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**Dominant Visual Frames in Climate Change News Stories: Implications for Formative Evaluation in Climate Change Campaigns**

**Abstract**

We propose a rigorous basis for identifying and assessing visual frames as part of a pre-production phase of formative evaluation for climate change campaigns. We review research on images in climate change communication, and the role of formative evaluation in communication campaigns in general and climate change campaigns in particular. Manual content analysis generated over 100 highly reliable image themes, and cluster analysis generated 15 dominant visual frames, from 350 images in 200 randomly-selected climate change news articles from 1974-2009. We discuss possible implications for utilization of those frames in climate change campaign messages. The dominant visual frames also provide bases for more structured and comprehensive formative evaluation research that could provide justification for using or avoiding certain visual frames when seeking to achieve particular outcomes through communication with specific audiences.

Keywords: climate change news, images, visual framing, communication campaigns, formative evaluation

**Dominant Visual Frames in Climate Change News Stories: Implications for Formative Evaluation in Climate Change Campaigns**

As awareness of and concern about the current and future consequences of climate change become increasingly prevalent, more effort is being devoted to designing effective public communication campaigns about the issue. While images are central to mass media in general, only recently has climate change communication research begun to identify and assess the presence, role, interpretation, and effects of images. This study examines how climate change visual frames can be identified, described, and analyzed as part of a formative evaluation component of climate change campaign message design. The following sections review research on image framing in mass media, science and climate change communication, and the role of formative evaluation in communication campaigns in general and climate change campaigns in particular. We then describe dominant climate change visual frames identified through previous research, suggest possible considerations in formative evaluation of each dominant frame, and outline a generalized strategy for formative evaluation of climate change images.

**Visual Imagery in Climate Change Communication**

**Images in Mass Media and Science Communication**

Images play a special role in the mediation of information. They expand cognitive capacity when processed in parallel with textual information (Clark & Paivio, 1991), and convey both literal (*denotative*) and symbolic (*connotative*) meaning (Barthes, 1977). They are perceived
and processed more quickly than text (Lang, Potter, & Bolls, 1999), direct attention to and influence exposure to and engagement with information (Quinn, Stark & Edmonds, 2007; Zillmann, Knobloch, & Yu, 2001). Exposure to visual imagery can promote cognitive elaboration and ethical reasoning (Coleman, 2006), and images play an important role in emotion, engagement and persuasion (Joffe, 2008; Lazard & Atkinson, 2015). Contextually-relevant imagery can enhance learning and memory of content (Bransford & Johnson, 1972; David, 1998; Graber, 1990; Levie & Lentz, 1982; Newhagen & Reeves, 1992), but imagery can also distort memory, reduce understanding, and pose barriers to communication, especially when words and imagery contain contradictory messages (Garry, Strange, Bernstein, & Kinzett, 2007; Graber, 1990; Harp & Mayer, 1997; Mendelson & Darling-Wolf, 2009; Zillmann, Gibson, & Sargent, 1999). Visuals can influence audience responses because relationships between elements of an image or between image and text are implied rather than explicitly stated. The apparent objectivity of some kinds of images, especially of photographs and graphs, can also reinforce a link between the image and reality (Messaris & Abraham, 2001).

Images have been central to the development, representation, and communication of science and technology (Lefevre, Renn, & Schoepflin, 2003; Pauwels, 2006). For example, Kemp (2003) describes the transformative double helix model of the structure of DNA as “the Mona Lisa of modern science” (p. 416) for its presentation of non-arbitrary and complex information in an iconic and aesthetic way, resulting in its wide use in scientific and popular media. Visual representations can play a particularly important role in scientific communication when the underlying scientific topic or essence does not have a physical form, when language is insufficient to portray the topic or is potentially misleading, or when the phenomenon does not exist on a human scale.

**Images of Climate Change**

**Image framing.**

Mass media and their images are an important source of public information about and perceptions of climate change, and environmental issues more generally (Ader, 1995; Corbett & Durfee, 2004; Meisner & Takahashi, 2013). However, creating or capturing images that effectively communicate about climate change – an abstract, complex, long-term, and often distant phenomenon – is particularly challenging due to the invisibility of many key aspects (e.g., emissions, ocean processes, temperature and chemical changes) and the temporal and geographical disjunctures between causes and effects (Doyle, 2011).

