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Engaging with Climate Change Imagery

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Summary and Keywords

Images are a key part of the climate change communication process. The diverse and interdisciplinary literature on how people engage with visual representations of climate change is reviewed. Images hold particular power for engaging people, as they hold three qualities that differ from other communication devices (such as words or text): they are analogical, they lack an explicit propositional syntax, and they are indexical. These qualities are explored in relation to climate change imagery. A number of visual tropes common to climate change communication (identifiable people; climate change impacts; energy, emissions and pollution; protest; scientific imagery) are examined and the evidence for each of these visual tropes in terms of how they engage particular audiences is reviewed. Two case studies, of polar bear imagery and the “hockey stick” graph image, critically examine iconic imagery associated with climate change, and how and why these types of images may (dis)engage audiences. Six best-practice guidelines for visual climate change communication are presented and three areas for further research in this nascent field are suggested.

Keywords: visual, imagery, climate change, engagement, emotion, affect, icon, saliency, visual trope

The Characteristics of Visuals for Communication

Images are an important, but often disregarded, part of the communication cycle (see Hall, 1980). While there has been a rapid growth in climate change media research, most studies examine textual information only, neglecting the visual dimension of communication (O'Neill & Smith, 2014). Here, the term *image* is used to describe concrete visual content elements, for example, a photograph accompanying a news media report (Wozniak, Lück, & Wessler, 2015; note therefore that “affective imagery,” or the mental images that people hold “in their minds,” is not covered here. See O'Neill &

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Smith, 2014, and Leiserowitz, 2006, for a discussion of these types of images). Defined here then as concrete visual content, imagery may be used to illustrate words or sound (e.g., a photograph alongside a newsprint article), or as a stand-alone image (e.g., a tweeted infographic).

Images help draw audiences in through vivid and emotional connections (Joffe, 2008), and they can help individuals recall information (Graber, 1990). If audiences share cultural references allowing them to read the image similarly, images can also transcend linguistic barriers (Popp & Mendelson, 2010; Maess, 2017). This point is key, however—audiences need to share a common understanding or “reading” of the image in order to make sense of it similarly. Hall (1973) argued that images hold particular power and are an integral part of understanding the values, attitudes, beliefs, and practices that shape our understanding about how the world works. The power of images thus lies in the fact that imagery needs to be decoded by audiences (“read”), working as a rather different communicative device to text. The three communicative qualities of images are discussed (see also Messaris & Abraham, 2001).

First, images are analogical. This means that our understanding of what an image represents is based on our experience of “matching” it to what we know is similar. Words, however, rely on social convention. As O’Neill and Smith (2014) explain: the word for the “sun” has no resemblance to the item it represents (the star at the center of the solar system). To be able to understand the written or spoken word *sun* requires familiarity with the social conventions that comprise the English language. In contrast, understanding a picture of the sun requires either experiential knowledge of the sun, or exposure to and understanding of similar images.

Second, images lack an explicit propositional syntax. Here, unlike with text (where causality can be stated with precise syntactic devices), causality can only be implied, with loose and imprecise cues (Grabe & Bucy, 2009). Making those causal links relies on the reader making sense of implied meanings. In climate communication, this second quality can be illustrated thus (drawing on O’Neill & Smith, 2014): a text can easily represent a sequence of events such as “climate scientists predict more extreme hot weather.” But to communicate this using only visuals requires a sequence of images (a climate scientist using a climate model, a graph showing increasing temperatures, an image of the shimmering hot sun) in order to imply the same causality. But, as the visual cues are loose and imprecise, the reader may interpret the images differently (perhaps, “scientists try to alter the sun’s output”).

Third, images are indexical. This means that images are often read as a direct representation of reality, rather than as an inevitable social construction of reality (Urry, 1992). The lack of indexicality can be particularly problematic for photographs or video images (i.e., “this photograph [or video] recorded directly what happened, so it must be true” rather than considering the ideology and narrative stance of the photographer or videographer, the camera angle and elements represented, what or who is missing in the images, and so on). Of course, readers can actively interpret and decode imagery

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critically, but it does appear that often audiences do undertake non-critical readings (see Philo, 2008). Indexicality continues to be an issue in climate change communication, as the response to a polar bear image alongside a letter to the journal *Science* (Box 1) demonstrates.

