UNDERSTANDING HOW AUDIENCES INTERPRET SCIENCE NEWS FRAMES

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Abstract: This thesis is an investigation into audience perception of the use of science frames versus non-science frames in news journalism covering science content. The effect of a science frame versus a non-science frame is measured through survey treatments that measure three dependent variables: The audience perceptions of the message source, meaningfulness of the message, and the journalistic 'objectivity' of that message. Participants responded more favorably to a science frame than to a non-science frame in national coverage of the discovery of Homo naledi from 2015 for all three variables. The findings indicate that using a non-science frame to cover a science story does not reflect well on the journalist, does not make the story more meaningful, and does not increase a sense of journalistic balance for audiences.

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CHAPTER I

INTRODUCTION

Science is always a construct; a model of reality based on observation. It falls to journalists to translate the esoteric jargon of the sciences into meaningful content for public action. But the journalist covering science stories must make many decisions in translating models of scientific research into meaningful news narratives for the general public. Albert Einstein addressed the difficulties presented to the science journalist:

> Either he succeeds in being intelligible by concealing the core of the problem and by offering the reader only superficial aspects or vague allusions, thus deceiving the reader by arousing in him the deceptive illusion of comprehension; or else he gives an expert account of the problem, but in such a fashion that the untrained reader is unable to follow the exposition and becomes discouraged from reading any further. (Einstein, 1949, p. 5)

Einstein's words seem naïve in our current media climate, where political and religious separatism, corporate interest, and the politics of ratings and sales have become part of constructing news narratives (Bennett, 2005). Citizens' and policy-makers' ability to evaluate the importance of scientific findings and to orient action toward it is formed largely through the mass media (Boykoff, M., 2005). As da Silva explained to members of the World Science Forum, "science journalists are an essential glue in civil society... But citizens, policy-makers and

administrators often do not have the time nor the expertise to fully appreciate its complexity and its implications" (da Silva, 2005, para. 3). Mass media are the mediating variable in public understanding of science issues.

The line that separates science and society is dissolving with new communication technology bringing science to the masses (Gibbons, 1999). Science policy and science problems are now defined in the mainstream, and the misrepresentation of science found in journalism are amplified through public discourse. The shifting locus of science discourse into mainstream journalism opens the door to inaccuracy and outright confusion through journalistic processes in which "the trend toward tabloidization, trivialization, sensationalism and dumbing-down was not only producing a less-informed populace but driving away readers and viewers" (Hartz & Chappell, 1997, p. 119).

Media outlets are making patterned decisions about the presentation of news that can be referred to as frames (Bennet, 2005; Gitlin, 1980). While frames are meant to help make the news more relatable, they have been found to limit the ability to facilitate successful communication between researchers and their publics by obfuscating the science content of news stories (Haigh, Bruce, & Craig, 2008; O'Neil, 2015; Trumbo, 1996). Political and ideological content find their way into science news via the frames chosen to present that news (Bennet, 2005; Gitlin, 1980; O'Neil, et al., 2015). This leads to what some have called 'the war on science' (Brewer, 2013), where ideological conflicts are played out with the competing frames given to science news stories to control the terms of discussion in public discourse.

Nowhere does news journalism's ability to communicate scientific findings seem more pressing than in news about climate science and environmental problems: The science news topic par excellence. But the public is generally misinformed about climate change (Trumbo, 1996). Boykoff (2005) found that it "is clear that science and policy shape media reporting and public

understanding. However, it is also true that journalism and public concern shape ongoing climate science and policy decisions" (Boykoff, M., 2005). This presents a non-linear system of influence, embedded in an industry with long-running professional practices and structures that pattern news content, and ultimately influence policy through incomplete understandings. But how can we address this disparity?

Lack of science training among journalists, the commercial interests of broadcasters, the perceived lack of interest or understanding of science in audiences, and the traditions of journalistic story-telling all readily emerge to explain deficiencies in depictions of science. Journalists first must identify the importance of science stories and the relevant sources for those stories (Dunwoody & Scott, 1982; Evans, 1991; Trumbo, 1996). Journalists must synthesize the information they gather by processes of translating and summarizing it, which opens the possibility of error in the story content through emphasis and omission **(**Borman, 1978; Evans, 1991; Singer, 1990). Journalism's preoccupation with 'central compelling characters' and emotionalism used to reveal news content is another the way that objectivity is lost (MacDonald, 2005; Molek-Kozakowska, 2013; Suleski & Ibaraki, 2010). And while science and journalism are principled on ideas of objectivity, the word does not mean the same thing in the two fields. Science seeks to balance factual evidence to discern the real; journalism seeks to balance the competing interests of its various publics to present a politically workable presentation of the real, which opens science discussions to manipulation by corporate, political, and ideological interest (Boykoff & Boykoff, 2004; Boykoff & Boykoff, 2007; Boykoff, M., 2005; Boykoff, T., 2008). Interest groups have used the news media to recreate messages that have been carefully constructed to obscure the impact of research that challenges their stance (Rampton & Stauber, 1997; Sproule, 1994), turning science news into a political contest in some instances (Bonds, 2010; Miller, 1999).

The potentials of news media to present ideas based in science fact give way to the economic values of attracting and maintaining viewership. The assumption that publics are using science news primarily for entertainment and, therefore, it must be shoe-horned into a familiar narrative format that obscures the scientific process itself and poisons the well of public science discourse. As these narratives are reproduced, frames emerge that privilege some interpretations of science over others and inculcate ideological and economic values (Gitlin, 1980). Many science news frames demonstrate a political or ideological bias that is roughly equivalent with the right/left or conservative/liberal dichotomy that has emerged in American political ideology (Dunlap, Xiao, & McCright, 2001). Some argue that being able to influence how a story is framed amounts to political power (Bonds, 2010; Miller, 1999) where public opinion is based on the latest or biggest news story (Brulle, Carmichael, & Jenkins, 2012; Mazur, 1990). Framing becomes a way to link science news content to other issues in the news and a way to instill political ideas as inherent to science stories.

The purposeful use of media frames in news stories changes the way people interpret and react to the story (Lynch and McGoldrick, 2012), but audiences tend to be at least aware that these frames exist and that they are influential (Ryghaug et al., 2011). Viewers have been shown to use popular news media frames in combination with other sense-making strategies to understand the complexities of science news. Specific media frames have been identified that helped audiences to structure their interpretations of science issues (Ryghaug et al., 2011). But, how do frames influence audiences' ability to find meaning in science news and make sense of science content? How do frames influence audiences' perceptions of the journalist as source in science news? How do frames influence audiences' perceptions of 'objectivity' in science news? And do audience interpretations of frames reflect the ideological dualism documented in science news by other researchers? While there is little research on how audiences interpret science news,

there is a wealth of research on how science news messages are constructed that can point toward possible interpretations.