The past decade has seen growth in analyses of visual framing of the environment and climate change (e.g., DiFrancesco & Young, 2011; Lester & Cottle, 2009; O’Neill, Boykoff, Niemeyer, & Day, 2013). When describing the historic lack of appropriate theories for the study of news visuals, Coleman (2010) noted that “visual framing provides an important new direction for theory building and future research” (p. 233). Entman (1993) proposed framing as one particular way in which media coverage can influence public attitudes. Framing is the “process by which the emphasis or construction of a message affects the interpretation of the receiver” (Shah, McLeod, Gotlieb, & Lee, 2009, p. 85). Framing can influence thoughts, attitudes, affect, and behavior, though most effects occur through complex interactions among audience characteristics, message features, and resonance with existing cognitions, as well as other situational and contextual factors. Messaris and Abraham (2001) make a case for how visual representations frame an issue by implicitly juxtaposing visual elements in a manner that suggests a particular interpretation of the relationships between the represented entities. Whether intentionally or not, images such as photographs, maps, charts, and drawings focus attention on
particular aspects or components of an issue. A few prior climate change studies have suggested a wide range of visual themes and frames in both news and climate action campaigns (DiFrancesco & Young, 2011; Doyle, 2007; Lester & Cottle, 2009; Manzo, 2010a, 2010b; O’Neill, 2013; Rebich-Hespanha et al., 2015; Smith & Joffe, 2009).

**Effects of climate change images.**

Strategies for climate communication that involve use of imagery are often predicated upon the notion that well-designed or well-selected images or frames will represent complex information in a way that is easy for the intended audience to understand and digest, reinforce the objective truth value of the message they convey, or invoke emotions that reinforce the urgency of risks and threats (Peeples, 2013; Schneider, 2011; Smith & Joffe, 2009). Such assumptions, however, may lead communicators to use imagery to elicit fear or anxiety, despite evidence that nonthreatening visuals related to normal emotions and concerns promote more effective engagement with climate change issues (O’Neill & Nicholson-Cole, 2009); overlook the visual skills or background knowledge necessary to interpret imagery in the intended way (Trumbo, 1999); or run the risk that the concreteness and objective truth associated with certain types of imagery may undermine nuanced communication about uncertainty and risk.

To date, relatively few empirical investigations of audience responses to climate change imagery have been reported. Prior to O’Neill and Nicholson-Cole’s (2009) evaluation of responses to fear-inducing visuals, Nicholson-Cole (2005) conducted a study of self-generated visual conceptions of climate change and found that participants reported difficulty imagining the future and described generally pessimistic visual conceptions that were negative, distant, and abstract, and did not reflect much personal relevance. Similarly, Lorenzoni and colleagues (Lorenzoni, Leiserowitz, De Franca Doria, Poortinga, & Pidgeon, 2006) found that mental images underlying climate change risk perceptions in the US and Great Britain tended to emphasize general and distant impacts or even confuse environmental problems, and evoke negative affect.

An investigation of responses to newspaper climate change images in Australia, the UK and the US (O’Neill et al., 2013) found that the images tended either to increase viewers’ perceptions of the importance of the issue (salience), or to promote viewers’ sense that they could do something about the issue (self-efficacy), but rarely both. Leviston, Price and Bishop (2014) found that while climate change impacts imagery generally elicited negative emotional responses, only images of natural disasters, extremes, and climate pollution evoked both high arousal and negative affect; in contrast, images depicting climate solutions and leadership elicited responses that were both positive and highly arousing. O’Neill and Hulme (2009) evaluated public engagement with images selected to illustrate six different climate change themes (called “icons”), three of which (polar bears, London, and a UK wetlands area) were identified as engaging by prior participants, and three of which (Arctic ice sheet, ocean acidification, and thermohaline circulation) were identified as prominent icons in discourse of climate experts. In general, participants found images associated with non-expert icons to be more understandable and more engaging than those associated with the expert icons.

In the context of climate change communication, one could argue that certain images and frames – for example, the stranded polar bear, the calving glacier, the billowing smokestack, or the hockey stick graph of the recent rise in global mean temperature – have become iconic representations of the issue, images that “are widely recognized and remembered, are understood to be representations of historically significant events, activate strong emotional identification or response, and are reproduced across a range of media, genres, or topics” (Hariman & Lucaites,
While use of iconic imagery can facilitate communication by aligning a message with narratives and schema already familiar to the audience, this communicative strategy also invokes risks. Repetitive use of particular image motifs may serve to normalize such visual representations to the point that they are looked through and taken for granted (Schneider, 2011), or to reify hegemonic narratives and frames, making it difficult for both communicators and audiences to imagine and contemplate alternative perspectives (Peeples, 2013). Dominant visual frames may confine or simplify communication about the issue by representing certain perspectives while ignoring others (Boykoff, 2011; Cozen, 2013; Hansen & Machin, 2013; Manzo, 2010a; Remillard, 2011). Furthermore, the repetition of similar images promotes development of a collective consciousness by “reproducing ideology, communicating social knowledge, shaping collective memory, modeling citizenship, and providing figural resources for collective action” (Hariman & Lucaites, 2007, p. 9).

