverage across newspapers. Coverage of shale gas development did not begin in the OH newspapers until 2009 and did not

take off with force until 2011; it began in NY and PA in 2007 and took off with force in 2009. Our sample runs from 2007-2012 in NY and PA, but from 2009-2014 in Ohio. The two six-year time frames overlap substantially, but not completely. Nevertheless, our analysis of coverage only from 2009-2012 (the period of overlap) for all the newspaper reveals the cross-state differences in coverage remain. Perhaps timing differences would have had more explanatory power if a greater proportion of the regional coverage had referenced national trends/discourse connected to shale gas development [1].

5.1. Comparison of our analysis with previous findings

As mentioned in the introduction, Mazur [1] and Jaspal and Nerlich [8] have also given attention to coverage of shale gas development in the mass media. Both parties examined coverage on a national level, Mazur in the US and Jaspal and Nerlich in the UK. Potentially because of the difference in scope/level of focus, important differences emerged between our findings and theirs. In contrast to Mazur's findings, national trends and discourse from elite media sources apparently had less effect on reporting in the regional newspapers. Magnitude of reporting mirrored more closely local development and local reactions to development than it did national events related to shale gas, such as the release of 'Gasland' or the Deepwater Horizon blowout, which Mazur [1] cites as affecting national discourse. Most articles in our regional sample spoke to local or state issues. That regulation of shale gas occurs predominantly at a state (not national) level in the US also may contribute to the more localised reporting in the regional newspapers. One might expect countries with principally national regulation of shale gas development to have less localised coverage and less variation in coverage due to regional differences in discourse and/or development.

In line with Jaspal and Nerlich [8], we do see meaningful variation across newspapers in the valence of SR of shale gas development. While Jaspal and Nerlich attribute much of this variation to ownership of the UK newspapers they analysed, we attribute it more closely to regional variation in discourse on and experience with shale gas development, which is picked up by and then spread further by the regional newspapers. In our interviews with the lead journalists who wrote on this topic at the four NY and PA newspapers (see [11]), all of these journalists cited as primary factors influencing their reporting: lack of resources at the small regional newspapers, the convenience and multitude of local informants, and personal journalistic norms (e.g., a commitment to capturing local voices, covering all sides of the issues, and remaining ‘objective’). All of the lead reporters for these newspapers (who wrote between 19% and 46% of the articles for their respective newspapers on shale gas development in the time frame from which we sampled) reported having considerable latitude in choosing the focus of their coverage. Furthermore, while discussions of shale gas development in the UK are not too regionally specific (because very little development has occurred in that nation to date and all regulation and leasing occurs on a national level), this is far from the case in the US.

Jaspal and Nerlich [8] characterise certain newspapers in the UK as pro- or anti-fracking outlets. Whilst the six regional newspapers clearly vary in their attention to positive and negative representations of shale gas development, it is not clear that the newspapers or key journalists at these papers actively support or oppose shale gas development. From our interviews in NY, PA, and OH, we would hypothesise that the readership in Binghamton (NY), Elmira (NY), and Scranton (PA) more likely opposes development and the readership in the other three cities more likely supports development on the whole, which could influence

reporting. The way in which this influences reporting, however, is likely through those voices being reflected – indeed, quoted – in the regional coverage.

These comparisons with previous analyses highlight again the importance of examining coverage on the local level – there may be meaningful differences in not only the content of coverage in local newspapers compared with national new media outlets, but also in the factors that affect what content is presented. These differences become particularly salient when we recall the survey data showing that local newspapers are much more frequently relied upon for information about shale gas development in local communities the Marcellus Shale region than national newspapers, or any other information source [9]. A useful future research question is whether this relationship holds in other areas affected or potentially affected by shale gas development.

A final comparison with previous research relates to research within the same geographic region, but that explored public perceptions directly through individual-level data collection. We explained at the onset of this article that one rationale for this comparative content analysis was to shed light on the importance of societal influences on public perceptions. To the extent that public perceptions vary on a regional basis and those perceptions vary in tandem with the focus of newspaper coverage, we have reason to believe that: (1) societal level influences are operative and (2) newspaper coverage is likely one such influence.

Comparison of our content analysis findings with some individual-level analysis of public perceptions in the Marcellus Shale region in NY and PA [9, 10, 41, 55] reveals consistencies in the focus on water quality, jobs, and roads/infrastructure as leading impacts that affect overall attitudes on development (across all regions). Whilst one cannot causally link the newspaper coverage and such measurement of public perceptions with certainty, contribution of this

coverage to public perceptions seems likely through the agenda-setting role of mass media (i.e., coverage draws attention to the potential salience of such impacts). Survey research [9, 10, 55] also shows that environmental concerns associated with shale gas development are generally more pronounced in NY compared with PA; this is also manifest in the newspaper coverage. Further, the surveys and newspaper coverage consistently portray greater focus on environmental and economic, compared with social, impacts [9, 55]. Unfortunately, we know of no survey data on public perceptions of shale gas development in the area of eastern OH currently under development. Our content analysis, at minimum, suggests topics worthy of exploring in relation to public perceptions in that area; it might also offer hypotheses worth testing (e.g., is focus on economic impacts relative to environmental impacts greater in this region compared to other states).

6. Implications

The similarities and differences across the six newspapers highlight important implications for: (1) communication about shale gas development, (2) policy, decision making, and regulation of shale gas development, and (3) future social scientific research on this form of energy extraction.