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CHAPTER II

Review of Literature

One of the earliest and most persistent concepts in studies of science news is evaluating accuracy. Charnley's (1936) concept of accuracy in newspaper journalism has been adapted for magazines (Borman, 1978; Singer, 1990) and television news (Evans, 1991; Singer, 1990; Hanson & Wearden, 2004). Research into the accuracy of specialized news, such as medical news (MacDonald, 2005), crises news (Singer, 1990), and science news (Borman, 1978; Evans, 1991; Fahnestock, 1986; Tankard & Ryan, 1974) evolved later from Charnley's discussion of news accuracy in general. A major theme in this work was the question of whether an individual error in news reporting is objective or subjective in nature (Charnley, 1936: Hanson & Weardon, 2004; Tankard & Ryan, 1974). While the idea of an objective error is relatively straightforward because it indicates a factual or verifiable error, categories of subjective errors are more ambiguous: They are subjective because they indicate the need for interpretation or contextual information. Tankard and Ryan (1974) found that most science newspaper articles (91.2%) had errors, and more than a fifth had errors in the lead paragraph. But most of these 'errors' were errors of omission ('relevant information about method of study omitted,' 'relevant information about results omitted,' etc.). The act of omission could be ascribed to the summarizing and translating processes a journalist engages in to make research intelligible to their audience.

Singer (1990) makes it explicitly clear that the commonly recognized types of error are

consistent with purposeful journalistic practices. Then the idea of error and accuracy becomes a construct of the researcher. What some researchers have called 'errors of emphasis' may not represent error at all, or even inaccuracy because they make the story accessible to lay readers, which is the journalist's purpose. Secondly, that if we judge accuracy in terms of similarity between such texts, differences must be shown to not fulfill separate purposes to be considered error. Singer (1990) points out that however different a news story may be from the original research it covers, inaccuracies that render the subject intelligible are not errors, which brings forth a third point: If there is purpose in these supposed inaccuracies that distort science messages, isn't finding that purpose a more interesting research question?

Moreover, these studies measured accuracy with the interpretations of experts from the respective fields of research covered in the news articles. But, is technical accuracy the main influencer on audience understanding of science news? Without connecting the idea of accuracy or error to audience understanding, the literacy needs of audiences are ignored. Treating all these categories of inaccuracy as error assumes that translation and omission negatively impact audience understanding and all inaccuracies are therefore an error, a mistake or a failing on the part of the journalist.

Writing is a process of decision-making, and journalists must respect the needs of their publics and editors as well as their news sources. For the same reason, the preceding research can tell us little about a news article's *salience* in communicating abstract science ideas to a larger audience; at best, they can have described news articles' *potential* to communicate ideas in science. The accuracy of science news means little if audiences do not find the story important.

Summary, Translation, and Frames

Rowan (1989) argued that one must recognize the different purposes that journalists and scientists have for their writing in order to evaluate their effectiveness. Scientists emphasize the presentation of evidence, in order to provide support for the researchers' primary claims as a part of the scientific process. Journalists summarize this to emphasize the presentation of newness or relevance, in order to attract audience members via entertainment value.

Borman (1978) and Evans (1991) found omission was the largest category of inaccuracy, and it was inversely proportionate to story length in both studies. These 'errors' are linked to summarization. Journalists were leaving out the scientific process to focus on findings, and "over-translation to lay terminology" caused accuracy problems (Borman, 1978, p. 345-346). This puts a finer point on the concept of inaccuracy, acknowledging its purpose.

Fahnestock (1986) emphasized that these differences are reflected in word choice, however:

> Accommodating the scholarly piece for the non-scholarly magazine is not, therefore, simply a matter of translating technical jargon into non-technical equivalents... the true accommodation involves finding the points of interest in the topic that will appeal to readers who are not apologists or even specialists in any life science. (p. 280)

Fahnestock found that journalists chose words that increased the sense of certainty, significance, primacy, and uniqueness of the research often, by simply omitting carefully couched language such as the words "appears" and "suggests". The acts of summarizing

and translating are subservient to constructing an interesting narrative and the journalist chooses to represent science either accurately or emotionally with every single word written (Molek-Kozakowska, 2013).

The act of translation can also lead to framing a news story (Singer, 1990; Evans, 1991), which can engender inaccuracy by shifting story focus or emphasis. For instance, Evans noted the importance of human-interest angles in translating science information and that several social science stories included "more or less political/ideological overtones" (Evans, 1991, p. 131). Singer (1990) explained errors of emphasis and the misrepresentation of speculation as fact are made possible by the perceived need to dramatize stories. But as Fahnestock (1986) pointed out, inaccuracies are not errors if they make complicated research accessible to lay reader, and constructing an interesting narrative in a news piece is the way journalists make science stories relatable. Frame theory helps to explain how messages are constructed for news audiences.

Todd Gitlin explains that "Media frames are persistent patterns of cognition, interpretation, and presentation, of selection, emphasis, and exclusion, by which symbol-handlers routinely organize discourse, whether verbal or visual" (Gitlin, 1980, p. 7). Bennett (2005) describes news frames as a way of adding to the entertainment value of news by "journalists actively constructing news drama, while downplaying known evidence that might complicate the impact and simplicity of a news reality frame" (Bennett, 2005, p. 1). Bennett described a media landscape in which the line between news and entertainment has become blurred. Audiences may no longer make distinctions between hard news and reality TV. Journalists are increasingly choosing entertainment frames for news stories. For Bennett, framing decontextualizes news information to

present it as a different kind of story. These framed stories often eliminate abstract information in favor of emotional or narrative content. Hence, science research news becomes a human-interest story. By focusing on conflict, news frames help to create the 'democratization of truth' where conflicting ideas can be considered to have equal merit based on emotionalism, not evidence. Bennett shows that frame theory is a way of explaining news inaccuracy as journalistic choice. Because frame theory explains how news inaccuracy adds value for an audience, it helps to explain why traditions of inaccuracy persist, even as access to higher quality news and information has expanded.

Frames can be conceptualized and measured in many ways. Trumbo (1996) demonstrated a dimension of framing from the standpoint of the text's purpose. Three out of four Trumbo's frames relate directly to topics that, ostensibly, are a matter of scientific inquiry and that help audiences orient to the science content of the story. O'Neil, et al. (2015) identified a set of frames that corresponds more to narrative modes and indicate possible orientations for audiences that link it to larger frames of political and economic interest. Analysis has shown that frames vary for a given science news story by media outlet and by medium (O'Neil, et al., 2015), across different media markets (Haigh, Bruce, & Craig, 2008), and through time to accommodate new information as the specifics of a story unfold (Shih, Wijaya, & Brossard, 2008).

Certain structural aspects of media contribute to the framing of science information. Calsamiglia and Ferrero (2003) demonstrate how a quote's formal presentation acts as a frame for the source being quoted. They show that in reporting on Mad cow disease research, journalists presented the research as inconclusive, not by acknowledging the limitations of scientific method itself, but by presenting scientific

authorities as ambivalent so that research was “a source of confusion rather than a contribution to an understanding of the problem” (Calsamiglia & Ferrero, 2003, p. 25). Presentation of the news piece as a whole also frames interpretation. Being on the front page frames a sense of urgency, but inclusion in the business section implies economic importance while detracting from other aspects like public health (Sarathchandra, 2010).

The human-interest angle is one of the predominant frames found in science news. Human-interest angles help make stories more relatable and can add familiar narrative structure to stories. Suleski and Ibaraki (2010) found that there was a positive correlation between a journal using a human-interest angle in a press release for a research paper and that research paper being covered in the press. Health and medicine research, which often carry a built-in human-interest angle, were covered more than any other science topic. To wit, Dunwoody and Scott (1982) found that neither specialization nor authority are the criteria journalists use in choosing science news sources. Trumbo (1996) found a significant decline in the percentage of scientists used as quoted sources in climate news, even as the absolute number of articles grew, while political and special interest sources increased slightly but not significantly. This indicates that journalists, as gatekeepers, filter out science research stories that do not have an apparent human-interest angle.