Although there is recognition that images used in public communication play an important role in the development of public awareness, knowledge, and attitudes, our understanding of how to use visual imagery appropriately and effectively in climate change communication campaigns remains incomplete and sometimes contradictory. Successful climate change messaging therefore requires interrogation of such assumptions, and evaluation of candidate images for use in particular contexts and with particular audiences. Thus we briefly note the nature of communication campaigns and their formative evaluation component.

**Communication Campaigns and Formative Evaluation**

Public communication campaigns are broadly defined as purposive attempts to inform, persuade, or motivate behavior changes in a relatively well-defined and large audience, generally for noncommercial benefits to the individuals and/or society at large, typically within a given time period, by means of organized communication activities involving mass media, and often complemented by interpersonal support (see Rice & Atkin, 2012, for a comprehensive review of public communication campaign components).

As climate change-related communication campaigns or interventions have risen in number and visibility, so have efforts to develop and describe strategies and to evaluate their effectiveness. Such work includes reviews of climate change communication history, challenges, and key considerations (Moser, 2010) and of relationships between information dissemination, awareness, and behavioral change in the context of climate change (Nerlich, Koteyko, & Brown, 2010), and proposal of a transdisciplinary framework for designing and evaluating ocean sustainability campaigns (Rice & Robinson, 2012). Specific climate change campaigns that have been the focus of academic study include Greenpeace’s efforts emphasizing the visual documentation of impacts (Doyle, 2007), the visual components of a variety of UK action campaigns (Manzo, 2010a), Oxfam’s *Climate change campaign* (Cugelman & Otero, 2010), and McKibben’s *Step it up* and Sierra Club’s *Beyond coal* campaigns (Cox, 2010). Nisbet and Kotcher (2009) have also examined the role and effects of opinion-leaders, using Al Gore’s *Climate project* and ’We’ campaign as examples (see also Nisbet, 2014).

Public communication campaigns may apply three kinds of evaluation: formative evaluation (collection of information about audiences and pretesting of draft messages), process or program evaluation (how well the campaign components were actually implemented), and summative evaluation (assessing effects and effectiveness). This study focuses on formative evaluation, which is crucial to achieving campaign message effectiveness (Dillard, Weber, & Renata, 2007). As Atkin and Freimuth (2012, p. 55) write, “Formative research can help identify what types of content and style will attract audience attention, facilitate comprehension, elicit
emotional reactions and elaborations, impart knowledge gain and skills acquisition, influence the formation or change of affective orientations such as beliefs and attitudes, and affect pertinent behavioral performance.” A comprehensive formative evaluation process involves research both before and during a campaign to engage and analyze community resources and stakeholders, explore meanings and contexts of relevant goal behaviors, identify audience characteristics and media preferences, develop and test candidate messages, and help anticipate potential barriers to campaign effectiveness. Such formative evaluation may include a wide range of methodologies, such as focus group interviews, in-depth personal interviews, surveys, theater testing, day-after recall, media gatekeeper review, readability testing, eye- and attention-tracking, physiological responses, combinations of these, etc.

Evaluation of public service announcement videos provides considerable foundation for climate communication campaign design (see Atkin & Freimuth, 2012). Bator and Cialdini (2000) provide one of the best overviews of applying persuasion theory and message design to environmental PSAs. As with many other communication campaign reviews, they emphasize the importance of conducting formative evaluation to understand the audience and message design. This involves identifying the at-risk audience; relevant, susceptible and feasible attitudes and behavior changes; message and source characteristics; and salience and interpretation of the issue. Their detailed discussion of message pre-testing, though mostly related to text, and established approaches for using online tools and metrics for evaluating PSA reach and effectiveness (e.g., Tian, Brimmer, Lin, Tumpey, & Reeves, 2009) are largely generalizable to images as well.

Dominant Climate Change Visual Frames in U.S. Print News

Current understanding of the role of imagery in climate change communication does not allow us to provide normative guidelines or effectiveness measures for specific combinations of imagery and text. However, our previous work and the work of others does allow us to 1) identify frequent types of climate change images and visual frames appearing in climate change news stories, and 2) to consider advantages or disadvantages of using these visual frames to engage and motivate audiences. We integrate these insights to outline a process for testing candidate visual imagery as part of the formative evaluation phase of climate change communication campaigns.

