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Fracking and Metaphor: Analysing Newspaper Discourse in the USA, Australia and the United Kingdom

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Abstract
We apply a mixed-method design centred on the deployment of metaphors to explore the role that language plays in the structuring of the public discourses of unconventional hydrocarbon development (UHD) across three major developed economies. We analyse UHD-related metaphorical devices deployed in broadsheet newspapers in Australia, the UK and the USA between January 2006 and May 2018. We develop an innovative Type Hierarchy Approach to metaphors by mapping through directed graph hierarchies. These allow concept-mapping analysis in terms of supertypes and subtypes, i.e. concepts ordered in terms of generality and inclusion as in "rapid expansion" -> "explosion". We find two broad discourses, each containing metaphorical constructions: *economic gain across temporal horizons* (incorporating *boom*, *bonanza, revolution* and *death* metaphors); and *risk tolerance and decision-making* (incorporating *gamble* and *insanity* metaphors). At the level of individual metaphors, deployment trends and patterns can be mapped along country borders rather than for example political alignment. *Boom* and *bonanza* appear most widespread in the USA, whereas UHD as a *revolution* is more closely associated with UK newspapers. Over time, UHD-related metaphor use decreases in all three countries, potentially reflecting an increasing public acceptance of UHD and moving shale gas from unconventional to conventional hydrocarbon development.

Keywords: fracking; mass media; metaphor; type hierarchy approach; unconventional hydrocarbon development

1 Introduction – the rise of unconventional oil and gas

Hydraulic fracturing and horizontal drilling techniques for so-called unconventional hydrocarbon sources from shales, coal bed and tight sands, are a matter of growing social scientific concern (Evensen, 2018). Recent advancements in drilling technology and slick-water hydraulic fracturing of porous rocks (including shales) have allowed the profitable extraction of oil and gas from previously untapped sources (Palisch et al., 2010). The economic growth emerging from the rapid deployment of unconventional hydrocarbon development (hereafter UHD) allowed the USA to move from a net importer to net exporter of liquefied natural gas (LNG), and to reduce domestic heating and electricity costs. UHD also has the

capability to enhance fuel security and energy access, and the new gas sources potentially offer a "cleaner" environmental footprint than coal and oil (in terms of both CO_2 and particulate emissions per unit of energy) (Sovacool, 2014). If governed effectively, UHD could also facilitate local economic development through job growth (Komarek, 2016), royalty payments and community benefits payments (Mason et al., 2015).

For the USA, UK and Australia, the primary type of UHD is fracking for natural gas, and this remains the focus of the remainder of this article. Fracking for gas is subject to significant negative environmental impacts including seismic activity (Das and Zoback, 2011); water contamination from gas and naturally occurring radioactive materials (NORM) (Brown, 2014; Finewood and Stroup, 2012); light, noise and air pollution (from drilling rigs, compressor stations and site traffic) (Jenner and Lamadrid, 2013; Rich et al., 2014); and greenhouse gas emissions including fugitive methane (Howarth et al., 2011). Negative socio-economic impacts include 'boom-town' effects (short-term economic gain from high-skilled employment during extraction, followed by long-term decline upon resource depletion). Increases in social isolation, crime and alcohol/drug dependence are of particular concern (Jacobsen and Parker, 2014; Stedman et al., 2012). Effects on house prices and local amenity values are also well-documented (Throupe et al., 2013). There are also less tangible 'soft' impacts from UHD, such as the role of shale gas development in disrupting social attachment to places that are affected (Poole and Hudgins, 2014), potentially changing the relationships that people experience with their environments and the institutions that govern them (Finewood and Stroup, 2012). Moreover, policy support for fracking may weaken support for niche energy transitions towards renewable alternatives (Johnstone et al. 2017), thus slowing transitions to more sustainable energy use. Overall, as Sovacool (2014) notes, when social and environmental externalities are taken into account, there are likely net economic losses from UHD. Collectively, concerns over the negative socio-economic and environmental impacts have sparked organised social movements of opposition at UHD sites (Bradshaw and Waite, 2017; Vesalon and Creţan, 2015), and more broadly across social media networks, with social connections built between protest groups through collective organisations such as *Frack Off* in the USA and UK, or the *Lock the Gate* coalition in Australia.

2 Conceptual background

2.1 Discourses of unconventional oil and gas development

Debate on UHD impacts is occurring at multiple scales and geographies, from local protest actions up to global energy policy deliberation. Of growing research interest is the role of news media in shaping public *discourse* around UHD (Jaspal and Nerlich, 2014; Jaspal et al., 2014). It is recognised that media narratives on UHD are often conflicting and ideologically driven (Gearhart et al., 2019), in turn shaping public perceptions of the technology. Research upon the discourse of UHD encompasses three primary dimensions of study:

1. *Framing, 'storylines' and shared social constructions* of UHD technology, resource use, industry actions and the interpretation of these elements within policy (Cotton et al., 2014; Schirrmeister, 2014). Studies in this vein have examined the concept of 'cleanliness' of the fuel in relation to other fossil fuels and renewables as a defining discursive characteristic (Cotton et al., 2014). Likewise, the concept of 'threat' is found to be a key determinant of political support (Jaspal and Nerlich, 2014); 'urgency' is mobilised within planning and policy processes to instigate rapid development for the

national good (Partridge et al., 2018); and discourses of local power and democracy are successfully mobilised by opposition actors (Bomberg, 2017).

2. *Specific linguistic features*. For instance, the word 'fracking' itself has influence over debates regarding the social acceptability of UHD policy and practice (Evensen et al., 2014; Grubert, 2016; Hopke and Simis, 2015). Of note is how the Anglo-Saxon nature of the word invokes parallels with profane language. This has been shown empirically to influence public support or opposition (with more neutral, scientific terminology to define UHD provoking greater support than the use of the word 'fracking') (McNally et al., 2018). Micro-level discourse analyses therefore explore the conditions under which language choice influences public attitudes and policy responses.
3. *Public perceptions*. These studies examine the demographic characteristics (Thomas et al., 2017), political ideologies, and technical knowledge (Crowe et al., 2015; Evensen et al., 2017; Lachapelle, 2017) of supporters and opponents (Cotton and Charnley-Parry, 2018), the conditions under which risks are perceived and negotiated (Whitmarsh et al., 2015), and the commonalities and shared interpretations of UHD discourse within and amongst different stakeholder groups (Cotton, 2015; Ladd, 2013).

Among these three categories of discourse studies, most examine individual countries that have been involved in rapid UHD (or are considering doing so), particular national media sources or specific case studies (in the case of micro-level analysis) at the point of site selection and development. Our empirical study thus addresses a knowledge gap on two fronts. First, we narrow UHD discourse to examine the specific linguistic features of UHD debates in print media, through a focus upon the role of *discourse metaphors* (Lakoff and Johnson, 1980; Zinken, 2003). Second, we simultaneously broaden the analysis through comparative assessment of three relevant English-language speaking countries that are actively pursuing UHD policy and practice, namely the USA, UK, and Australia. The international comparative dimension of our analysis allows us to compare and contrast country-level discourses, building upon a growing interest in cross-country comparisons within the social science of UHD (Stedman et al. 2016; Whitton, et al. 2017) and to start exploring underlying factors that shape these similarities and differences.

2.2 Metaphors and discourse

Metaphors are an essential part of language and hence of discourse – they are devices which transfer *meaning* and are, in the most basic sense, *comparisons* (Ortony, 1975). Metaphor is, as Charteris-Black (2004) argues, evidence of human capacity to perceive similarity relations: our ability to find the similar in the dissimilar - a fundamentally heuristic and creative process of novel linguistic encoding. Metaphors as linguistic devices thus have 'added value' in expanding the emotional, conceptual and evaluative power of language (Musolff 2016). Though metaphors have long been interpreted as an ornamental or rhetorical feature of language (Ortony and Fainsilber, 1987), they are increasingly understood as core components of our communicative interactions and everyday cognition (Gibbs Jr, 2017). Lakoff and Johnson (1980) in particular, are credited with emphasising the centrality of metaphor, not just as a linguistic device, but also as a core component of human thought. Lakoff and Johnson's (1980) analysis find metaphors to be *cognitive events* before they are linguistic ones. They are the mode by which humans structure concepts and, therefore, a core part of their understanding of reality (Larson, 2011). Our conceptual system, in whose terms we think and act, has a fundamentally metaphorical nature and the so-called *conceptual metaphor* is a mode of thought that achieves a correspondence, or mapping, between two conceptual domains. The first domain is an *abstract domain* that is, in turn, understood in the terms of a second *concrete*

domain. Lakoff and Johnson (1980) observe that a metaphorical conceptual system regulates the way in which we conceptualise an abstract concept by merging two conceptual domains in order to generate a third, richer and more elaborate meaning. The concrete domain can be understood as a *source domain*, in the sense that the concepts that structure it come from everyday life and represent lived experiences. These concrete experiences are then deployed to explain abstract and intangible *targets* (whether these are emotions, desires, or imaginings, or else relate to concepts such as spirituality, time, risks, life and death, etc.).