Evans (1991) stressed the ritualistic nature of science reporting: The idea of science itself is what fills the news hole, not individual research findings. Evans’s research indicates that the journalistic process severely bottlenecks the science news that is available to the public by relying heavily on just a few science journals as sources for news stories without real regard for the importance of the research. Scholarly articles

were named as sources in a little more than a third of all science stories in newspapers and television news. In hard-news format stories about science, almost 75% of journal sources came from just four journals (Evans, 1991). Evans suggests that these journals use public relations that determine how stories will be covered.

These findings together indicate that the 'rituals' of science journalism did not actively seek out the most news-worthy science news stories, did not seek out the most qualified science news sources, and that non-scientist sources were, non-the-less, sources for science news in an environment where a there is "no strong consensus among news outlets as to what constitutes a newsworthy science story" (Evans, 1991, p. 93). Moreover, Evans found that few of the stories studied (4 out of 377) make reference to science itself, which means that they are not reporting on scientific method, the key to cultivating a science-literate audience.

Omissions of qualifications and evidence from original research in favor of emotional content leads to a more emotional response from readers that skews understanding of the article, resulting in what MacDonald (2005) called sensationalism. MacDonald has shown that use of concrete nouns increased the sensationalizing human-interest angle of the story while misrepresenting the tentative and cumulative nature of science research. This is relevant to the current discussion because it indicates that the act of placing a science news story in the narrative frame of journalism creates sensationalism in and of itself. In this way, science journalism may emphasize the relevance of science research to the public while obscuring the meaning, certainty, and practice of research. Moreover, Molek-Kozakowska (2013) found that sensationalized headlines tended to evaluate or pass judgment on the news, concluding that

sensationalism was a way to create entertainment value in news stories where other immediate personal values were not available. Molek-Kozakowska called sensationalizing a compensatory strategy that had the additional feature of guiding the reader to an emotional response. Molek-Kozakowska (2013) pointed out that the use of metaphor (one of her categories of sensationalism) has been shown to reproduce dominant ideologies. This points to a deeper argument in the structure of news frames, below the surface of fact and quotes in a news story; the tacit reality presented by news frames may include unquestioned assumptions about reality that color interpretation of the news.

But frames are not just constructs added by researchers. Lynch and McGoldrick (2012) demonstrated differences in audience reception to news media frames. Their findings indicate that news frames change the way people interpret and react to the story. Similarly, Ryghaug et al. (2011) found that participants used popular news media frames in combination with other sense-making strategies to understand the complexities of global warming in general. Specific media frames were identified that helped audiences to structure their interpretations of science issues.

O'Neil, et al. (2015) also found "US polarization was evident in the broadcast media surveyed, with frame use differentiated by media outlet along partisan lines" (O'Neil, et al., 2015). This indicates that frames are a way of representing and recreating perceived conflict in science stories. These researchers identified frames in climate news that cast the emergence of science controversy in bold relief: Settled Science, Political or Ideological Struggle, Uncertain Science, Role of Science, and Disaster frames were more frequent than others. These frames are opposite responses to news content that reflect

ideological and political standpoints extra to science. Framing and audience interpretation are further complicated by the 'counter-frames' (Brewer, 2013) in 'fake-news' programs that directly challenge the validity of dominant science news frames. Audiences have been shown to be aware that they are being used and audiences are using these concepts to interpret the news (Ryghaug et al., 2011).

Science as Controversy

Media representations of controversial science issues influence policy decisions and therefor are subject to manipulation by interested parties within industry to control the terms of public debate (Miller, 1999). Miller (1999) concluded that "the policy process can and does change depending on the varying relationships between the public, the media, interest groups and policy actors." Similarly, Bonds (2010) found that "environmental knowledge is often a political contest," where actors compete for media attention. Sproule (1994) describes "business advocacy groups" that "skew news coverage by forming citizens' organizations that impart a grass-roots aura to business lobbying" (Sproule, 1994, p. 184). The amount of coverage that can be generated about a topic is the biggest factor in the contest because the "beliefs of the audience follow directly from the intensity and volume of reporting" (Mazur, 1990, p.295). Protestors' and journalists' attention to an issue tends to reinforce each-other: The more coverage a hazard gets, the more concerned and oppositional the wider public becomes. Despite these findings, Mazur maintains that "we must avoid the simplistic interpretation that risks are merely journalistic constructions, created and sustained to sell advertising in

newspapers or on television. Journalists do not create news out of nothing" (Mazur, 1990, p. 320).

Individuals may not have true attitudes on issues, and attitudes "are usually based on the latest media presentations on an issue, as well as on ideological cues" (Brulle, Carmichael, & Jenkins, 2012). These authors used "all available national public opinion polls on climate change, [to] chart the quarterly changes in concern about climate change from 2002 through 2010" (Brulle, Carmichael, & Jenkins, 2012). They found that articles in popular science magazines, *New York Times,* and major broadcast television did make a significant impact in public opinion, but politics were also important. For instance, each mention of the film An Inconvenient Truth in the *New York Times* correlated with significant public concern. However, "science-based information is limited in shaping public concern about the climate change threat.

Other, more directly political communications appear to be more important" (Brulle, Carmichael, & Jenkins, 2012). Public statements made by Democrats increased public concern significantly; but "the message sent to the public by the Republican voting record on environmental bills is very influential" (Brulle, Carmichael, & Jenkins, 2012). This data stresses the importance of elite cues to public opinion, saying "In an extremely partisan environment, Republican votes against environmental bills legitimate public opinion opposed to action on climate change. When the Republicans increase voting support for environmental bills, it reduces partisanship and increases public support for actions to address climate change." However, control variables exert influence: With "a shock to the economy or intensification in the wars, the general public may reduce their level of concern about climate change" (Brulle, Carmichael, & Jenkins, 2012).

As frames structure news narrative over time, these frames become durable patterns that add continuity to audience understanding and to political and ideological platforms. In most of the forgoing research, there is a trend toward polarization of news frames a Right/Left, pro-climate/anti-climate dichotomy (Dunlap, Xiao, and McCright, 2001; McCright & Dunlap, 2011). Dunlap, Xiao, and McCright (2001) found that this polarization is consistent with dichotomies identified in public opinion and in the growing divergence between US political parties since the early 1970s in terms of ideology, economic ideology, and policy (Dunlap, 2001; Dunlap, 2011).

These findings confirm a common-sense understanding of partisan divisions that influence voting patterns. More to the point, they provide a quantitative grounding that journalistic frames are consistent with party ideology, and that the political polarization of science news content correspond to observed public opinion and voting. Without knowing how closely news framing influences or is influenced by public perception, it is fair to say that the dichotomies in policy, public demographics, and opinion correspond to major identified frames in science news (Dunlap, Xiao, and McCright, 2001; McCright & Dunlap, 2011).