We have previously reported on a content analysis of 350 images and accompanying captions and headlines that appeared with 200 randomly selected U.S. newspaper and magazine stories about climate change from a set of 5,637 articles from 1969 through 2009 (Rebich-Hespanha et al., 2015; Rebich-Hespanha & Hespanha, 2014). In this earlier work, we first identified and reliably coded 118 visual themes appearing in the images, and then performed a cluster analysis of the co-occurrences of the 103 non-geographic coded visual themes (Rebich-Hespanha et al., 2014) across the 350 images. Through qualitative interpretation of the resulting clusters of themes1, 42 overall visual frames emerged. Figure 1 shows the frequency of

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1 The clustering approach identified two themes as related when they frequently co-occur in the same images. Each image may be associated with more than one theme, and each theme may appear in one or more images. Agglomerative clustering begins with each theme as its own cluster and then sequentially identifies the most related themes (based on patterns of co-occurrence in the image set) and joins them to form larger clusters. Grouping of themes proceeds until all themes are part of a single large cluster within an overall hierarchical “tree” structure.
appearance of the 15 dominant visual frames. The government, politics, and negotiation frame, observed in 34% of all of the coded images, appeared most frequently. Climate science, research, and scientists and monitoring and quantifying frames were also very salient, each appearing in 21% of the coded images. Other frequently observed frames include (in order of decreasing frequency) temperature record; regular (sometimes vulnerable) people; food and agriculture; alternative energy and energy prices; industry impact on the environment; future climate, vulnerable landscapes, and adaptation; citizen leaders; wilderness and nature recreation; storms; impacts on polar animals and landscapes; view of globe from space; and energy efficiency. The following sections provide additional information about each of these visual frames, and discuss how awareness and understanding of these common elements of visual representations of climate change can serve as one important component of formative evaluation of climate communication campaigns.

![Frequency of appearance of the 15 dominant visual frames.](image)

* Insufficient operationalization of the regular people theme prevented a precise estimate of the prevalence of this theme, but it is at most 13%. The ambiguity in coding was related to the salience of the presence of the regular person or people.

**Government, Politics, and Negotiation**

This visual frame reinforces the perspective that governments and political processes are central to definition of and societal response to climate change. This frame is often represented with a photo of a political figure – frequently, a simple headshot or an ‘action’ photo in which

This hierarchical tree is then segmented into clusters by thresholding the maximum distance between members of the same cluster.
the political figure in question is examining an efficient or alternative energy technology, participating in international negotiations, or discussing legislation. Communicators may wish to be cautious when using politically framed imagery, as such images are likely to provoke strong emotional responses, message avoidance and disengagement among specific audiences (O’Neill et al., 2013), especially along partisan lines (very salient for climate change issues; see Leiserowitz, 2006). This frame also serves to reinforce the notion that addressing climate change requires or relies upon government action, and may contradict other message elements that promote alternatives to government (in)action or urge assumption of community or personal responsibility.

**Climate Science, Research, and Scientists**

This frame positions climate science and scientists as important *agents of definition* (Carvalho, 2007) for the climate change issue. Images containing this visual frame often include photos of scientists and/or their research equipment, as well as diagrams illustrating, for example, how the greenhouse effect (or another aspect of the climate system) works. Such images support the idea of science and scientists as central to definition of the issue. However, because scientists are most often associated with documenting or projecting the causes and impacts of climate change, this type of imagery may be difficult for audiences to understand or engage with (O’Neill & Hulme, 2009) and may discourage viewers from thinking about potential mitigation or adaptation actions. Further, conservatives’ trust in science declined sharply in the past 30 years, while moderates’ and liberals’ trust remained stable (Gauchat, 2012), so such portrayals may have different implications depending on audience partisanship and ideology.

**Monitoring and Quantifying**

This frame reinforces the perspective that empirical evidence is the grounding for our understanding of both the problems associated with climate change and the feasibility and benefits of possible solutions. Much of the imagery associated with this frame is in the form of charts, graphs, and maps with a thematic focus on emission levels, energy generation and fuel use, and carbon markets and trading schemes. Because such images typically contain graphical representations of data, they can be used to imbue the message with a sense of objectivity or authority, and portray otherwise invisible changes over time or relationships among multiple factors. However, such graphical representations may fail to engage (and even alienate) potential audiences who lack the motivation and/or requisite skills to accurately interpret graphical data representations (Trumbo, 1999). Although there are some exceptions, such graphics also tend to focus on what has already occurred, thereby possibly discouraging the audience from thinking about alternative futures.