Given the power that metaphors have in structuring not just written and spoken language, but thought and action, they then become important objects of social scientific study (Núñez, 2000). Metaphors become important windows through which we can better understand the interpretive frames employed by actors involved in contentious socio-cultural debates (Hilligoss, 2014) and the ideological interpretation of events (Zinken, 2003). We assert that metaphors have influence upon reasoning and public action, and do not simply describe it (Thibodeau and Boroditsky, 2013). An understanding of metaphors can provide insights into perception of political operations (Wehling, 2016) and why certain policies have more chances to be adopted than others (Hülsse and Spencer, 2008).

Metaphor research is also a growing component of ecological economics research. For example, previous studies have explored how specific metaphors such as "market failure" (Bromley, 2007) or "degrowth" (Drews and Antal, 2016) structure our understanding of both the economy and its relationship to the natural environment. At a general level, there is a concern that by emphasizing economic quantification in environmental valuation, this limits the scope for effective environmental research and management by crowding out other understandings of human–environment relationships. In light of previous research on metaphoric relationships and environmental management (Larson, 2011; Norgaard, 1995; Norton and Noonan, 2007), we argue that research into the diverse metaphors that permeate human-environment relationships is an essential component of ecological economic research. It allows us to assess (in this case) the social–economic-ecological systems that emerge and relate to UHD, because metaphors permeate the language and action of different stakeholders involved in energy policy and environmental management (including "the public"). Analysing differences in metaphorical constructions can therefore allow us to explore commonalities, competing and contested claims around this most complex and contested set of environmental management issues (Norton and Noonan, 2007; Ison et al., 2013).

As Demeritt (1994) notes, metaphors become tools through which one can imagine and engage with nature - they are cognitive instruments that encourage us to conceptualize, learn about and make sense of nature (Bell, 2005; Klain et al., 2014), and to make normative claims about how nature should be (Ayres, 2004; Carolan, 2006; Nilsen, 2010). On one level, we therefore understand metaphors to be intrinsic components of our entire cognitive system, but when these metaphors are shared through communicative platforms (such as those in mainstream newspapers), commonly used metaphors become embedded in public thought and action – they become *discourse metaphors* – "relatively stable metaphorical mappings that function as a key framing device within a particular discourse over a certain period of time" (Zinken, 2003: 364), and thus occupy an important place in the cultural imagination (Zinken et al. 2008). Metaphors have a dialectical relationship with discourse and public perception – they are products of human perception and communication but also generate social conditioning and pressure when widely communicated (such as when used by the mass media). Metaphors can highlight certain aspects of a concept while at the same time hiding others (Lakoff and Johnson, 1980, p. 10), and thus become powerful *framing* tools. Metaphors are deployed for different reasons – for

instance to "sensationalize or hold the reader's attention" (as per Heywood and Semino, 2007), create subtly persuasive messages that serve different ideological purposes, and to convey different political messages (Charteris-Black, 2004; Santa Ana, 1999). It is important to note that news-media deploy a high proportion of metaphorical language – far higher than fiction or conversational language (Krennmayr, 2015) to meet these purposes. Understanding the differences between metaphor deployment across news media sources in different socio-cultural contexts is thus an important means to explore how discourse and public perception of controversial environmental policy issues are influenced by language.

We aim to evaluate discourse metaphor deployment through empirical research. We investigate how the choice of metaphors relating to UHD both reflects differences in conceptualisation and perception of UHD across the three case countries, and also shapes them. The use of specific metaphors in connection with a given topic creates a conceptual domain – a certain organization of human experiences. Different conceptual domains will organise experiences and shape our thoughts and language in different ways (Gibbs Jr, 2017; Ison et al., 2013; Nerlich and Jaspal, 2012; Renzi et al., 2017), their application in print and broadcast media thus influences the ways in which members of the public think, reason, reflect and gather further information on issues (Thibodeau and Boroditsky, 2011). We do not imply that certain metaphors "cause" certain policies or actions, however, since metaphors play a prominent role in framing UHD, they contribute to our understanding of the technologies and its applications and thus influences how social actors respond to their implementation in society (e.g. Nerlich and Jaspal, 2012).

3 Materials and methods

Metaphor analysis requires mapping structures to tease out the metaphorical relationships between domains (Carbonell and Minton, 1983). Our research design centres on the application of a Type Hierarchy Approach (THA) (Aronson et al., 1995) to the analysis UHD metaphors identified in our sample. The underlying idea of THA is that it uncovers specific organisations of human experiences: a *conceptual domain*, i.e. the connection of a topic with a specific metaphor. As argued above, metaphors establish a correspondence between different semantic domains (which we have described as *source* and *target* domains). When a word or expression from a source domain is attached to a target in (in this case) written language, these two elements together facilitate a reader to perceive and interpret an entire system of implications. New concepts are introduced into the target domain from the source domain, which fundamentally alters the way in which the target domain is understood by the communicators. Metaphorical source domains can have both positive and negative valence or sentiment (Mohammad, 2016) and can therefore have considerable influence upon reader perceptions of the target. For example, in Renzi et al.'s (2017) study of discourse metaphors of nuclear energy used in news-media, the conceptual domain of *rebirth* of nuclear power can be used both to describe the renewal of a long-lost technological programme (such as when describing a "nuclear renaissance"), or it can be used to describe the mutation of the body cause by ionising radiation to create "unnatural new life".

The THA approach is designed to reveal and report on the conceptual, perceptual and cognitive differences within the conceptual structure domain surrounding the metaphor target being analysed. A type hierarchy is fundamentally a network of concepts organised according to generality – a semantic network that moves from *supertypes* downwards to *subtypes*. The two are related in that the subtype shares all of the properties of the supertype. For example, we

could take the supertype of *living things*. Below this, we could map the subtypes *animals* and *plants*. Within the semantic network, any given instance of the subtype entails that it is also an instance of the corresponding supertype (Way, 1991). THA is a qualitative analysis of these semantic networks. In practice, our THA follows the protocol developed by Renzi and Napolitano (Renzi, 2009; see also Renzi et al., 2017; Renzi and Napolitano, 2011) to produce a series of Type Hierarchy directed graphs which display the mapping of the concept supertypes and subtypes. At the top of the TH graph diagrams, are the more general types: concepts that become more and more specialised as we follow the edges of the graphs downwards. Thus, for any given concept in the graph, the concepts directly linked to it from above are its supertypes, while the concepts directly linked to it from below are its subtypes.

We innovate in THA by developing a three-stage procedure. First, metaphors are collected and sampled (this is described below) and the semantic picture is extracted from the source domain, paying particular attention to terms conveying positive and negative responses when read and interpreted by a possible reader (Nerlich and Halliday, 2007). Second, through qualitative analysis, researchers draw the conceptual corresponding network in the target domain of UHD. We did this by assigning to all concepts from the source domain a corresponding concept in the target domain. Third, the mapping between the domains is analysed in order to discuss the implications, using the graphs to guide qualitative discussion of the metaphors and their implications for the shaping of UHD discourses. Due to its qualitative nature, it must be noted that the THA is fundamentally *interpretive*, thus whilst our analysis focused on what we identified as the most potent UHD-related metaphors based upon the sampling approach described below, this is not a comprehensive list of *all* metaphors emergent within the corpus.

3.1 Sample

We investigate UHD metaphors deployed in Australian, UK and US-based broadsheet newspapers between January 2006 and June 2018. Details of newspaper titles are found in Table 1. The time frame allows us to capture the full development of UHD from the earliest development of the industry (and hence as a relatively fringe topic) to a major news theme of environmental and energy policy reporting in all three countries.

INSERT TABLE 1 ABOUT HERE

Two broadsheet newspapers were selected for each of the three countries that – based on circulation – can be considered as leading national newspapers. Political alignment of newspapers has been found to impact coverage levels of various societal challenges (Barkemeyer et al. 2018). It is plausible to assume that centre-left newspapers also take a somewhat more critical stance on the deployment of UHD, which in turn may also impact the metaphorical framing in relation to UHD. Hence, for Australia and UK, political alignment was taken into account, with the Age and the Guardian typically seen as left-leaning, whereas the Herald Sun and the Daily Telegraph can be classified as centre-right broadsheets. The two US-based newspapers, New York Times and Washington Post, can be characterized as centrist/ liberal. All six broadsheets have in common that they are national in scope and are generally seen to report upon national public agendas. National broadsheet papers can be expected to provide the highest amount of coverage on political issues, and to have the highest agenda-setting impact for policy makers and the general public (Barkemeyer et al., 2013). Data were collected using keyword searches of the LexisNexis repository for each of the six newspapers.