The traditions of the news media and the evolution of the marketplace have created an environment that is hostile to the messages of scientists. The very traditions that are meant to support balanced social discussion in the news have been shown to be open to the manipulation of interested parties, distorting science messages. Sproule (1994) found "modern democracy depends heavily on the ability of today's journalist to discern fact and solid opinion from inaccurate propaganda" (Sproule, 1994, p. 150). He describes the journalist's role as that of a judge in relation to the public as jury, ensuring

fair treatment of evidence leading to public action. This definition highlights the journalist as translator and gatekeeper of science information in an ongoing conflict over the framing of science information. 'Balanced' reporting emerged as a means to objectively address multiple perspectives in a news. Despite the emphasis on objectivity, evidence, and evaluation, the use of balance in reporting is not readily compatible with scientific method.

Journalistic balance is not like scientific objectivity (Boykoff & Boykoff, 2004). The professional practice of balanced, or 'objective' coverage leads the emergence of non-science frames in science news. For the Boykoffs, focusing on balancing ideas from the sciences with politically and economically motivated ideas took away from a discussion of legitimate opposition from within the sciences, and it created space for manipulation of science news content by distorting its news-worthiness. Boykoff and Boykoff (2004) found that 52.7 percent of prestige press articles employed the journalistic norm of balance to give "roughly equal attention" to idea of human-caused climate change and to the idea that climate fluctuations are purely natural. The authors conclude that this balance gave voice to a marginal group of climate skeptics and to "industry opponents of action regarding global warming" (Boykoff and Boykoff; 2004). In 1998 these industry opponents proposed a "campaign to recruit a cadre of scientists who share the industry's views of climate science and to train them in public relations so they can help convince journalists, politicians and the public that the risk of global warming is too uncertain to justify" (Quoted in Boykoff & Boykoff, 2004). Journalistic balance legitimated anti-science messages by presenting these messages as equally important to science content, even though these messages were a part of a manipulative

campaign to purposely exploit the practice of balance in order to introduce erroneous science ideas. From the standpoint of technical scientific accuracy, these messages are more than errors, they are lies. The authors found that:

> adherence to the norm of balanced reporting leads to informationally biased coverage of global warming. This bias, hidden behind the veil of journalistic balance, creates both discursive and real political space for the US government to shirk responsibility and delay action regarding global warming. (Boykoff & Boykoff, 2004).

The norm of balanced reporting had a real-life impact on policy. M. Boykoff (2005) went on to say "the American public and policymakers have been presented with the misleading scenario that there is a raging debate among climate-change scientists regarding humanity's role in climate change" (Boykoff, M. 2005). There was a significant difference between scientific consensus and television coverage regarding anthropogenic climate change from 1996 through 2004 (Boykoff, T., 2008). The norm of balance conflated science issues with religious and political issues. While balance can represent conscious, professional decisions, sometimes "balance can serve as a crutch for reporters when they lack the requisite scientific background or knowledge, or are facing formidable time constraints" (Boykoff & Boykoff, 2007).

The larger point here is that the Boykoffs' concept of balance is really a misuse of journalistic practice that steals focus instead of engendering understanding. It is the journalistic practice that makes it possible for non-science and even anti-science ideas to frame science-news content- and in patterned ways that often over-serve political and

economic interests. Balance emerges as a means to represent partisan interpretation of science instead of science itself. This right/left polarization reproduces dichotomies in public opinion, policy, and voting patterns (Dunlap, Xiao, and McCright, 2001; McCright & Dunlap, 2011). Can we extend these dichotomies to news stories on other polarized sciences issues such as the field of science alternately framed as Evolutionary Theory and "the theory of evolution"? Bennett (2007) describes global warming and evolution among science stories that have tended to an 'artificial balance' when heated political battles led to two-sided coverage. Much like anthropogenic climate change, evolutionary theory conflicts with the teachings of mainstream Protestantism. Each of these fields of science have a counter-movement opposed to it. Perhaps the most salient similarity in the popular consciousness is that these fields have garnered hostility from right-wing pundits who use theistic and political arguments to delegitimize scientific findings in what Brewer (2013) called 'the war on science.'

CHAPTER III

METHODOLOGY

In order to test the differences in audiences' understanding of straight-forward science news frames compared to those of non-science news frames, this experiment uses a survey to compare audience responses to two differently-framed news pieces covering the same international news story as the independent variable. The survey measures several dimensions of audience understanding for three dependent variables: The source, translation, and objectivity to answer these research questions:

R1: How do frames influence audiences' ability to find meaning in science news?

R2: How do frames influence audiences' perceptions of the journalist as source in science news?

R3: How do frames influence audiences' perceptions of 'objectivity' in science news?

This data is analyzed for differences along a political demographic dimension to answer the additional question:

R4: Do audience interpretations of frames reflect the ideological dualism documented in science news by other researchers?

This Methodology section will describe the articles used in the experiment treatments and the design of the survey instrument in the experiment.

The Articles

The researcher chose two news pieces based on their dissimilarity in use of science news frames, and in this way, they are intended to represent extremes in coverage: One using a science-news frame; the other using a conspicuously non-science frame to construct an understanding of the same news story. Both covered the discovery of Homo naledi, an extinct primate that may be related to humans. Both summarized and translated scientific information for the audience, and both tried to place the discovery within a larger context, indicating its importance and explaining the details. Both attempted to add entertainment value by making the story more relatable. But where one balanced the research findings against concepts within scientific method to indicate the story's importance, the other used a metaphor to balance the findings against an ambiguous, anti-science frame. It was immediately clear to the researcher that these two pieces also represent extremes in ideological approach to the subject matter, not because of the information presented, but because of the presentation of that information through different ways of knowing.

One is a TV broadcast segment from CBS Evening News, Treatment A, which creates a narrative with an over-all science-news frame. It gave deeper context with interview clips of the lead researcher and by showing the researchers at the archeological site, the dangers they faced, and images of the ancient remains they found. The interview clips with the primary researcher and narrative emphasis on the researchers working together to overcome danger created a human interest angle that made the story personal and relatable. The correspondent appropriately hedged the scientists' claims, emphasizing the need for further analysis, employing the journalistic norm of balance (Boykoff & Boykoff, 2004; Boykoff & Boykoff, 2007; Boykoff, M., 2005; Boykoff, T., 2008) to give equal weight to opposing views *within* the science.

The other story is a text article from CNN wire (Pearson, 2015), Treatment B, that creates a narrative with a metaphor as its over-all frame that focuses on how the naledi discovery might

fit into the "family tree" of taxonomical relationships with other primate species (including humans). It gave deeper context with a confusing amount of unrelated research, so that the magnitude of scientific information renders the story ridiculous and creates a sarcastic tone. The reader is invited to dismiss the news of Homo naledi as another unimportant announcement from a far-fetched scientific theory, creating what we might call a frame of disbelief, or of unimportance, harkening to the 'Uncertain science' frame identified by O'Neil, et al. (2015), which recreates conservative ideology. The CNN piece never directly challenges any of the ideas presented in terms of ideological or scientific controversy. Instead, the challenge is couched in hostile word choices such as "That's kind of the state of affairs in human evolution, especially now that a new branch of the clan has crawled out of some anthropological backwater and horned its way into the party" (CNN, 2015, para. 3). The article undermines the value of science through word choices that frame the story as ridiculous while simultaneously framing the story as important (though if only in a tacit way) by reporting on it with science sources. In this way, the article is framed to give weight to both the evolutionary science behind the story and anti-evolution ideology, employing the journalistic concept of balance (Boykoff & Boykoff, 2004; Boykoff & Boykoff, 2007; Boykoff, M., 2005; Boykoff, T., 2008) to give weight to opposing views *between* science and the larger community. In both news stories, we see that the narrative frame chosen directed the use of summary and translation at a formal level: Word choice, images, framing of quotes, and argument structure.