**Temperature Record**

This frame emphasizes the role of global temperature phenomena as diagnostic for changes to the climate system, and is typically observed in two distinct types of imagery. One type consists of graphs, charts, and maps comparing past, present, and projected future temperatures; the other includes photographs that represent unseasonably warm temperatures in particular locations during particular moments in time. As was the case for the monitoring and quantifying frame, graphical depictions of historic temperature trends can be used emphasize the objectivity of claims regarding a changing climate, but they can also serve to disengage certain audiences. The hockey stick graph, which has arguably achieved status as an icon of the controversy over the existence of global warming, may also reinforce the “divide between the makers and viewers of climate-change graphics” (Walsh, 2015, p. 366) and prime attitudes and cognitions that make certain audiences less willing to engage with new perspectives on the issue.
While photographs showing locations experiencing unseasonably warm temperatures may be used to bring home the reality that climate change is happening, the same imagery may perform a distancing role (Doyle, 2007; O’Neill, 2013) if the audience perceives the location as a faraway place.

**Regular (Sometimes Vulnerable) People**

This frame presents a particular view of the relevance and roles of regular people – in other words, people who are not in positions of influence – in the experience of and public deliberation about climate change. Within the frame, three distinct roles emerge – regular people can experience or be vulnerable to the impacts of climate change or the policy decisions related to climate change; they can serve as audience or context for other people such as political, business, or civic leaders; and they can participate in protests, demonstrations, or other climate-related events. When inhabiting these roles, regular people do not appear to be agents of definition (Carvalho, 2007) on the issue of climate change, but rather are dependent upon the actions and decisions of those who are empowered to define both problems and possible solutions. While this frame may be useful in evoking emotional responses through identification with the plight of those represented in the imagery, such framing may also diminish a sense of self-efficacy and ability to take actions to address the issue (O’Neill & Nicholson-Cole, 2009).

**Food and Agriculture**

This frame emphasizes the connections between climate systems, food production, and consumption and focuses on the food-related habits, businesses, and preferences that affect human impact on the environment or the vulnerability of food systems. Imagery associated with this frame typically illustrates greenhouse gas emissions associated with production of different foods, contrasts the environmental impacts of factory farming (and meat production more generally) with the impacts of other foods and farming methods, and highlights the economic and cultural systems in which food production and consumption are embedded. Charts, graphs, and diagrams are often used to represent the degree of impact or illustrate the connectedness of the food and climate systems, but these relatively complex visualizations may not be easily understandable by some viewers (O’Neill & Hulme, 2009; Trumbo, 1999). Photographic images of factory farms may draw attention and arouse emotions of some audiences, but may also decrease interest and openness to new ideas among audiences who have strong economic and cultural ties to agricultural production and consumption or who feel they are being manipulated emotionally. Images associated with traditional and sustainable food production methods may evoke a sense of nostalgia or a desire for stronger connectedness to natural systems for some, but may strike others as romanticized and unrealistic. Because images containing the food and agriculture frame most often focus on the production side of the food system, they may constrain thinking about the problem and prevent audiences from considering other components of commercial food systems such as transportation, processing, marketing and advertising, and convenience and luxury-driven consumption habits (Hansen & Machin, 2013).

**Alternative Energy and Energy Prices**

This frame positions climate change as a (potentially) costly energy technology problem. The primary focus is on alternatives to fossil fuel energy, and on the economic aspects of possible transitions to these alternative sources of energy. Energy prices are most often represented through charts or graphs, and alternative energy technologies through photographs. While there is some evidence that this frame can generate positive affect and arousal for audiences (Leviston et al., 2014), the frequent intersection of representations of alternative energy technologies with costs of these technologies privileges an economic perspective on these
potential solutions, likely making it more difficult for audiences to consider other types of costs and benefits of both traditional and alternative energy sources. Photographs depicting wind energy technology often show white turbines dotting a picturesque landscape, while photographs of nuclear energy technology typically have a more industrial feel. While romanticized alternative energy technology imagery may encourage certain audiences to develop positive feelings about alternative energy, repeated representation of energy issues as a technology problem may make it difficult for audiences to think of innovative solutions to energy issues that involve, for example, changes in consumption habits and reduction of energy demand, and of the competing political and regional forces involved in any such change.

**Industry Impact on the Environment**

This frame identifies industrial development as a key cause of damages to the climate system. Typical imagery containing this frame includes photographs, illustrations, and other artistic representations of industrial landscapes. Billowing smokestacks are particularly salient visual elements, and are often appropriated as icons of industry-driven destruction of the environment. Because of the frequent repetition of this iconic representation, it may be the case that this imagery has lost its power to engage certain audiences, who essentially see through this iconic visual frame (Schneider, 2011). This frame, in combination with the alternative energy and energy prices frame, also supports the idea that technology is both cause of and solution for the climate change problem. Because this technical frame can depersonalize and distance energy issues, such framing may prevent audiences from seeing social and cultural aspects of the energy consumption problem and recognize the ways in which their own behaviors create demand for such technologies.