All articles within the time period that contained the search terms "fracking"[1], "shale gas", "coal seam gas" or "unconventional gas" were captured. Only the print content of the six newspapers was considered, whereas online content such as blog entries was excluded from the analysis.

3.2 Metaphor identification

In a first step, web searches were performed using the search strings "fracking is like" and "shale gas is like" in order to generate an initial list of metaphors that have been used in the context of UHD. We then read and manually screened 5% of the overall sample (395 articles) to familiarise ourselves with the text corpus. In order to minimize bias, a systematic sampling procedure was applied to draw the subsample from the overall corpus, arranging all articles in chronological order and then selecting every 20th article for manual screening. In this stage, we were explicitly open to searching for new metaphors. Based on this procedure, ten metaphors that we identified as the most potent were selected for subsequent frequency analysis (see Table 2). As with previous empirical studies in this field, we acknowledge that other researchers may arrive at different classifications based on the same dataset (Nerlich and Halliday, 2007). For each metaphor, keyword searches were performed across the entire corpus of UHD-related newspaper articles. We then carefully read the articles in which metaphors and analogies were found, in order to comprehend their use and meaning. The review of the newspaper articles also had the purpose of identifying whether the occurrence of a metaphor really referred to UHD. Simply reading the sentence in which the term is found is usually insufficient to fully understand the meaning of the metaphors (though some examples in Table 2 show their use in context across the metaphorical domains and within the newspaper sample). As such, all full-text articles were processed manually by alternating pairs of co-authors – a highly time-intensive approach. There is also a risk of not having noticed cases in which there were other metaphors in the article, other than those sought. However, the manual method allows researchers to fully understand the metaphors in the context of how the writer 'deliberately' (Gibbs Jr, 2011) employs them – the nuances of meanings are identified, and the resulting Type Hierarchy has a high level of completeness. It should also be noted that we do not consider here additional visual clues (images) or editorial devices (e.g. highlighting) modifying the visibility of the metaphors, as these were not accessible.

INSERT TABLE 2 ABOUT HERE

4 Results

4.1 Interpreting Type Hierarchies

Through the Type Hierarchy and subsequent frequency analysis, two of the most commonly occurring metaphors concern the comparison between UHD and *revolution* or *boom* (see Figure 1 (a) and (c)). The concept of *revolution* is connected to the ideas of radical reversal of a constituted order and of a transformation that occurs in a sector of activity. This can relate to material conditions through technological advancement (such as an 'industrial revolution'), or else a change in ideological conditions through rapid political change (such as the French

[1] Whilst the search query thus also captures articles that exclusively focus on unconventional oil – rather than unconventional gas – screening of articles showed that his applies to <2 per cent of all articles, thus not having a notable impact on the trends and patterns reported in this study.

Revolution). Revolution is a temporal metaphor that denotes rapid change – this might be the total reversal of a point of view (a disruption to the status quo) which, in turn, might generate new and positive outcomes for society. Yet it is also related to orbital or axial rotation – ending up in the same place where you were before the revolution began – a cyclical view of time that challenges linear and diachronic understandings of temporality (Adam, 2013). Technological and cultural innovations might give a new life to a community, marking a new starting point and hope in a better economic future, or conversely you may end up at the same place where you started once the resource extraction is complete. The subtypes of revolution confer concepts of change, transformation and radical innovation, but also disorder and upheaval. Hence, *revolution* is a tri-valent metaphor within the discourse that is interpreted through a lens of what we might term risk-through-change: it can be interpreted as either something positive (an opportunity for radical change), something static (transient change that leads to a new status quo) or something negative – a constant state of disorder.

Related to the rapid risk-through-change concept is the metaphor of *boom.* The prevalence of the *boom* metaphor is potentially rooted in the concept of the frontier mentality– the territorialisation of the UHD resource (e.g. Rasmussen and Lund, 2018). Boom transmits the perception of a rapid expansion of economic activities, of opportunities. Like *revolution*, the use of *boom* might stir positive and hopeful feelings in a reader. The direct supertypes of *boom* are *successful chance* and *prosperity*, which are in turn subtypes of economic conditions. Thus, UHD development will stimulate an improvement in economic conditions. *Boom* also has a sonic quality – it is an arousing sound, and, in the context of an explosion, it represents a purposefully instigated loss of control. The explosive nature of a *boom* implies that expansion is rapid (almost instant) but also short-lived and quickly dissipating. The corollary to *boom* is the *boomtown* - reflecting the negative influence of the *boom* metaphor – it is what is left behind when the expansion has ended. The metaphor *boom* is commonly used in the articles to underline only the positive inference of economic expansions, but there is both positive and negative emotional valence attached to how a boom is *controlled* (through practices of economic and environmental governance) to maximise economic opportunities whilst minimising harmful effects. The latter include crime, drug and alcohol dependence and mental health problems commonly experienced in communities that experience rapid expansion of a transient workforce for resource extraction and then the rapidly contracting population when the boom ends and the residual social infrastructure cannot be supported by the smaller population (Jacobsen and Parker, 2014; Stedman et al., 2012). Therefore, it is the nature of the explosion and how it is governed that is important in understanding the *boom* metaphor.

INSERT FIGURE 1 ABOUT HERE

Bonanza (Figure 1 (b)) has a Latinate root – from *bonus,* through Spanish meaning ‘fair day’, to English meaning prosperity and success (particularly in relation to mining and resource extraction) – the term was used in the 19th Century when a gold seam was sufficiently large to lead to a gold rush. Bonanza is semantically related to unexpected good luck and opportunity, in turn deriving from the concept of a new beginning. It also has an indirect link with the concept of awakening. In a similar way to the expression ‘manna from heaven’, *bonanza* implies something fortuitous and beyond human control – it has a miraculous or supernatural quality. From the THA the picture that emerges has a positive valence – it infuses a sense of hope and encourages people to look to the future with joy and security. UHD is therefore semantically connected to the idea of good luck – it is a technique that relieves us of primary concerns such as nourishment and that perhaps makes us rich through an abundance of resources. The web of semantic relationships, between fine weather, good fortune and future

security such as that brought about by the metaphor of *bonanza*, unlike revolution and boom, acts to stimulate universally positive feelings within the reader.

When taken together, *bonanza* and *boom* frame UHD as contributing to the basic needs of humanity and providing people with the opportunity for a prosperous future. These metaphors seem to appeal to the basic needs linked to survival and security: from eating to drinking, from breathing to the need of safety, in terms of a shelter to live, and linked to work and to health. In fact, these metaphors structure the discourse to communicate how UHD builds prosperity for communities across *short* temporal horizons – alleviating poverty and stress. They promise future reward: wealth, success, profitability, affluence, opulence, the good life, good fortune, ease, plenty, welfare, comfort, security, well-being within the type hierarchy. Yet within this is a cautionary alternative interpretation (or valence) within the metaphors - they also reveal the short-term nature of this security, that it is temporary, fragile and can leave a worse state of affairs when it has ended. The 'boomtown' and the 'gold rush' are examples of this less positive framing of the boom. Thus, within the discourse metaphor is a subtle call for caution – to maximise the positive aspects and ameliorate the negative ones through careful *long-term* planning, not just the maximisation of short-term economic gain.

The metaphor that conveys the most overt sense of unpredictability in relation to long-term planning is *gamble* (Figure 1 (e)). Its subtypes are *bet* and *stake*, and its supertypes *speculation* and *venture*, which is the surplus of economic risk. *Gamble* as a metaphorical construction is a familiar vehicle for expressing future uncertainties (see for example Ritchie, 2009). Gamble conveys the concepts of probabilistic thinking, economic/environmental risks and of fundamental uncertainty, but also the thrill that comes from relinquishing control in favour of leaving the consequences to chance. This metaphor leads us to think of UHD in terms of unpredictable positive or negative consequences both on an environmental and economic level - that due to the novelty of the technique the outcome cannot be decided in advance. It is a metaphor that ignores potential consequences, which could be dangerous and could cause damage with the hope that only positive outcomes will emerge. Like *boom*, there is a negative moral connotation to *gamble* that we did not make explicit in the type hierarchy. In many cultures and religions, gambling is reprehensible. In Judeo-Christian and Abrahamic religions, *gamblers* are removed from the circle of the faithful as impure, and it is an act in some cases strictly prohibited even in its minimal circumstances, like a playful bet among friends. In environmental discourse, *gambling* stands in opposition to *precaution* – an established principle of environmental governance that tries to foresee negative consequences in advance of action through foresight and active risk mitigation (Stirling, 2003). To define UHD as a *gamble* thus implies that it breaks the norms and conventions of good environmental governance, as established by existing environmental treaties. Thus, this metaphor brings to mind both positive associations from the thrill of loss of control, but also negative feelings and sensations. For the risk-averse, it is associated with the fear of finding oneself in unstable economic and environmental conditions, and thus its use has strongly *normative ethical* implications for the proponents of UHD.