The Survey

The survey was constructed using Survey Monkey and copied into two versions: One with the CBS news piece (survey A) and the other with the CNN news piece (survey B), each with 48 questions (including demographics). The independent variable is the difference between

the articles in terms of their framing of the same news story and the tactics employed to do so. The survey is constructed to measure three dependent variables: The audiences' evaluation of the article as science message in terms of translation and summarization; evaluation of the journalist as message source; and the audiences' perception of the article as journalistically objective. The dependent variables are measured using five-point Likert scales and paired adjectives (see appendix A).

A pilot study was conducted using opportunistic sampling of the investigator's classmates and those who responded the Survey Monkey posts to Facebook with 31 total respondents (Seventeen people responded to Treatment A; Fourteen people responded to Treatment B). The pilot survey was collected from November 23, 2015 to December 1, 2015. Though the sample was too small to indicate significance in the differences, the pilot study indicated interesting differences in at least seven of the experimental dimensions of the survey.

Other participants for the survey were recruited using emails through the researcher's university broadcast email service and a few from solicitations on Facebook. Participants were shown the link to one survey each and were not aware of the other version of the survey, not that it was constructed for comparison. Responses were collected through April 2016. In all, there were 331 respondents (172 respondents to Treatment A and 159 respondents to Treatment B), culled to 195 (108 and 87 respectively) participants to exclude those who did not affirm that they watched or read the news piece in their survey. Of those, 102 are women (54.3%), 83 are men (44.1%), and the rest chose not to answer. The ages of participants range from 18 to 76 years with half born after 1986. Their ages are distributed between the generations with 12.4% in the centennial generation (born in or after 1996), 59.9% are millennials (born from 1977 to 1995), 9.1% are from Generation X (1965 to 1976), 17.8% are baby boomers (1946 to 64), and .5% from the silent generation (born before 1945). Politically liberal views are overrepresented with 46.8% participants self-identifying as liberal, 22.8% as conservative, and 22.8% as moderate. The

majority of participants are associated with an Oklahoma university as faculty, staff, or students, and only 4.9 % reported no college experience. Overall, the sample population was younger, more educated, and more liberal than nation averages. The university affiliations and education levels of participants indicate that the sample population has a higher than average understanding of scientific method and interest in science in general that will color their interpretations of science news: It is likely that the research participants have already been primed for science messages and will be more responsive to science-oriented frames.

CHAPTER IV

FINDINGS

A t-test was performed to find differences for the three dependent variables between the two treatments. The first of these variables, source, is meant to capture the audience perception of the journalist in terms of trustworthiness, professionalism, and how informed they appear to be. The second variable, translation, is meant to capture the audience perception of the message as a whole along many dimensions with special attention to its ability to translate and summarize scientific information in a meaningful way for the audience. The third variable, bias, is meant to capture the audiences' perceptions of the news piece as objective, where a high score indicates the perception of 'balance' in the news piece as opposed to 'bias.' Leaving the concepts of balance and bias undefined in the survey instrument means that participants were free to evaluate this dimension of the articles using their own standards, which is more relevant the research questions.

Table 1: *t*-test

	Treatment	N	Mean	Std. Deviation	Mean Difference
Source	B	87	2.9847	1.07221	-1.02767
	A	108	4.0123	.77998	
Translation	B	83	3.1705	.85860	-.70373
	A	104	3.8743	.71577	
Balance	B	86	2.9767	.93591	-.50897
	A	105	3.4857	1.09732	

There is a significant effect on all three dependent variables. Participants evaluated treatment A more favorably for each variable. The most significant effect is on the audience perception of the journalist as source, $t(193) = -7.74$, $p < .0001$. The audience perceptions of the message as a whole are significantly different, $t(185) = -6.11$, $p < .0001$. The audience perceptions of the story as balanced is also significantly different between the two treatments, $t(189) = -3.41$, $p < .001$.

Table 2: ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Translation	Between Groups	9.599	2	4.799	7.127	.001
	Within Groups	119.190	177	.673		
	Total	128.788	179			
Objectivity	Between Groups	5.773	2	2.886	2.667	.072
	Within Groups	195.921	181	1.082		
	Total	201.694	183			
Source	Between Groups	4.753	2	2.376	2.105	.125
	Within Groups	204.285	181	1.129		
	Total	209.038	183			

An ANOVA was run to find the effect of participants' self-identified political orientation on the dependent variable. The groups varied significantly on the Translation variable, $F(2, 177) = 7.127$, $p = .001$, with the Liberal group demonstrating more favorable responses for both treatments, compared to the Moderate group, and the Conservative group. No significant differences were found for Objectivity, $F(2, 181) = 2.667$, $p = .072$, and Source, $F(2, 181) = 2.105$, $p = .125$, along this dimension.

Table 3: Independent Samples t-test

			Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
Moderate	Translation	Equal variances assumed	-.72985	-1.22473	- .23498
		Equal variances not assumed	-.72985	-1.22317	-.23654
	Objectivity	Equal variances assumed	-.04762	-.65057	.55533
		Equal variances not assumed	-.04762	-.65248	.55724
	Source	Equal variances assumed	-1.07937	-1.71299	-.44574
		Equal variances not assumed	-1.07937	-1.71434	-.44439
Liberal	Translation	Equal variances assumed	-.60892	-.93890	-.27894
		Equal variances not assumed	-. 60892	-.96939	-.24846
	Objectivity	Equal variances assumed	-.66581	-1.12139	-.21023
		Equal variances not assumed	-.66581	-1.11816	-.21346
	Source	Equal variances assumed	-.97065	-1.35124	- .59006
		Equal variances not assumed	-.97065	-1.39312	- .54818
Conservative	Translation	Equal variances assumed	-.74837	-1.16037	-.33638
		Equal variances not assumed	-.74837	-1.15887	-.33788
	Objectivity	Equal variances assumed	-.72925	-1.25743	-.20106
		Equal variances not assumed	-.72925	-1.25642	-.20207
	Source	Equal variances assumed	-1.18263	-1.69589	-.66937
		Equal variances not assumed	-1.18263	-1.69072	-.67455

An independent samples t-test was also run to find the effect of political orientation on the variables. Much like the sample as a whole, both the Liberal group and Conservative group favored Treatment A on all three variables. However, in the politically Moderate group, there is no significant difference between treatments.

Discussion

The treatment had a significant impact on the audience perception of the message, message source, and the objectivity of the piece. For each variable the mean score is more favorable for Treatment A, using the CBS (broadcast) piece with a predominantly science-oriented frame to discuss the discovery of Homo Naledi. The significant effects of the experiment's treatments indicate that news frames do impact the way audiences understand science news, and that the science frame is preferable for the sample population.