**Future Climate, Vulnerable Landscapes, and Adaptation**

This frame casts climate change as a range of possible futures and of potential paths to those alternative futures. Artistic imagery is very common for this frame, and includes representations of imagined future landscapes, ranging in tone from dystopianism to techno-optimism. Imagery showing landscapes impacted by or vulnerable to sea level rise are particularly common. These visual representations often employ artistic modes of expression to render changes or expected changes visible through superimposition of visual elements onto current landscapes. Images of geoengineering technologies that could offer paths to some of these alternative futures also represent this frame. While such imagery may help audiences envision difficult-to-imagine changes, the dystopian elements in some of these images may encourage a sense of defeatism among audiences. Because the images are often renderings of imagined futures, they may not resonate with audiences who prefer realistic representations.

**Citizen Leaders**

This frame establishes non-political figures such as entrepreneurs and leaders of environmental non-profit organizations as agents of definition for climate change. People represented in images containing this frame are typically advocating points of view or working toward specific actions. While this frame provides a possible counterpoint to the government, politics, and negotiation frame and the assumption that politics and government are necessarily the primary locus of action on climate change, images focusing on citizen leaders reinforce the distinction between influential leaders and regular people. While some audiences might be inspired to take action by these leadership figures, others may fail to engage or may be left feeling that the more modest actions they can take personally are inconsequential or unnecessary (O’Neill et al., 2013). As with all frames that involve representations of people, certain audiences
may feel alienation if they do not identify with these individuals’ backgrounds, social identity, or values.

**Wilderness and Nature Recreation**

This frame represents climate change as a threat to the use and non-use values of wild and natural places. This frame has ties to sublime views of nature, and the value of the mere existence of those wild places as well as the recreation value that can be derived from them. Images containing this frame are most often photographs of magnificent vistas or natural scenes, and often include representations of people who have traveled to experience these special places. One might expect images representing this frame to appeal to audiences who participate in nature recreation or place high value on the existence of wild. However, use of this visual frame to communicate about the vulnerability of wild places to climate change and environmental degradation may paradoxically encourage demand for more environmentally-costly travel to experience such places. Further, the beauty and vigor of such portrayals may make it more difficult to imagine threats to and vulnerability of wilderness.

**Storms**

This frame associates climate change with devastating storms and the resulting loss of land area. Despite the difficulty of drawing a scientifically-based causal connection between particular extreme weather events and climate change, this frame may, for some audiences, reinforce a sense of vulnerability, risk, and need for urgent action in the face of a changing climate (Leviston et al., 2014). However, because images associated with this frame usually represent the here and now, use of the frame may also invoke a sense that dangerous climate change is already inevitable, and that it is too late to do anything about it (Doyle, 2007). In addition, such imagery is generally linked to particular locations, which may serve to make the message feel relevant for local audiences but reinforce a sense of distancing for audiences who are further from the location of the weather event.

**Impacts on Polar Animals and Landscapes**

This frame emphasizes the climate-related risks faced by sensitive species and ecosystems such as those in the polar regions. Two images that have been used repeatedly to represent this frame have achieved iconic status – the photograph of the stranded polar bear, and the image of the calving glacier or melting sea ice. Such imagery may engage audiences with the issue through identification with the plight of charismatic megafauna (Feldhamer, Whittaker, Monty, & Weickert, 2002) or the anticipation of nostalgia for spectacular frozen landscapes that are quickly disappearing. However, as noted earlier, others have warned (e.g., Doyle, 2007; O’Neill, 2013) that repeated use of imagery depicting impacts and vulnerabilities in remote locations may have a distancing effect on audience perceptions, and frequent repetition of the same iconic images may habituate audiences to the degree that they no longer give the images much attention (Schneider, 2011).

**View of Globe from Space**

This frame reinforces the status of climate change as a global issue, and may diminish the influence of individual, local, and ideological differences. At the same time, by providing the viewer with a technologically-enabled view from afar, this frame encourages audiences to take on the role of the detached observer, and can also have a ‘distancing’ effect (Ingold, 1993). This frame may also imply the need for a global solution to a global problem, and therefore reduce the audiences’ willingness to consider possible local and small-scale solutions. Scannel and Gifford (2013) found that engagement with climate change messages was stronger for locally relevant messages, and for participants with greater place attachment. On the other hand, there is also
evidence that focus on local issues can lead to lack of engagement for individuals who have a perception of control over the local environment (O’Neill & Hulme, 2009).