The metaphor of *death* has a clear negative valence. The connection between fracking and *death* (Figure 1 (d)) is the most overtly negative of the discourse metaphors. Among its supertypes, we find destruction on one 'end' and a subtype of "loss" which is in turn a subtype of "causes of sorrow". Therefore, UHD causes sorrow, loss; it is the end and *death* itself. It represents organic and human destruction. However, it is also conceptually presented as an absolute – a binary position to describe the state of the industry as either flourishing (alive) or halted (dead). The *death* metaphor is commonly employed not just to conceptualise the

negative impacts of the industry upon society or the environment, but rather to describe the way in which environmental regulation prevents growth (for example "death knell for the industry" or an industry "strangled at birth"). The *death* metaphor can therefore be juxtaposed against the *boom* metaphor – a state of rapid uncontrolled activity, whereas death is the absence of activity. This powerful imagery is used as a framing device to spur action to save it – that the *boom* or *bonanza* itself is threatened with cessation. The complexity of this discourse is notable. The use of such extreme abstract concepts in the metaphorical framing of UHD reveals the highly emotive nature of the broader discourse within civil society. The use of such metaphors through communicative media is likely therefore to exacerbate social conflict over UHD development, rather than ameliorate it.

The last metaphor of interest is *insanity* (Figure 1 (f)), which has as super-types "mind disorder" and "mental illness" and as subtypes "lunacy", "irrationality" and "derangement". They latter in particular are pejorative terms, associated with shame, stigma, instability, and solitude. While insanity denotes mental instability in informal contexts, fundamentally the metaphor has a medical science root and the term (derived from the Latin word 'sanus' that means healthy) has been used in medicine and psychiatry to refer to psychopathology – the metaphor and its related types are conceptually associated with psychiatric conditions, but they also carry socially negative connotations concerning abnormality or deviance. When UHD is semantically linked to the *insanity* metaphor this reframes the associated risk and danger not simply as morally irresponsible (as with the *gamble* metaphor) but as fundamentally wild, uncontrollable and otherworldly – dangerous because it cannot be rationalised. Yet the metaphor is also used as a personal slur against decision-making authorities ("actor X would be insane not to…"). Insanity is a term that seeks to diminish or marginalise against specific actors by pointing out their irrationality and then exaggerating it to a problem of mental health. This reveals a discourse of *bounded rationality* - that rather than being rational actors in policy-making, politicians/green activists/unconventional gas proponents are psychologically ill-equipped to make good judgements about UHD outcomes – and this is a phenomenon seen in the communication of a number of environmental risk domains (cf. Holden, 1984).

4.2 Metaphor Tracking

When examining the patterns of metaphors use within the text corpus, we find a highly uneven distribution of UHD-related coverage over time as well as across newspapers (Figure 2 panel A).[2] In the first five years of the review period, coverage is almost exclusively restricted to the two Australian newspapers in our sample: The Age and Herald Sun, showing local peaks in May 2008 as well as mid-2010, with the latter coinciding with the formation of the Lock the Gates Alliance to protest UHD in Queensland. From early 2011 onwards, coverage picks up across all three countries, reflecting developments such as minor seismic events linked to Cuadrilla's drilling of Presse Hall in Lancashire (UK) and the UK government imposing a moratorium on shale gas extraction; discussions around negative consequences of drilling in Arkansas and Wyoming (US); and the extension of a moratorium in New South Wales (Australia).

The Guardian and the Daily Telegraph clearly stand out in terms of peak coverage levels, with the Daily Telegraph reaching the highest number of articles per month (109) across the entire sample in August 2013, to some extent linked to UHD-related protests in the town of Balcombe

[2] See supplementary material for a list of key dates and events that received media attention.

(UK). However, whilst Daily Telegraph coverage drops continuously right after this peak and reaches coverage levels similar to the Australian and US-based newspapers by late 2014, the Guardian continues to show a very high article frequency until 2016 and though it then subsequently drops, levels remain clearly higher than those observed for the other five newspapers. Here, several clear peaks occur between August 2013 and May 2016. In stark contrast, the uptake in coverage in the New York Times and the Washington Post, whilst also starting in early 2011, remains much more modest by comparison. It is interesting to note that for Australia and the UK, article frequencies for the two centre-left newspapers is much higher when compared to their conservative peers. In the US, coverage levels in the New York Times are clearly higher than those in the Washington Post throughout the review period.

INSERT FIGURE 2 ABOUT HERE

In very general terms, metaphor occurrence unsurprisingly follows the trends and patterns in relation to coverage levels identified above (Figure 2 panel B). Metaphor frequency increases markedly with the uptake of fracking-related coverage from early 2011, reaches a peak in late 2012 and afterwards follows a downward trajectory. One point to note, however, is that the peak in metaphor frequency (Figure 2 panel B, December 2012) does not coincide with the equally clear peak in overall newspaper coverage (Figure 2 panel A, August 2013). Furthermore, *boom* and *revolution* emerge as clearly dominant metaphors throughout, whereas the use of other metaphors is much more limited and often associated with specific periods within the overall review period. Most notably, the use of the metaphors *bonanza* and *game changer* is mostly restricted to the years 2011 to 2014. Likewise, Table 3 shows that metaphors are not evenly spread across the six newspapers. Instead, metaphors are more likely to appear in the two US-based newspapers and, to a certain extent, in the British Daily Telegraph, whereas frequency in the two Australian newspapers in particular is clearly lower. The use of the *boom* metaphor is fairly widespread across all six outlets, but particularly frequent among US-based newspapers; *revolution* is mostly restricted to the UK-based and US-based newspapers but particularly prominent in the Daily Telegraph. At a lower level, the same pattern applies to *bonanza*, *game changer* and *gamble*. *Insanity* forms an exception in that it can exclusively be found in the two Australian newspapers.

INSERT TABLE 3 ABOUT HERE
INSERT FIGURE 3 ABOUT HERE

Figure 3 shows that the occurrence of metaphors is not simply a function of article frequency. When metaphor use is expressed as a percentage of the number of UHD-related articles per year, it becomes clear that the years 2012 – 2014 are most closely associated with increased metaphor use. In line with overall coverage on UHD, metaphor deployment per number of articles also levels off markedly in more recent years. Metaphor frequency as a percentage of the total number of articles in a given month (expressed as 6-month moving averages in Figure 3) reaches peak values of above 30 per cent in early 2013 but decreases to level of 10-15 per cent from early 2015 onwards[3]. To some degree, this overall trend is replicated at the level of all individual newspapers included in the sample. However, the Australian Herald Sun forms an exception in that it reaches a plateau from 2012 onwards and does not show the same downward trend in more recent years.

[3] Note that metaphor frequency as expressed in Figure 3 is highly volatile prior to 2011 due to the very limited amount of overall coverage.

INSERT FIGURE 4 ABOUT HERE

Crucially, Figure 4 shows that there are notable country-level differences in metaphor frequency over time. Coverage and metaphor occurrence over time develop in similar ways in UK and US-based newspapers (albeit peaking at different levels in both cases), with metaphor occurrence increasing at a slightly earlier point in time in the two US-based newspapers. This earlier uptake is largely driven by the *boom* metaphor, coinciding with the point in time in which the it was reported that the US surpassed Russia in both oil and gas production as a result of UHD development and export. By contrast, even though coverage in Australian newspapers picks up at a much earlier stage, metaphor occurrence only increases once we observe an increase of the use of fracking-related metaphors in UK and US-based newspapers.

A number of trends and patterns have emerged from our frequency analysis across the six broadsheet newspapers from three countries, showing different levels of penetration between countries and individual newspapers. The *boom* metaphor appears clearly dominant in the two US-based newspapers, whereas *revolution* metaphor is much more widespread in the UK, most notably in the Daily Telegraph. In contrast, neither of these two are particularly frequent in the Australian publications. However, the *insanity* metaphor is exclusively observed in Australian broadsheets (albeit at a much lower frequency level), whereas UHD as a *panacea* is only referred to in UK and US-based newspapers. In general terms, it appears that differences in metaphor deployment can be mapped alongside country borders (cf. Shaw and Nerlich, 2015) rather than for example political alignment.