Recognizing these three qualities of imagery is important when it comes to considering how audiences engage with visual representations of climate change. It helps to explain how one image can divide audiences in terms of their readings of an image. Take the iconic 1972 Apollo 17 space photograph of the globe suspended in space, an image that still appears now in the climate change visual discourse (Rebich-Hespanha & Rice, 2016). A popular reading of this image is of the “whole earth” (Cosgrove, 1994). Here, viewers see the Apollo images through an environmental lens, where the fragility of life is represented through the marvel of a (relatively) tiny habitable planet in an otherwise lifeless cosmos. This leads to a narrative of humans’ responsibility for environmental protection. In complete contrast, “one-world” readings view the image as representing secular mastery of the globe and the spread of a specific socioeconomic order across space (Cosgrove, 1994). This example demonstrates how even if meaning of a visual appears self-evident, this is simply because the visual is so widely distributed and understood within a culture that it is no longer recognized as being socially constructed (Hall, 1980). It is important to recognize that the use of images is inherently ideological (Hall, 1973), and that powerful interests can become naturalized if specific types of images continue to dominate over others (Hansen & Machin, 2008).

Engaging Audiences with Climate Imagery

O’Neill and Smith (2014) critically reviewed the literature on visual climate communication at the three points in the communication cycle: the moment of production (the conditions and practices that lead to a form of visual appearance); the moment of the (visual) text (the particular construction and arrangement of the visual, itself the product of the practices and technologies employed); and the moment of consumption (readers drawing upon available cultural competencies to “make sense” of and realize into coherent meaning the visual image). This review leads on from O’Neill and Smith (2014) to examine in detail the moment of consumption—or, how audiences engage with climate change (see *Methods for Assessing Visual Images and Depictions of Climate Change* for a review of the moment of the visual text). Here, engagement is defined as an individual state of involvement in climate change at cognitive, affective and behavioral levels (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007).

Visual climate change communication is a relatively new research area, with geographers, sociologists, and media specialists all calling attention to the research gap that exists on the subject (Moser, 2010; Anderson, 2009; Hansen & Machin, 2008; Lester & Cottle, 2009). In particular, while research continues apace in the moment of the visual text, research examining how audiences engage with climate change imagery is still nascent. In particular, most work focuses on audiences within the United States, Western

Europe, Australia, and Canada, with little understanding of how audiences in other nations engage with climate imagery. This emerging literature, and work in allied fields, is examined to shed light on how and why audiences engage with climate change visual imagery.

Image Tropes and Public Engagement

There appears to be a dominant visual concourse of image tropes associated with climate change, at least in Western nations examined to date (e.g., see O'Neill, 2013; León & Erviti, 2013; Rebich-Hespanha & Rice, 2016; and reviews in O'Neill & Smith, 2014 and Metag, Schäfer, Barsuhn, Füchslin, & Kleinen-von Königslöw, 2016). Prominent visual tropes are examined and reviewed in terms of the evidence for public engagement with these types of visuals.

Identifiable People

This is the most dominant type of imagery. A 2011-based study of Australian, U.K. and U.S.-based print media found 48% of news articles about climate change were associated with an image of an identifiable person (O'Neill, 2013).

Images of **politicians and people involved in political processes** are particularly prominent. Rebich-Hespanha and Rice (2016) found that 34% of all images coded in their 30-year longitudinal study of U.S.-based print media fell into the category of “government, politics and negotiation.” Similarly, the O'Neill (2013) study found high levels—28%—of images depicted an image of a politician. However, despite the widespread dominance of political figure imagery, such visuals seem to lack widespread audience appeal.

O'Neill, Boykoff, Day, and Niemeyer (2013) carried out a Q-method¹ study using visual cues to examine how U.S., U.K. and Australian participant cohorts engaged with climate imagery drawn from the print media. They found a dominant and mainstream discourse on climate imagery. Images of people—in particular images of leading politicians—made participants strongly feel that climate change was not important (low salience). These sorts of images also made the Australian participant cohort feel that they weren't able to do anything about the issue (low sense of self-efficacy). Metag et al. (2016) replicated the O'Neill et al. (2013) study in Germany, Switzerland, and Austria. They found largely consistent results, suggesting that the dominant visual discourse identified by the O'Neill et al. study was consistent cross-culturally (at least, in Western nations). For example, Metag et al. also found that imagery of people, including political leaders provoked strong feelings of low salience, and very low self-efficacy. However, this contrasts somewhat with a U.S.-based study by Rebich-Hespanha (2011). She found that positive emotions were associated with a photograph of international political leaders signing an

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agreement. Further work should examine different types of political imagery to test why this might be (for example, people may well engage with out-of-context headshots of political leaders differently, compared to political leaders actively working together on climate policy). O'Neill, Williams, Kurz, Wiersma, and Boykoff (2015) used a literature review, together with an analysis of media articles arising from the reporting of the IPCC (Intergovernmental Panel on Climate Change) Fifth Assessment Report, to assign particular visuals or visual tropes to particular climate change frames. They found that images of political figures were particularly associated with the "Political or Ideological Struggle" frame. They draw on the sociopolitical context of the frame to claim that this news framing can particularly act to polarize audiences with regard to climate change.