**Energy Efficiency**

This frame positions energy efficiency as an important means for addressing climate change. Images associated with this frame are often charts or graphs showing energy consumption rates or photographs or illustrations showing technologies such as CFL and LED light bulbs and high-efficiency automobiles. While this frame may encourage audiences to demand more efficient versions of the technologies they are currently using, it may also constrain their ability to consider energy reduction alternatives that do not involve incremental improvements in existing technologies. Because this is also a technical frame, audiences may be discouraged from considering potential non-technical approaches to energy demand reduction (Dewulf, 2013).

**Summary**

These 15 most frequent visual frames may have considerable influence either separately or as elements of associated news stories, and have the potential for both positive and negative influence on knowledge, attitudes, or behavior concerning climate change. Climate change communication campaign designers should at least be aware of the possibilities of these frames, and assess how representative audiences interpret or respond to the frames. The next section proposes a formative evaluation strategy for assessing the relevance and effects of such possible interpretations and salience.

**A Strategy for Formative Evaluation of Visual Elements of Climate Change Communication Campaigns**

Awareness of these dominant visual climate change frames during the formative evaluation process can guide selection of promising visual imagery and communication strategies. While the preproduction and production testing phases of formative evaluation include a broad array of tasks, considerations, and methodologies (Atkin & Freimuth, 2012; Bator & Cialdini, 2000), we focus primarily on aspects that can be used to evaluate the relevance and utility of common visual frames for climate change.

Following the formative evaluation process outlined by Atkin and Freimuth (2012), Figure 2 presents a strategy for incorporating strategic selection and evaluation of visual imagery into formative evaluation for climate communication campaigns. Preproduction, the first phase of formative evaluation, begins with goal identification and information gathering, and can be accomplished through conventional techniques (e.g., surveys, interviews, observations) and/or using a participatory/co-development approach (Bracht & Rice, 2012). Once this information has been gathered and initial campaign goals have been identified, message designers can also make decisions about which communication functions the visual message elements will serve.

For example, will imagery be used to prime existing knowledge, beliefs, or attitudes, or will it be used to motivate creative thinking or alternative perspective taking? If the goal is to activate prior knowledge, choosing a dominant visual frame can quickly elicit existing attitudes, emotions, and cognitions relevant to the issue, by relating audiences’ existing understandings to new information (Entman, 1993; Lang, Potter, & Bolles, 1999). If, in contrast, the goal is to motivate audiences to think creatively or take new perspectives on the issue, communicators might consider avoiding use of iconic imagery that represents dominant frames, as noted above.

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2 A case study illustrating each step in this process is beyond the scope of this overview.
Such imagery may serve to reinforce underlying values and entrenched ways of thinking about the issue (Boykoff, 2011; O’Neill, 2013; Peeples, 2013), emphasize vulnerability (Manzo, 2010a), disconnect viewers from deeper and more complex issues (Doyle, 2007; Hansen & Machin, 2013), foster defeatism (Doyle, 2007); and limit consideration of other relevant issues (a central goal of framing; Entman, 1993). This is not to say that dominant visual frames cannot be used innovatively, but we suggest that communicators aiming to utilize these frames to support alternate perspectives apply established frames in novel ways. For instance, application of dominant visual frames in atypical combinations (e.g., alternative energy and energy prices with storms, or wilderness and nature recreation with energy efficiency) could lead to positive engagement for particular audiences. Furthermore, use of a dominant frame or typical combination of dominant frames could be effective if employed by a novel messenger (e.g., polar impacts framing used by native people rather than by environmental NGOs or climate scientists).

Figure 2. Considerations for visual imagery in preproduction and production testing phases of formative evaluation (based upon Atkin & Freimuth, 2012).

Once the intended roles for visual communication have been established, a set of candidate visual elements or frames can be identified. Preliminary evaluation (e.g., through questionnaires, informal interviews, responses to images, participatory processes) involving representatives of intended audience(s) can be used to inform selection of the most promising of
these candidate visual elements and/or frames. The selected visual elements can then be
developed into more complete concepts that include both visual sketches and key phrases.
Concepts developed during this phase should also undergo preliminary evaluation, and several
rounds of concept development and preliminary evaluation may be needed to support visual
concept selection before moving onto draft message development and production testing.

Following concept development and selection, full scale production testing can begin. To
prepare for production testing, message designers prepare a set of draft messages that include
images and text (or visual and textual message components that can be combined in various
ways for comparative analysis). These draft messages are then tested with members of the
intended audience(s), and messages are selected and refined based upon evaluation outcomes.