Metaphorical imagery appears particularly widespread in US-based newspapers, whereas the two Australian broadsheets show relatively low levels of metaphor deployment. It is notable that the increase in metaphor occurrence appears to follow the uptake of metaphors in UK and US-based discourse, whereas the uptake of metaphors in Australian newspapers is not in line with the uptake of UHD *coverage* in Australian newspapers. In the UK, the Guardian emerges as an atypical case: on the one hand, Guardian coverage of UHD clearly surpasses that of the other five newspapers, not least because of its extensive sustainability section; on the other hand, metaphor frequency per article is markedly lower than in the Daily Telegraph and more in line with the two Australian publications. One explanation for this deviation from overall trends and patterns might be the extensive sustainability section of the Guardian, with a steady flow of UHD-related news items. In contrast, UHD is less likely to make it onto the media agenda in the other five newspapers in the absence of dedicated sustainability pages; here, coverage is more likely to be restricted to cases in which UHD is headline news, thus also reflecting a more emotive language and higher levels of metaphor deployment.

Discussion and conclusions

Metaphors reveal the complexity and contradiction by which we communicate and perceive UHD. Discourse metaphors are powerful in shaping ideas and attitudes – when exposed to metaphorical framing, individuals are systematically influenced by metaphorical descriptions (Bosman, 1987). When employed in mass media, discourse metaphors have considerable power in shaping the broader *imaginaries* (i.e. culturally specific symbols, beliefs and ideologies) that influence public perception, citizen action, and policy responses in subtle but crucial ways (Moore et al., 2015). On a basic level, metaphors are used to convey two antithetical visions by the use of semantically positive and negative images of the technology,

of the future socio-economic prospects of affected communities and the environment, and of the decision-makers and other stakeholder involved. Yet the metaphors employed commonly had twin meanings that were context-dependent – encompassing both positive and negative semantic valence (Mohammad, 2016). We posit therefore that rather than simply providing positive or negative views of the technology in question, the metaphors collectively articulate two broader discourses that subtly shape the way in which we perceive the technology. The first is of *economic gain across temporal horizons:* incorporating the *boom*, *bonanza, revolution* and *death* metaphors. The second is of *risk tolerance and decision-making,* which involves the *gamble* and *insanity* metaphors.

The *economic gain across temporal horizons* discourse steers readers towards thinking about the timescales of economic benefits in a broader social and environmental context. A *bonanza* is a framing of short-term economic gain with an overwhelming semantically positive focus – a windfall or unexpected surprise that improves the economic condition of the local community/industry/taxpayer –without reference to negative consequences. Though on the surface *boom* is very similar to *bonanza*, it also invokes an interpretation that the economic gain is rapid, temporary and swift to contract – leaving a boomtown that, like the gold rush town, becomes overburdened with population loss, socio-environmental and health problems and an infrastructural legacy from resource extraction that is expensive to maintain. Like *boom, revolution* implies sudden change, though differs because a boom is temporary, and a revolution implies something longer term - a fundamental change. Revolution invokes the idea of a structural difference in the nature of the energy economy that results from the application of UHD technology. The revolution might be 'permanent' (to use Marxist terminology) or it might imply something axial – that future changes to the energy economy (future revolutions) will replace UHD in an ongoing cycle. Finally, *death* also invokes the finality of these processes of economic and socio-environmental change. Its common use in context e.g. the 'death of the industry' implies the cancelation or negation of the positive valence of the other metaphors. As a discourse metaphor *death* invokes a negative semantic valence on *cessation of growth* – it may be fast and sudden (the term 'strangled at birth' was quoted by the CEO of a major UK UHD organisation for example) or slow through tightening regulations. When taken together, these four metaphors discursively frame UHD in terms of *sudden change,* which confirms similar findings by Partridge et al. (2018) that highlight the importance of *urgency* to the way in which UHD is framed in public policy and stakeholder perceptions. However, when qualifying the suddenness of UHD, *bonanza* implies an unexpected short-term positive change, *boom* implies short-term gain and longer-term loss, whereas *revolution* implies a 'long tail' of economic gain within a cycle of development and change, and *death* implies no change at all. We posit therefore that these metaphors are essential tools in communicating the different visions of the temporal scales of economic and socio-environmental trajectories for UHD.

The second discourse of *risk tolerance and decision-making,* qualifies the relationship that societies have with UHD environmental and socio-economic risks, given the temporal nature highlighted in the first discourse. We argue that *gamble* emphasizes the risk dimensions – particularly their inherent unpredictability. Yet both *gamble* and *insanity* are judgements, not just about the riskiness of the technology and extractive processes, but of the judgement of those that make decisions about them. As in many environmental controversies, proponents of a specific course of action towards UHD will commonly question the rationality of their opponents – using terms like 'irrational' (to which 'insane' is the extreme pejorative form) (Ocelík and Osička, 2014) in order to undermine the legitimacy of opposition claims. This is a variation of *ad hominem*. The two metaphors invoke different types of ad hominem attacks to decision-makers. Gamble implies a moral judgement– that decision-makers are aware of the

consequences being potentially negative, but go ahead anyway; whereas *insanity* implies that decision-makers are *not aware* of the consequences of their chosen course of action, and that this is detrimental overall, because the decision-maker lacks an essential capacity to understand what is best. Thus, whereas the first discourse evokes a framing of the material impacts of UHD across time, the second evokes a framing of the political decision-making processes and decision-makers themselves.

Finally, we note that these discourses 'spike' at various times beginning in 2012 up to mid-2016. The prevalence of metaphorical language drops away by 2017 in terms of coverage across our international sample, and in the Australian case, metaphorical language does not track with issue coverage. We speculate that this drop in the use of metaphorical language implies a change in the way in which media commentators *think* about UHD. One potential explanation is that there has been a collective move from 'system 1 to system 2' thinking or 'hot to cold' thinking on the issue. System 1 is automatic, uncontrolled thinking which involves rapid judgments and decision-heuristics; and system 2 is controlled, involving conscious reflection, calculation and filtering of system 1 (Kahneman and Egan, 2011). As rapid change in the industry emerges, and new UHD appears in the USA, UK and Australia in 2012, this potential dynamic of change and *threat* (Jaspal and Nerlich, 2014) may influence system 1 thinking observed by the prevalence of metaphorical language around temporal scales, risk and decision-making; which then later dies away to system 2 thinking involving less emotive metaphorical framing as UHD becomes an increasingly familiar aspect of the energy landscape (mirroring the work of McNally et al., 2018). This is significant, as other studies have shown, because emotive language has an observable effect in stimulating social opposition to UHD (Evensen, 2016; McNally et al., 2018), so the rise and fall of metaphorical language may exacerbate or ameliorate social opposition at key moments of UHD planning and policy making.

Conclusions and future research

When reduced to their simplest components, the two dominant metaphorical framings of UHD (*economic gain across temporal horizons*, and *risk tolerance and decision-making*) across English-speaking media in the three countries, show the technology as temporally-situated, fundamentally risky, and governed by unreliable decision-makers. It should be noted that whilst the *economic gain across temporal horizons* discourse emerges as generally more frequent across the three countries, clear variations can be identified, with the two US-based newspapers emphasizing the boom metaphor, whereas UK-based coverage is dominated by the *revolution* metaphor. At much lower levels, the discourse of *risk tolerance and decision-making* is reflected by the *insanity* metaphor in Australian newspapers, whereas coverage in the UK and USA is geared towards the *gamble* metaphor. When looking at the media framing effects, both of these discourses emphasize *uncertainty, short-termism,* and *unreliability*. We conclude therefore that the broad media discourse across our sample will likely steer readers to prefer a *precautionary approach* to the governance of UHD – one which better models the consequences and negative socio-environmental outcomes (instead of the short term economic gains) and stimulates public confidence in the capacity of decision-makers to make good quality decisions about the governance of unconventional oil and gas development.

Though our study does not examine the causative relationship between metaphor deployment and public attitudes it is notable that public support is either declining (UK, Australia) or is contextualised (USA) in the context of a precautionary media discourse around fracking. There is strong evidence of anti-fracking public perception in the UK. The Government's own public

attitudes tracker put public support for fracking at 13% support and 35% oppose (BEIS, 2019), showing a downward trajectory for support. In Australia coal seam gas activity is largely "tolerated", though there is evidence of a fall in support over time (CSIRO, 2016). In the USA, Davis and Fisk (2014) find that a "small-plurality expresses support. However, a majority of our respondents favor regulatory actions to ensure that health and environmental concerns are not sacrificed." It is worth examining, therefore, in future research, whether or not the patterns of specific spikes in metaphorical language use correlate with the emergence of specific anti-fracking campaigns, at particular time points, and whether or not such metaphorical language carries over into their campaign materials – an important issue, given that anti-fracking advocacy groups have proven successful at influencing news media content (Neil et al. 2018). More generally, future research should explore the link between metaphorical framing in the mass media and public opinion in a cross-country setting. This would be indicative of a causative influence of discourse metaphors in shaping political action.