The data demonstrates that participants found the narrative constructed around a science-news frame over-all more interesting, more accurate, and easier to understand. This indicates that the science-news frame summarizes and translates the science content of the story in a more entertaining and meaningful way for audiences. Using a non-science frame to translate science information led to the "over-translation to lay terminology" described by Borman (1978, p. 345-346). Moreover, this indicates that using a non-science frame to structure news narratives for entertainment value can be counter-productive, leading to less audience engagement. It would seem that filling the science-news hole is different from conveying meaningful science information to the public.

The data also demonstrates that participants found the narrative constructed around a science-news frame to be more balanced, as opposed to biased. This extends the Boykoffs' research (Boykoff & Boykoff, 2004; Boykoff, M., 2005; Boykoff & Boykoff, 2007; Boykoff, T., 2008) by connecting different frames of balance identified in their content analyses to audience

reception. The Boykoffs argue that while the professional journalistic practice of 'balance' is intended to bring a sense of objectivity to news content, it often leads to informationally biased coverage in science news by exaggerating the importance of non-science information. The present research extends the Boykoffs' text analyses to audience interpretation: The use of this balance norm in the non-science frame did lead to lower levels of perceived balance. This also indicates that participants are aware of the information bias created by the norm of balance.

That the largest impact was on the perception of the source indicates that participants may be ascribing the ability of the news piece to satisfy other criteria to the competence of the journalist. Moreover, that the low evaluations of the articles are reflected in audience perceptions of objectivity and of source indicates that using non-science frames for science stories may be damaging to audience perception of a news organization as a balanced and professional news source.

The literature demonstrates a political and ideological dichotomy in public opinion that corresponds to dichotomies in the many science-news frames it identifies. If this dichotomy extends to audience interpretation of science-news frames, then it should be reflected in a polarization of audience reception along political demographics for the news pieces used in the present research. But the sample did not demonstrate this polarization. Treatment A was more favorable for both the Conservative and Liberal group (though the Liberal group found treatment A more favorable than the Conservative group). Interestingly, in the politically Moderate group, there is no significant difference between the treatments on the Objectivity variable. The Moderate group had a neutral response to Objectivity in both treatments. However, that the Liberal group responded more favorably to the Translation variable for both news pieces may reflect this political divide in an unexpected way. It could be that the science topic itself had more of an impact than its frame for conservative participants.

Limitations

An issue that complicates interpretation of this experiment is that the news piece in Treatment A is video and in Treatment B, it is print. Ideally, these two stories would come from the same news medium, but such news pieces were not available for the naledi story. It is possible that the differences in sensory experience between these two media account for some of the difference between the two treatments. The forcefulness of images and sounds in broadcast news may be more cogent and accessible in a way that trumps the difference in frames used. Conversely, it is also possible that the medium of a news story influences the choice of news frame for the story: Multi-media can simultaneously communicate multiple modes of knowing, making it possible to layer science information with emotive content. In the experiment, the broadcast piece uses imagery of researchers in the field to create a sense of human interest while simultaneously providing more hard-news information in the voice-over. However, in the context of this research, it does not seem that differences in news media can explain the differences in perceptions of Objectivity and Source that do correspond to perceptions of the story as a whole.

Another limitation of this research is that the sample population is not representative and may have led to an understatement of differences. Most of the participants indicated at least some college experience (95.1%), compared to a national average of 58.9% of adults 25 and older having some college in 2015 (Ryan & Bauman, 2006). In this way, the sample reflects a population that may have higher-than-average science literacy levels, be predisposed to expose themselves to science in the news, and to favor science-frames compared to the general populace.

Participants indicated politically liberal attitudes twice as often as conservative ones, so that the data will not capture the differences in political affiliation or its effect on interpretation of frames as robustly as hoped. More than half of the participants are under the age of thirty, meaning the durability of ideas associated with science news frames as established ways of

knowing may also be understated. The homogeneity of the sample indicates that the differences in experiment treatments may be understated or that participants will favor a science frame.

Another issue is that by asking participants to give their attention to a news piece as a part of the survey, the real-life conditions of watching science news have not been recreated. The ques associated with placement in a print or broadcast are absent. This experiment cannot tell us how the stories would have engaged audiences in their normal behavior, nor whether participants would have chosen to engage with these science news stories at all. At best, this data can tell us about each news piece's *potential* to communicate to audience members who have already decided to give their attention to it.

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CHAPTER V

CONCLUSIONS

These findings challenge the common-sense notion that shoe-horning a science-news story into an entertainment narrative will create better audience understanding, better journalistic credibility, or better ratings. Industry practices that aim to make science information more accessible to lay audiences are, in this instance, distorting the meaning of scientific research without creating a narrative that audiences find more useful. Moreover, the value or lack of value audiences perceive in a news piece seems to be amplified in the perceptions of the journalist as source. This could mean that audiences are ascribing the quality of the work to the journalist over other factors. This indicates that the use of non-science frames have the potential to damage the credibility of journalists who use them. It is also possible that this is reflected in audience perception of news outlet.

The most unexpected aspect of the data is that political identification did not influence audience reception of news frames for the Conservative group and the Liberal group. Both of these groups favored Treatment A for every variable. This is surprising because the literature indicates that the frames used in science news covering controversial topics follow a more or less political ideological dichotomy and that these differences are reflected in news outlets. Three ideas emerge to explain this. The first possibility is that political ideology inherent to science-news frames is not strongly reflected in audience interpretation. This could mean that this

dichotomy is something of an industry construct that does not speak to the information needs of audiences. This seems unlikely when we consider the controversy surrounding evolution in the education system. It seems more likely that the aspects of political ideology that are meaningful for audiences were not represented in the experiment instrument. However, considering the relative youth and higher-than-average education level of the sample, this may be the product of an overly homogeneous sample. Or it may be that the debate between evolution and creation is largely resolved for our sample. A fourth possibility emerges from the ANOVA analysis, where the Liberal group had a significantly more favorable evaluation of Translation for both treatments. This would fit the expectations created by the literature if it means that the non-science news frame did not compensate for the fact that the article covered evolutionary theory, which has been identified as an idea associated with the liberal side of political dichotomy.

The politically Moderate group demonstrated a neutral response to the Objectivity variable for both treatments. This may be because this group is less sensitive to ideas of bias and balance. Still, it indicates that political identity is a component of how audiences interpret science news: Identifying as conservative or liberal increases the perception of bias or balance. Perhaps these groups are more actively seeking the ques that indicate balance in a representation of their beliefs.

Participants judged the story with the science-news frame to be more balanced even though it was not 'balancing' opposing viewpoints between science and other domains. This strengthens the Boykoffs' research (Boykoff & Boykoff, 2004; Boykoff & Boykoff, 2007; M. Boykoff, 2005; T. Boykoff, 2008) in that the journalist practice of balanced reporting did not create a better understanding of science issues, in this case, for the audience. Using balance in the story *increased* perception of bias, which seems self-defeating from an industry standpoint, where journalistic credibility is tantamount to success.

That participants responded more favorable to the science-news frame than a non-science-news frame in all three variables indicates two important departure points for discussion. The first point: This research indicates that science-oriented frames in news can create a deeper understanding of science issues in the mainstream and lead to more informed public policy. In the experiment, participants found the science-news frame more meaningful, leading to deeper understanding.