As discussed previously, the visual imagery used in public communication campaigns is
often believed or intended to perform special functions related to the unique communicative
properties of images. For this reason, message designers should ensure that their formative
evaluation strategy includes assessment of whether or not the candidate visual elements can
achieve the desired effects with the intended audience(s) (McGuire, 2012). For example, do the
images draw the attention of the desired audience(s) and stimulate the desired emotional
response? Is the visual imagery memorable, and does it increase the memorability of the overall
message? Do the visual elements cue desired (or unwanted) prior knowledge or attitudes? Do the
visual and textual components of the message reinforce or contradict one another? How do
audience characteristics such as existing knowledge, beliefs, attitudes, values and behaviors
influence responses to particular message elements or strategies? Such relationships can be
explored through well-designed comparative analyses implemented throughout the concept
development, preliminary evaluation, and production testing phases of formative evaluation.
Further, ongoing formative evaluation is necessary to respond to insights or changing contexts
during the campaign.

Vivid imagery that presents dominant visual frames is often a key element of emotional
appeal-based climate communication strategies. While current understanding of the potential for
emotional appeals to motivate changes in attitudes or behaviors suggests that appeals to positive
emotions are likely more effective (O’Neill & Nicholson-Cole, 2009; Ruiter, Abraham, & Kok,
2010; Searles, 2010), potentially fear- or anxiety-inducing imagery is still very commonly used
in climate communication. Dramatic use of dominant visual frames related to temperature
anomalies, climate impacts on humans, animals and landscapes, industry impacts on the
environment, and storms and other natural disasters, for example, are intended to stimulate
motivation through strong emotional involvement. Formative evaluation is therefore of special
importance to communicators who are considering use of fear-evoking imagery, as such
messages should be tested with intended audience to verify that the message truly elicits the
desired emotional response, and that the expected changes in attitudes, beliefs, intentions or
behaviors are actually observed.

Limitations

The 350 images analyzed here are a random sample from 200 climate change news
stories selected from a much larger population of news stories published over a considerable time
period. It is particularly unfortunate that, given copyright restrictions, we cannot include images
that would help to illustrate the nature of the 15 visual frames. Further, the coding of over 100
image themes is based on highly detailed and contextual manual analysis with excellent
reliabilities, and the visual frames emerge from a novel conceptualization using cluster analysis.
However, images in print news stories provide only a very small portion of content about climate
change available to potential audiences. Further, this analysis was focused specifically on visual images, and aside from their associated headlines and captions, does not consider the text of the accompanying news stories. Climate-related news imagery often presents messages unrelated or in contradiction to the messages in the accompanying text (DiFrancesco & Young, 2011). Furthermore, we do not report on issues related to selection and creation of such images by editors and journalists, readers’ interpretations of the images, or any directly observed effects of viewing these images (Nicholson-Cole, 2005).

As with most content analysis studies, we make no claims about the choices behind, or effects of, the visual frames identified in these new stories (see Olausson, 2011, p. 282). In particular, suggestions about which visual frames to use (or avoid) to achieve particular climate change communication goals, or regarding the likely effectiveness of such combinations, though based on insights from our work and the work of others, are, at this point, speculative. Certainly some next steps in this area of research would be assessment of audiences’ interpretations and responses (knowledge, attitude, behavior, commitment) to specific visual frames, and then in combination with textual climate change frames. Also, while this study presents a rigorous basis for considering possible combinations of climate change visual frames and text elements as part of a pre-production phase of formative evaluation for climate change campaigns, it represents only a small, initial aspect of formative evaluation.

**Conclusion**

This study is grounded in, and contributes to, research on visual framing, formative evaluation in public communication campaigns, and climate change communication. Using a set of over 100 highly reliable image themes clustered into 15 dominant visual climate change frames and drawing upon insights from other studies of audience responses, we show how climate change message and campaign designers can make more informed decisions about which types of frames might be most appropriate for varying audiences and message goals. Because visual imagery is intended to serve a variety of functions in communication campaigns (e.g., to draw attention, stimulate emotional response, enhance memorability, or cue prior knowledge/attitudes, represent complex or abstract concepts), formative evaluation should explicitly assess whether or not selected imagery is fulfilling its intended purposes. When designing climate communication strategies, an evaluation of whether priming of existing cognitions would best serve the campaign goals, or whether the intended message relies on creative thinking or new perspectives should inform choices between well-established and novel frames. In cases for which dominant frames are considered suitable, prior research provides a useful basis for anticipating the types of audience responses that dominant image frames are likely to evoke. The results and suggestions presented here provide a foundation for much more comprehensive formative evaluation research that could provide testable propositions and informed guidelines about using or avoiding particular visual frames for climate change campaign messages targeting specific audiences or communication outcomes. Of course, even successful climate change campaign messages involving appropriate and effective use of images are only a very small component of necessary ongoing and multi-level community, national, and global efforts.

**References**