Figure 1. Source type hierarchies and corresponding mapping to the target domains.

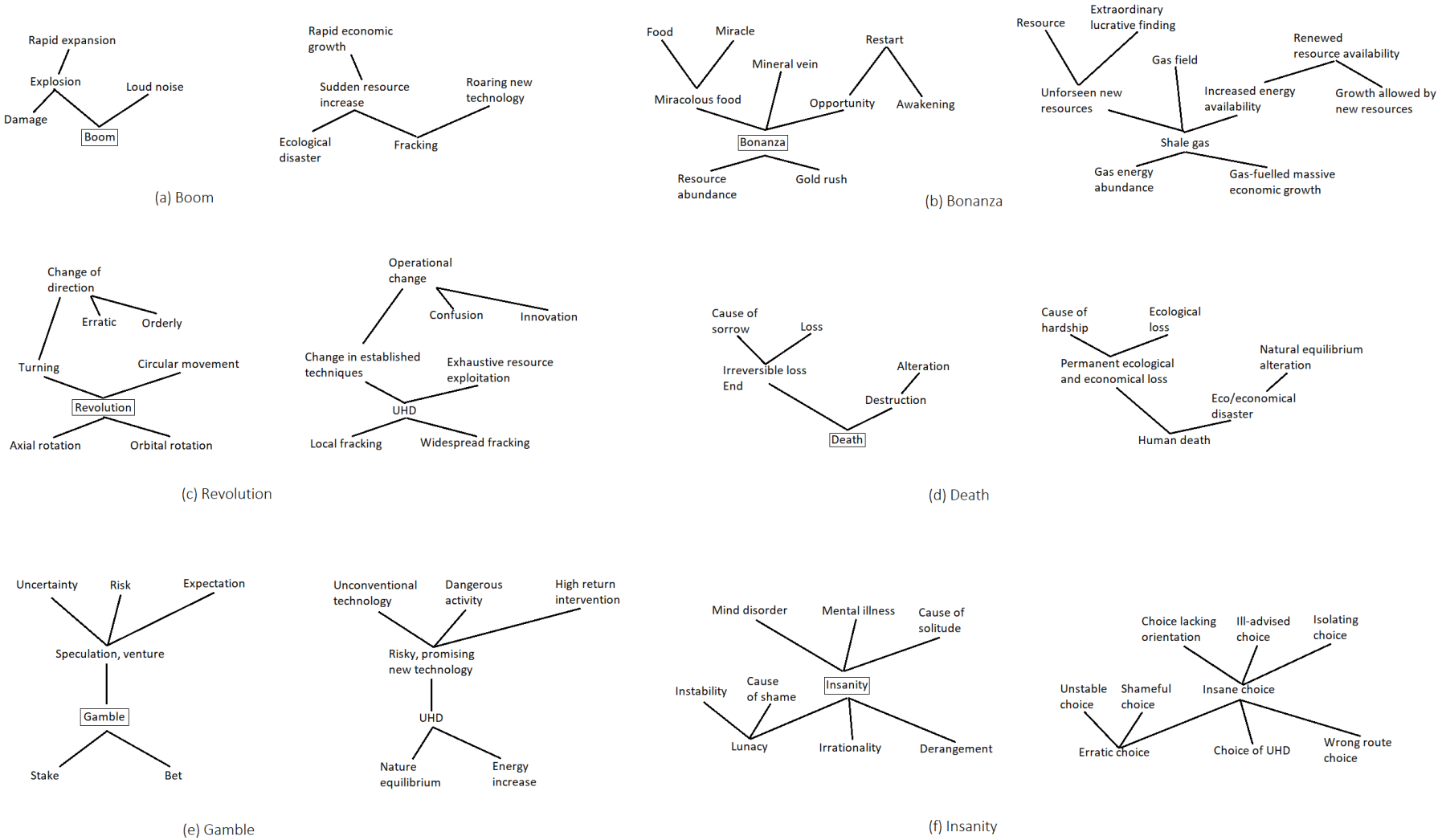
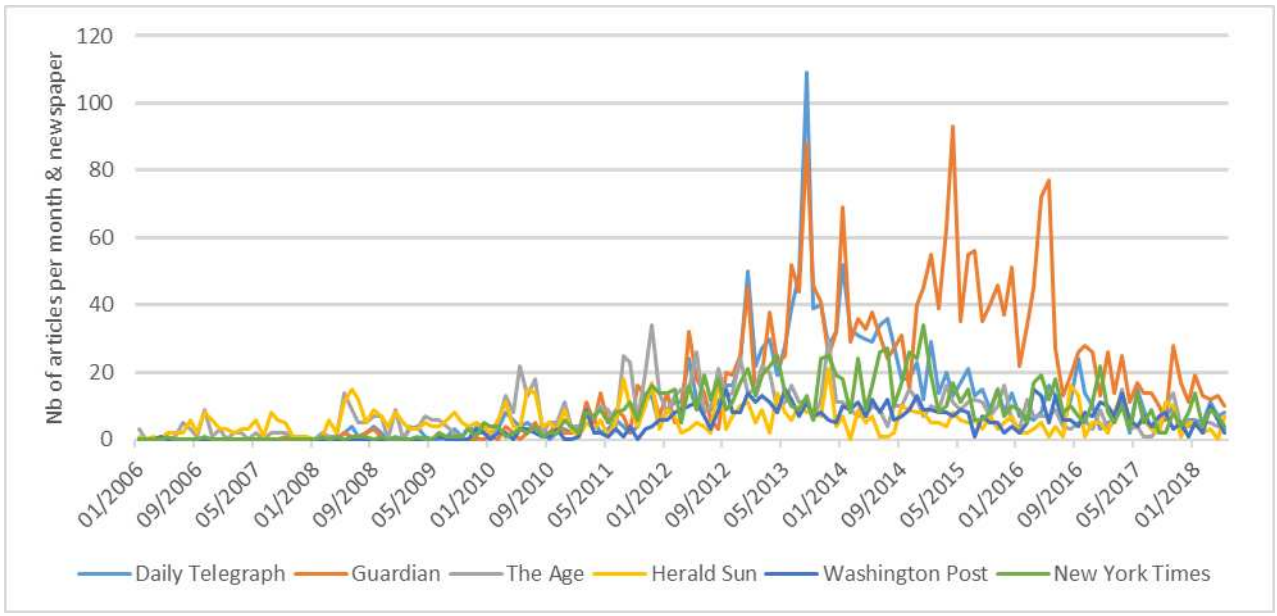