Audiences also evaluated the journalist more favorably for the science-framed piece. The differences in the Translation and Objectivity variables were amplified in the Source variable. This leads to a second point: This research indicates that the use of frames in science news may reflect on the credibility of the journalist (and potentially on the news outlet). In a highly fractured news marketplace, journalists are accountable for how their news messages compare to other messages. And audiences seems to be aware of the constructed nature of news content.

Both points could be discussed in terms of news-industry responsibility: The responsibility to the general public to inform policy discussion; and responsibility to maintain viewership and the revenue that comes with it. The experiment indicates that these two values are not opposed. Journalists do not need to sacrifice science literacy by distorting science information into an entertainment frame in order to maintain audience interest nor respect. Conversely, journalists do not need to sacrifice audience attention to promote science literacy. This research indicates that frames are simply not accomplishing what they are intended to in science-news reporting. It is time for news outlets to rethink what constitutes good science news in terms of audience understanding and in terms of maintaining those audiences.

Another dimension of this finding is that science narratives are not necessarily compatible with other ways of knowing. Evolution, like climate science, is a field of science that creates counterpoints to dominant beliefs and undermine religious dogma. By extension, these

counterpoints undermine economic practices that assume a static world with infinite resources for human use. In these cases, science and anti-science frames recreate epistemological conflicts with economic consequence. Moreover, the anti-evolution movement is linked to the political Right, where theistic arguments against evolutionary science strengthen anti-science claims in general.

In news coverage of evolution "The controversy is primarily political, motivated by deeply held feelings about identity" (Shortell, 2001). The Intelligent Design movement perpetuated the controversy by framing themselves as a "theistic and academic movement" as a means to undermine to concept of science itself in public discourse (Martin, et al., 2006). These researchers (along with the Boykoffs') work highlights the possibility that the appearance of raging scientific debate in news journalism could be a balancing of deeper, epistemological issues inherent to larger frames of understanding that activate political, economic, and ideological arguments, though they may be inconsistent with scientific arguments.

Where science frames and anti-science frames recreate ideological conflict, the question of framing and science literacy becomes epistemological: Is science compatible with other ways of knowing? In this way, science frames in news texts become a meaningful (read: observable) eruption of the reconciliation of the ideals of scientific enlightenment with other, conflicting values in the mainstream, what some have referred to as the 'modern condition.' The present research questions seem to resolve themselves to this epistemological question. But, instead of asking the lofty (and difficult to operationalize) question of whether science is compatible with other ways of knowing, the research questions for this experiment asks: Do science news frames (as other ways of knowing) make scientific method compatible with audience understanding?

This rupture may be fertile ground for exploring contemporary epistemological issues from a philosophical standpoint, but more importantly, it indicates the importance of developing science literacy for journalists and science educators who are faced with trying to teach science

without also teaching political, economic, and ideological controversy. Without a grounding in the rationale of scientific method, journalists and the public at large are likely to recreate industry constructs of science newsworthiness that conflate science with other ways of knowing. Debating the purpose and practice of science is a fair occupation, but it science news, it has been shown to detract from meaningful public discourse and policy.

If inaccuracy in the news has purpose, then those purposes should be subservient to the larger communication purposes of the individual news story and of journalism as a whole. This paper has identified news framing as the agent of both accurate and inaccurate science reporting, working from the standpoint that news frames summarize and translate dense scientific information for audience understanding lends purpose to inaccuracy and omission. But the practice journalistic balance in a highly polarized, left/right, pro-science/anti-science environment makes science journalism frames the loci of manipulation of public discourse.

Still, defining a science frame versus a non-science frame is an ambiguous task because the difference between the two has emerged from the preceding literature revue as a balancing of dualisms. Frames tend to simplify and omit science information, but summary and translation can create value for audiences through narrative story telling. Frames tend to shift focus by adding entertainment value, but this can make science information more accessible. Journalistic frames of balance tend to recreate conflicting viewpoints, but this can also make the objective nature of scientific debate more accessible. Frames seem to recreate inaccuracy where they tend to conflate science with some other way of knowing, be it a political mode, economic mode, or even an overly journalistic mode. Science frames seem to emerge where news narrative emphasizes science as a way of knowing. But the final test of the scientific accuracy engendered by these frames depends on how they communicate science information to the public, which means that we will have to ask the audience.

This research could serve as a starting point for discussing the peculiarities of science reporting: The limitations of narrative frames in science news and in general, as well as a discussion of the appropriate limits of using journalistic balance in science news. It would be interesting to see how these same variables play out in a different, more controversial science news story such the existence of anthropogenic climate change. The instrument from this experiment is readily adaptable for use with other science news pieces. This makes it possible to use the instrument to compare the current data with audience understanding of other kinds of science news frames and non-science frames as well as differences in medium. Because the instrument uses audience understanding as its metric, it has the potential to connect professional journalistic practices to their communication outcomes or media effects.

In a climate of growing distrust in corporate media outlets, the perception of a war on science can only serves to intensify cynicism and drive away audiences. As the final draft of this thesis is written, a GIF is circulating in social media that echoes this general distrust, saying "Turn off corporate media. They're wasting your time and insulting your intelligence." Narrative frames and journalistic balance become a means for interest groups to legitimate their claims and de-emphasize the importance of scientific research in the public imagination, but it seems a growing segment of the audience is aware of this. The same journalistic practices that are meant to summarize, translate, and balance dense science information into something meaningful for audiences are turning them away. For news journalism to foster the kind of public science discussion necessary to democracy, journalists must construct news narratives to cultivate science literacy in audiences, not pander to their illiteracy.

REFERENCES

Bennett, W. L. (2005). Beyond pseudoevents: Election news as reality TV. *American Behavioral Scientist, 49*(3), 364-378.

Bonds, E. (2010). The knowledge-shaping process: Elite mobilization and environmental policy. *Critical Sociology, 37*(4) 429–446. DOI: 10.1177/0896920510379440

Borman, S. C. (1978). Communication accuracy in science reporting. *Journalism Quarterly, 55*(2), 345-346.

Boykoff, M. (2005). The Disconnect of news reporting from scientific evidence. *Nieman Reports, 59*(4), 86-87. Retrieved from http://argo.library.okstate.edu/login?url=http://search.proquest.com.argo.library.okstate.edu/docview/216752015?accountid=4117

Boykoff, M., & Boykoff J. (2004). Balance as bias: Global warming and the U.S. prestige press. *Global Environmental Change, 15*(2), 125–136.

Boykoff, M., & Boykoff, J. (2007), Climate change and journalistic norms: A case-study of US mass-media coverage. *Geoforum, 38*(6), 1190-1204.

Boykoff, T. (2008) Lost in translation? United States television news coverage of anthropogenic climate change. Retrieved from: http://link.springer.com/article/10.1007/s10584-007-9299-3

Brewer, Paul R. (2013). "Science: What's it up to?" The Daily Show and the social construction of science. *International Journal of Communication, 7*, 452–470.

Brulle, R. J., Carmichael, J., & Jenkins, J. C. (2012) Shifting public opinion on climate change: An empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. *Climatic Change, 114,* 169–188. DOI: 10.1007/s10584-012-0403-y

Calsamiglia, H. & Ferrero, C. L. (2003). Role and position of scientific voices: Reported speech in the media. *Discourse Studies, 5*, 147. DOI: 10.1177/1461445603005002308

Charnley, M. (1936). Preliminary notes on a study of newspaper accuracy. *Journalism Quarterly, 13*, 394-401.