6.1. Communication

Whilst attention to social impacts was already notably absent in the NY and PA newspapers (both in total amount and relative to other categories of impacts), it was significantly lower in the OH newspapers. The dearth of coverage afforded to social impacts (e.g., effects on community character, peace and quiet, energy independence, beauty, noise, light pollution) in

regional newspaper coverage – which is the leading source of information for many people in communities affected by shale gas development – is troubling. To make informed decisions about: how to regulate shale gas development, whether to personally lease one’s land, whether to engage in activities supporting or opposing development, and/or how to vote for politicians with certain perspectives on shale gas development, one must at minimum understand the *range* of effects associated or potentially associated with development. Whilst social representations conveyed through newspaper coverage cannot be assumed to tell people how to perceive an issue, they have a demonstrated ability to agenda set – to supply people with, for example, an assortment of issues to associate with development. To the extent that public attitudes towards and perceptions of shale gas development are anchored by public discourse, including media coverage, communication efforts will need to account for trends in regional discourse. We view the low levels of social impacts mentioned in newspaper coverage as an opportunity for academics researching social impacts of shale gas development to share their research, in an accessible form, more widely with journalists and via other public channels [11, 56-57].

Other opportunities for researchers to share relevant, digestible information with journalists lie in providing context on what is happening relevant to shale gas development in other states/regions. We noticed that few articles in the OH newspapers cited experience with shale gas development in regions other than in eastern OH. This offers some explanation for variations between newspapers. Even development in western PA, which is close by, was infrequently mentioned. Journalists at regional/local newspapers have very limited resources; it is not surprising that they are often unable to research effects of and conversation about shale gas development outside their own region.

Beyond communicating with journalists, our findings highlight the importance of understanding nuance in local/regional coverage for a range of actors invested in the issue of shale gas development, including activists (pro- and anti-shale gas development) and politicians. Differences in coverage of impacts within each newspaper and between newspapers can reveal which impacts might warrant more focus. Activists and/or politicians could then use their communication channels to draw attention to under-emphasised but important (from their point of view) impacts. For example, our results clearly indicate that environmental and social impacts receive relatively little attention in the OH newspapers.

Understanding valence of newspaper coverage is also useful for individuals wishing to strategically communicate about development. For example, very few articles in our samples reference positive environmental impacts (for examples of such impacts see [58-61]) or negative economic impacts (see [56, 62-63]). Anyone familiar with discourse on this issue, however, could quickly point out that positive environmental and negative economic impacts *could* be associated with development (e.g., *positive environmental*: reduction in greenhouse gas emissions when replacing coal for electricity generation, less surface/habitat impact compared with other forms of energy development; *negative economic*: boom and bust cycle of development, reduced property values, effects on extant tourism, crowding out of local industry).

6.2. Policy

Perhaps the most straight-forward and important policy implication from our research is the realisation that even in areas that are relatively similar physically, culturally, and economically, meaningful differences can emerge in local coverage of shale gas development. For policy construction, this intimates a need for policy makers to be aware of which social

representations about development are being shared in key mass media outlets, in order to understand better the content to which their constituents are exposed. Policy, of course, need not be tailored to address these specific representations, but it is likely that the success or failure of any policy/regulation on shale gas development will rest in part on its congruence or divergence from key social representations.

Several major political debates related to shale gas development were well covered in the regional newspapers. For example, NY's research into potential public health impacts, PA's consideration of what type of impact fee to assess, and OH's deliberation over the role of injection wells and hydraulic fracturing itself in inducing earthquakes all took centre stage for a time. Each case is an example of social representations emerging through political conversations and then those representations being spread further through mass media. At least for these regional newspapers, it seemed that one of the most effective means for broadcasting a specific representation of shale gas development was to have that representation take a prominent place in political discourse.

6.3. Research

The sizable variation in frequency of impacts cited in the OH versus NY and PA newspapers intimates that regionally-specific discourses can and do emerge on this issue. Whilst much research examines perceptions of shale gas development on a national level, our findings suggest that, at least in areas proximate to development, important differences in local social discourse might influence those representations. Our findings suggest that because regional discourse can vary considerably, it likely affects individual perceptions of development at regional scales. Future research would benefit from attending more clearly to individual and

social influences on public perceptions of development. A social representations approach could prove useful in this respect.

We focused on local/regional newspaper coverage because research in the Marcellus Shale region showed that this was *the* leading source of information for local residents about shale gas development. Future research could explore the extent to which local/regional newspapers hold such a privileged position in other areas throughout the United States. A national survey we conducted in the US (unpublished) showed that television was the primary information source on this topic, followed by Internet news sites; local newspapers were relied on third most. One hypothesis is that local newspapers are more important in: (1) communities where shale gas development is occurring or will potentially occur and (2) small, rural communities (these two areas often overlap). By having more certainty on the extent to which various news sources are used, future content analytic work could focus most intently on the sources with greatest potential for anchoring and spreading social representations.

Another potentially useful research direction based on our findings would be survey, interview, and/or focus group research that explores directly the role of regional newspaper coverage in small, rural communities in shaping discourse on and perceptions of shale gas development. This could shed light on the extent to which agenda setting is indeed occurring and to which social representations shared by newspapers become engrained in society. For example, even in areas such as New Brunswick, Canada, where our interviews have shown that virtually everyone (on all sides of the issue) distrusts the regional newspaper coverage on shale gas development, the newspapers still seem able to agenda set through the topics they cover [64].

Finally, more information would be useful on the generalisability of the claim that the primary impacts in each category (environmental, economic, and social) are consistent across

news sources. This is a potentially important finding that could make strategic, targeted communication easier for people active on the issue of shale gas development.

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