Figure 2. Fracking-related articles and those containing metaphors

(a) Frequency of fracking-related articles by newspaper



(b) Frequency of fracking-related metaphors by metaphor type

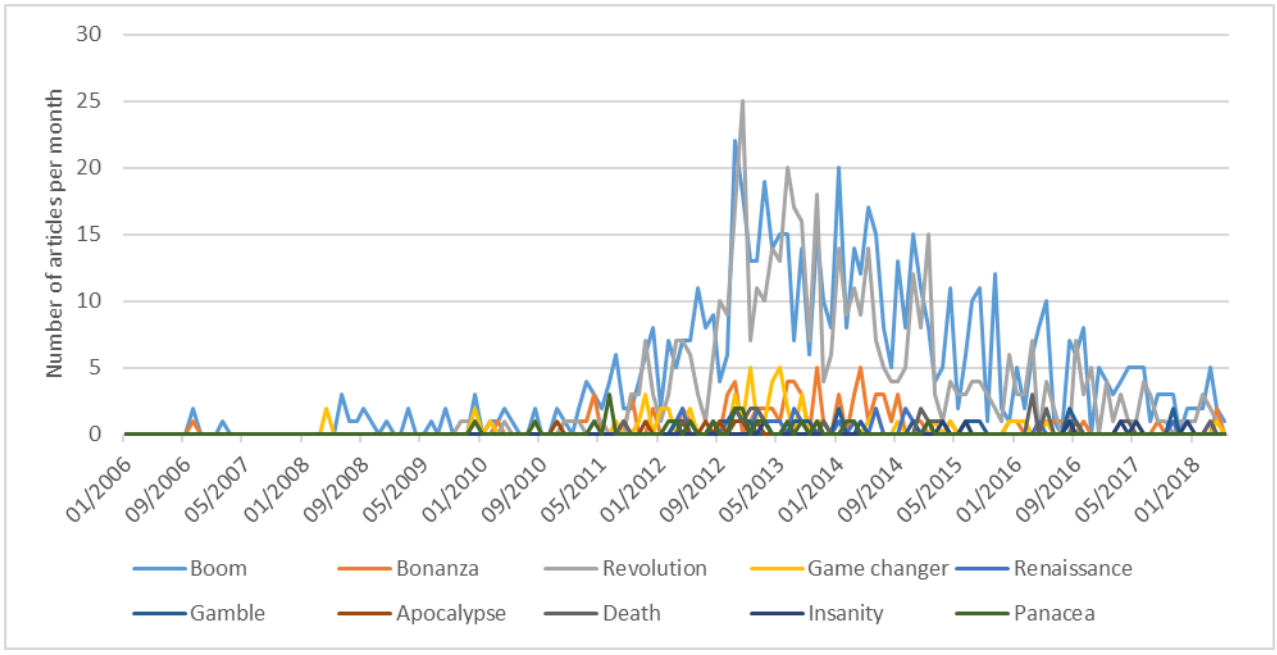


Figure 3. Metaphor frequency over time

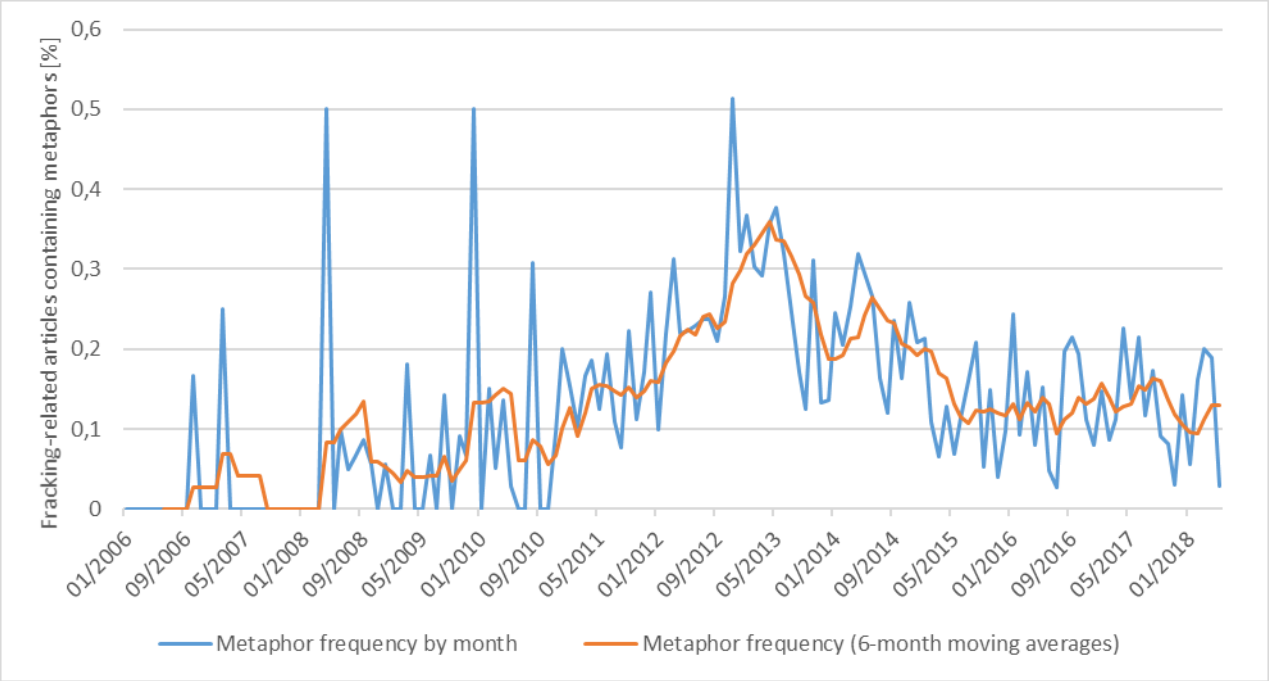
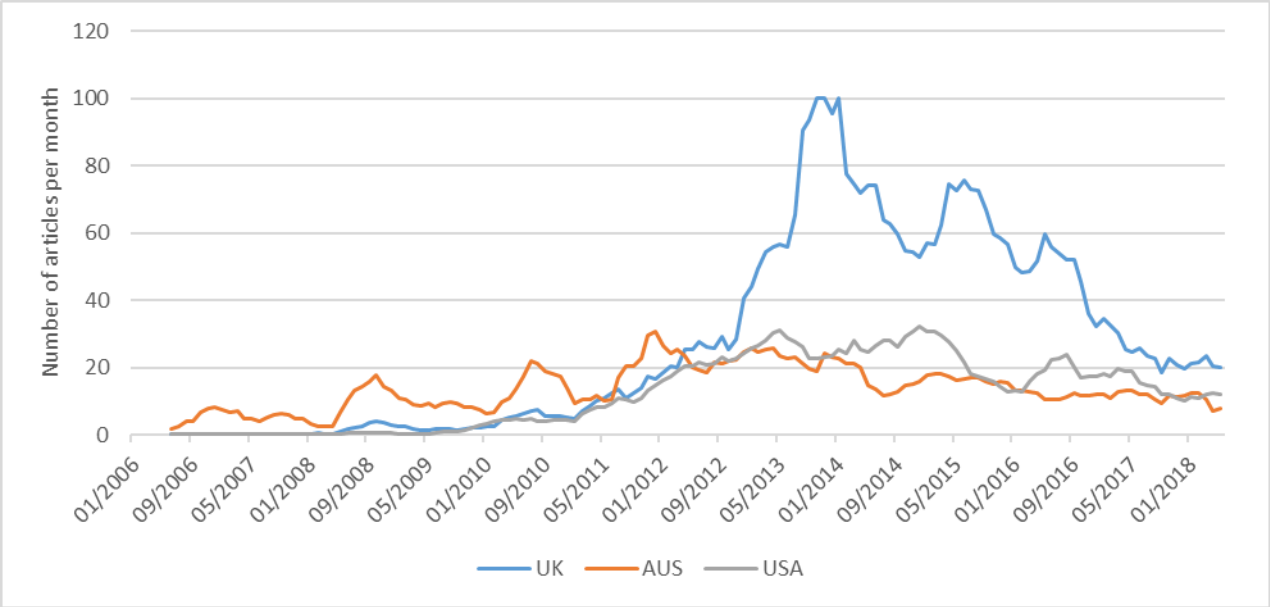


Figure 4. Fracking-related articles and those containing metaphors by country

(a) Frequency of fracking-related articles by country (6-month moving averages)



(b) Frequency of fracking-related metaphors by country (6-month moving averages)