Dunlap, R. E., Xiao, C. & McCright, Aaron M. (2001) Politics and environment in America: Partisan and ideological cleavages in public support for environmentalism. *Environmental Politics, 10*(4), 23-48. DOI: 10.1080/714000580

Dunwoody, S. & Scott, B.T. (1982). Scientists as mass media sources. *Journalism Quarterly, 59*(1), 52-59.

Einstein, A. (1949). Forward. L. Barnett, *The Universe and Dr. Einstein* (2nd ed.). London, England: Victor Gollancz. Retrieved from: https://ia700809.us.archive.org/13/items/TheUniverseAndDrEinstein/Barnett-TheUniverseAndDrEinstein.pdf

Evans, W.A. (1991). Media presentation of scientific research: Press coverage of physics, biological, and social science. Temple University, UMI Dissertations Publishing. ProQuest Dissertations and Theses. Retrieved from: http://search.proquest.com/docview/303966055?accountid=4117

Fahnestock, J. (1986). Accommodating science: The rhetorical life of scientific facts. *Written Communication, 3*(3), 275-296.

Gibbons, M. (1999). Science's new social contract with society. *Nature, 402* (Sppl.) c81-c84.

Gitlin, T. (1980). *The whole world is watching*. University of California Press: Berkley, California.

Haigh, M. M., Bruce, M., & Craig, E. (2008). Mad cow Coverage More Positive in Midwest Papers. *Newspaper Research Journal 29*(1), 50-62.

Hartz, J. & Chappell, R. (1997). Worlds apart: How the distance between science and journalism threatens America's future. Nashville: First Amendment Center.

Retrieved from:

http://www.freedomforum.org/publications/first/worldsapart/worldsapart.pdf

Lynch, J. & McGoldrick, A. (2012). Responses to peace. *Journalism, 14*(8) 1041-1058. DOI: 10.1177/1464884912464175

MacDonald, S. P. (2005). The Language of journalism in treatments of hormone replacement news. *Written Communication, 22*(3). 275-297. DOI: 10.1177/0741088305278027

Martin, J. D., Trammell, K. D., Landers, D., Valois, J. M. & Bailey, T. (2006). Journalism and the debate over origins: Newspaper coverage of intelligent design. *Journal of Media and Religion, 5*(1), 49-61.

Mazur, A. (1998). Global environment change in the news. *International Sociology, 13*(4), 457-472. DOI: 10.1177/026858098013004003

Mazur, A. (1990). Nuclear power, chemical hazards, and the quantity of reporting. *Minerva, 28*(3), 294-323.

McCombs, M. E. & Shaw, D. L. (1972). The Agenda-setting function of mass media. *The Public Opinion Quarterly, 36*(2), 176-187.

McCright, A. M., & Dunlap, R. E. (2011). The Politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *The Sociological Quarterly, 52*(2), 155–194.

Miller, D. (1999). Risk, science and policy: Definitional struggles, information management, the media and BSE. *Social Science & Medicine, 49*(9), 1239–1255. Retrieved from: http://dx.doi.org/10.1016/S0277-9536(99)00163-X

Molek-Kozakowska, K. (2013). Towards a pragma-linguistic framework for the study of sensationalism in news headlines. *Discourse & Communication, 7*(2), 173-197. DOI: 10.1177/1750481312471668

Pearson, Michael. (Sep 10, 2015, 5:30). Homo naledi: Scientists discover new species of human ancestor in fossils. CNN Wire. CNN.com. Retrieved from: http://fox59.com/2015/09/10/homo-naledi-scientists-discover-new-species-of-human-relative-in-fossils/

O'Neil, S., Boykoff, M., Niemeyer, S., & Day, S. (2013). On the use of imagery for climate change engagement. *Global Environmental Change, 23*(2), 413-412. DOI:10.1016/j.gloenvcha.2012.11.006

O'Neill, S., Williams, H., Kurz, T., Wiersma, B., & Boykoff, M. (2015). Dominant frames in legacy and social media coverage of the IPCC Fifth Assessment Report. *Nature Climate Change, 5*(4), pp.380-385. Retrieved from: http://www.nature.com.argo.library.okstate.edu/nclimate/journal/v5/n4/full/nclimate2535.html

Rampton, S. & Stauber, J. (1997). Mad cow U. S. A.: Could the nightmare happen here? Common Courage Press. Monroe, Maine.

Ryan, C. & Bauman, K. (March, 2006). Education Attainment in the United States: 2015: Current Population Reports. Census.gov. Retrieved from: http://www.census.gov/content/dam/Census/library/publications/2016/demo/p20-578.pdf

Ryghaug, M., Serensen, K. H., & Naess, R. (2011). Making sense of global warming: Norwegians appropriating knowledge of anthropogenic climate change. *Public Understanding of Science, 20*(6).

Sarathchandra, W. A. D. E. (2010). Mad cows and poisoned apples: An analysis of newspaper portrayal of food scares in the US. (Order No. 1485606, Michigan State University). ProQuest Dissertations and Theses, 44. Retrieved from: http://search.proquest.com/docview/746585893?accountid=4117.

Shih, T., Wijaya, R., & Brossard, D. (2008). Media coverage of public health epidemics: Linking framing and issue attention cycle toward an integrated theory of print news coverage of epidemics. *Mass Communication and Society, 11*(2), 141-160. DOI: 10.1080/15205430701668121

Shortell, T. (2001). The Conflict over Origins: A Discourse Analysis of the Creationism Controversy in American Newspapers. *Mass Communication and Society, 14*(4).

Sproule, J. M. (1994). Channels of propaganda. EDINFO Press and ERIC Clearinghouse on Reading, English, and Communication. Indiana University. Bloomington, IN.

Suleski, J., & Ibaraki, M. (2010). Scientists are talking, but mostly to each other: A quantitative analysis of reported in mass media. *Public Understanding of Science, 19*(1), 115-125. DOI: 10.1177/0963662508096776

Trumbo, C. (1996). Constructing climate change: Claims and frames in US news coverage of an environmental issue. *Public Understanding of Science, 5*(3), 269-283. DOI: 10.1088/0963-6625/5/3/006

APPENDIX A

Each survey had 19 experimental dimensions, analyzed to measure three dependent variables: Bias, translation, and source.

Survey Questions for Source variable.

- 22- The journalist that wrote this story seems trustworthy.
- 23- The journalist that wrote this story seems informed.
- 24- The journalist that wrote this story seems professional.

Survey questions Translation variable.

- 13- The news story does a good job of explaining the scientific research.
- 15- The story is accurate.
- 16- The information in this news story contradicts other information that I have.
- 17- I learned something from this story that I did not know before.
- 18-This news story fits into how I see the world.
- 19- This story has an accurate view of how science works.
- 20- This news story is interesting to me.

- 25- Overall, the news story is easy to understand.
- 26- Overall, the news story is important.
- 27- Overall, the news story is realistic.
- 28- Overall, the news story is believable.
- 29- Overall, the news story is scientifically accurate.
- 31- The numbers and dates in the story seem realistic.
- 32- The numbers and dates in this story seem accurate.

Survey questions for Objectivity variable

- 30- Overall, the news story is balanced to show both sides of the story.
- 14- The story is biased.

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