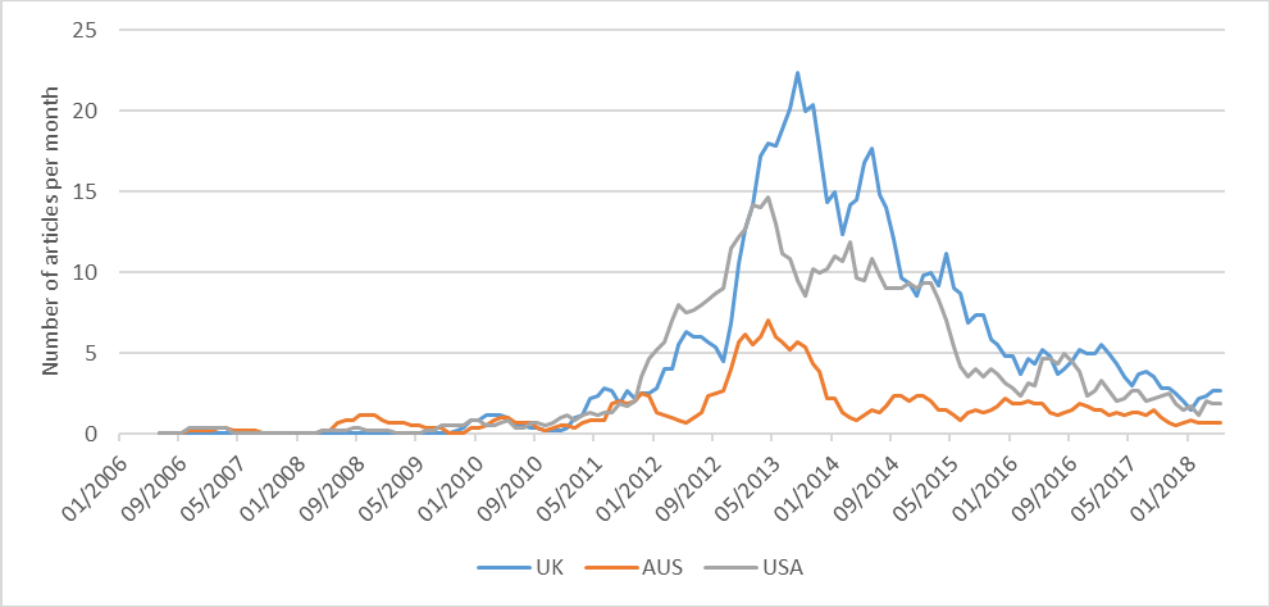


Table 1. Newspapers included in the study

Title	Country	Circulation 2016	Total number of UHD-related articles in sample	Average number of articles per month	Political alignment
The Guardian	UK	164,163	2,483	15.33	Centre-left
Daily Telegraph	UK	472,033	1,586	9.80	Centre-right
The Age	Australia	96,120	1,168	7.21	Centre-left
Herald Sun	Australia	331,715	833	5.14	Centre-right
New York Times	USA	2,101,611	1,161	7.17	Centrist/ liberal
Washington Post	USA	356,768	664	4.10	Centrist/ liberal

Table 2. Illustrative examples of UHD-related metaphors

Boom	As environmental concerns drive power companies away from using coal, natural gas has emerged as the nation's No. 1 power source. Plentiful and relatively inexpensive as a result of the nation's **fracking boom,** it has been portrayed as a bridge to an era in which alternative energy would take primacy.	New York Times	USA	29/03/2018
Revolution	BP'S largest project slated for 2017 has fired up in Oman, in the major's most ambitious bid to translate the US **fracking** boom across new borders. The $16bn (£11.9bn) gas project has used the same controversial drilling technique, which unleashed an energy **revolution** in the US, to prepare around 200 wells to tap gas that lies three miles below the earth's surface in extremely hard, dense rock.	Daily Telegraph	UK	26/09/2017
Bonanza	While Australia's gas boom, particularly for **coal seam gas,** is of a much smaller scale than the US shale **bonanza,** many of the issues are identical.	The Age	AUS	03/07/2016
Game changer	Then there's the US, the world's biggest economy, where ultra-cheap energy costs from **coal seam gas** is a **game changer.**	The Age	AUS	18/08/2013
Death	An amendment to the Infrastructure Bill, which contains provisions to make the extraction of **shale gas** and oil easier and commercially viable, would have imposed a moratorium on the process for up to 30 months. It was heavily beaten after Labour abstained having forced ministers to agree to tougher regulation. Had the vote been passed it might have sounded the **death** knell for **fracking** before it had even got off the ground.	Daily Telegraph	UK	27/01/2015
Renaissance	For a state that established itself on a gold mining boom, Victoria sure knows how to stop even the smallest mining **renaissance** in its tracks. The decision to ban **fracking** -- underground hydraulic fracture stimulation which is used to help gas flow in onshore wells -- is a classic case of misinformation and pure humbug being used to conveniently redirect investment to other states.	Herald Sun	AUS	31/08/2012
Gamble	Energy analysts agree the UK cannot replicate the American experience of **fracking**, and that **shale gas** will do little or nothing to lower bills. Pinning the UK's energy hopes on an unsubstantiated, polluting fuel is a massive **gamble** and consumers and the climate will end up paying the price.	The Guardian	UK	13/12/2012
Panacea	Natural gas is not a **panacea.** The extraction process known as "**fracking**" - responsible for the current glut - raises serious environmental concerns. Ultimately, the only way to halt climate change is to wean the global economy from its dependence on fossil fuels.	Washington Post	USA	26/02/2013
Apocalypse	The reason we don't need **fracking** is not because we're deep greens, waiting for an **apocalypse,** it's because we are the best placed nation in Europe, among the best placed in the world, for alternative energies - we are windy, we are surrounded by tides, we've played a key part in the development of renewables, and could continue to (so long as nobody destroys our universities).	The Guardian	UK	27/12/2012
Insanity	We could actually go down a similar path with **coal seam gas** to replace coal-fired power, as **shale gas** has done in the US. Of course, first best would be to stick with the coal; but at least with (more expensive) gas we could sustain reliable, relatively cheap (compared with useless wind) and plentiful power. But no, state governments have insanely stopped even that.	Herald Sun	AUS	30/05/2017

Table 3. Metaphor frequency

	Guardian	Daily Telegraph	The Age	Herald Sun	New York Times	Washington Post
	UK	UK	AUS	AUS	USA	USA
Total number of articles (Jan/2006-May/2018)	2483	1586	1168	833	1161	664
Boom	4.87%	6.31%	7.02%	5.16%	16.45%	17.77%
Revolution	5.03%	11.29%	2.40%	2.16%	7.49%	6.02%
Bonanza	0.89%	2.02%	0.26%	0.36%	1.81%	0.60%
Game changer	0.44%	1.45%	0.34%	0.60%	1.03%	0.90%
Death	0.12%	0.44%	0.00%	0.12%	0.43%	1.81%
Renaissance	0.08%	0.19%	0.00%	0.24%	1.29%	0.90%
Gamble	0.28%	0.63%	0.00%	0.00%	0.43%	0.30%
Panacea	0.32%	0.50%	0.00%	0.00%	0.26%	0.45%
Apocalypse	0.04%	0.13%	0.17%	0.12%	0.34%	0.00%
Insanity	0.00%	0.00%	0.17%	0.60%	0.00%	0.00%
SUM	12.12%	24.15%	10.36%	9.36%	29.97%	28.92%

Supplementary material (online only)
List of key dates and events that received media attention

UK

- August 2010 - Cuadrilla starts drilling Presse Hall in Lancashire, Northwest England
- April 2011 - Cuadrilla's drilling triggers two minor seismic events
- May 2011 - House of Commons Energy and Climate Select Committee report concludes shale gas will be a "game changer"
- July 2011 - Government imposes moratorium on shale gas extraction
- June 2012 - Royal Society and Royal Academy of Engineering Report recommends mitigation steps to reduce seismic risks
- December 2012 - UK Government lifts moratorium on UHD
- July 2013 - Protestors in Balcombe lead opposition to UHD in their town
- July 2015 - Lancashire Country Council rejects all of Cuadrilla's planning applications for UHD
- August 2015 - Government announces plans to speed up planning applications
- December 2015 - Government grants new exploration and development licenses
- August 2016 - Government consultation on shale gas wealth fund and community engagement
- October 2017 - Scotland bans UHD
- October 2018 - Fracking paused as magnitude 0.4 earthquake detected near a Lancashire well
- Feb 2019 - Fracking refused at a second site in Lancashire
- March 2019 - the High Court found the UK government's policy was unlawful and failed to consider the climate impact of shale gas extraction

USA

- January 2010 - Gasland documentary released
- March 2010 - EPA initiates study into impacts of UHD on water
- April 2011 - the Ground Water Protection Council launched FracFocus.org, an online voluntary disclosure database for hydraulic fracturing fluids
- July 2011 - Arkansas Oil and Gas Commission shuts down four waste-water disposal wells and imposes permanent moratorium on disposal in counties which have experienced earthquakes
- December 2011 - EPA issues draft report claiming that hydraulic fracturing was "likely" the cause of water contamination in Pavillion, Wyoming
- May 2012 - Vermont becomes the first US State to ban UHD
- July 2012 - Earthworks' Oil & Gas Accountability Project (OGAP) finds chemical contaminants in the air and water of rural communities affected by the Shale extraction process in central New York and Pennsylvania
- November 2012 - USA surpasses Russia in oil and gas production
- July 2013 - Pennsylvania imposes moratorium on UHD
- December 2014 - Oklahoma experiences 538 seismic events of magnitude 3.0 or greater in 2014
- December 2014 - The State of New York imposes ban on UHD

- January 2015 - EPA concludes study of groundwater impacts of natural gas drilling
- November 2016 - Monterey county in California bans UHD
- April 2017 - The State of Maryland bans UHD

Australia

- November 2010 - Lock the Gates Alliance formed to protest UHD in Queensland
- December 2011 - New South Wales extends moratorium on UHD
- November 2012 - Victoria places moratorium on UHD
- August 2013 - *Undermining Australia - Coal vs. Communities* documentary released
- October 2013 - *Fractured Country - An unconventional invasion* documentary released
- March 2015 - Frackman documentary released
- September 2016 - Victoria has permanently banned UHD
- November 2018 - Western Australia government lifts moratorium on UHD

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