The O'Neill et al. (2013) and Metag et al. (2016) studies also found that images of other types of prominent and identifiable people, such as **celebrities and business leaders** provoked both a low sense of salience and of self-efficacy.

Climate Change Impacts

Images of climate impacts are also relatively common in the mass media, with O'Neill (2013) finding that 23% of U.K. print media (7% Australia; 16% U.S.) pictured imagery of climate impacts. Ice imagery (e.g., glaciers, ice sheets) appears particularly prevalent on TV, accounting for the majority of shots on Spanish news bulletins about climate change (León & Erviti, 2013). In terms of engagement with these images, O'Neill et al. (2015) found that images of climate impacts were particularly associated with the "Disaster" news frame. This particular frame appeals to news values of dramatization and personalization, and has strong and readily available compelling imagery. However, they draw on the O'Neill et al. (2013) Q-method study, which found that pictures of impacts illustrated through **climate extremes** (such as the **flood aerial view**, **melting ice-sheet**, and **drought-cracked ground**) promoted feelings of salience about the issue but undermined feelings of self-efficacy, results also echoed in Metag et al. (2016) to warn that such a frame can lead to fear, denial, and apathy (see also O'Neill & Nicholson-Cole, 2009).

In contrast to these studies, Hart and Feldman (2016) found no evidence that exposure to climate impacts (an image of **large-scale flooding**) had any effect, either negatively influencing efficacy, or positively influencing perceived issue importance. Potentially, this is because of the difference in methodology: their study utilized a large experimental panel survey (rather than a rich and in-depth mixed quantitative-qualitative study) of U.S.-based participants, who were exposed to mocked-up news stories. Regardless, this difference is worthy of further investigation.

Nerlich and Jaspal (2014) used theory drawn from visual thematic analysis (rather than experimental studies) to examine the images of extreme weather that were used to illustrate news articles and blogs reporting on the draft of the Intergovernmental Panel on Climate Change Special Report on Extreme Weather Events (Field et al., 2012). They

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found five main visual themes arose. The first and largest group of images, of **flooding**, was split into two distinct subgroups; the first subset is read as representing a lack of compassion to people “getting on with it,” distancing viewers; while the second positions the people pictured as victims in need of assistance. The second visual theme was of **drought** images. Common to these images was a lack of people; and a solemn, gray, and gloomy aspect suggestive of an unnatural, premature aging of the earth. The authors read these images as constructing a sense of powerlessness, and of futility in attempting to safeguard life. The third visual type was images of **extreme heat**. People are missing entirely, and the orange-red tones and burning white sun construct a feeling of impending apocalypse. Accordingly, the images present a world as unbearable for humans, and inspire feelings of intense fear. The fourth visual trope of extreme weather was **hurricanes**. Rather than being images of people affected by extremes, these images used satellite imagery to construct a truly global picture of extreme weather on the planet. The blue-green shades and images of the earth may provoke aesthetic pleasure in the sublime and awe-inspiring, but the authors claim that the lack of human activity and portrayal of planetary scale provokes feelings of collective global helplessness and overwhelming fear. Last, were a set of images picturing **melting ice and rising sea-levels**. Common to these is an absence of human life, and the portrayal of the huge magnitude and imminence of this extreme weather type, which the authors suggest would provoke feelings of fear and helplessness.

Similarly, imagery of catastrophic climatic **tipping points**, such as the planet abruptly entering a new ice age, induce feelings of fear and helplessness. Lowe et al. (2006) examined audience perceptions of climate change after viewing *The Day after Tomorrow* (though they do not focus on the visuals specifically). They found the ice age narrative made participants significantly more concerned about climate change, but also made them feel that extreme events due to climate change would be less likely.

Corner, Webster, and Teriete (2015) used four focus groups, together with a nationally-representative online panel survey in Germany, the UK and US, to test participant responses to several dozen images. They found that imagery of climate impacts is emotionally powerful, but that the tension between saliency and efficacy remains (O’Neill and Nicholson-Cole, 2009; O’Neill et al., 2013) clear. These sorts of imagery are clearly impactful and attention-grabbing but also invoked feelings of hopelessness, with the visual power of climate impacts potentially overwhelming for most viewers. Instead, Corner et al. (2015) recommend showing images of **local (but serious) climate impacts**, in a delicate balance of making the image relevant to the audience (localizing the impact is one key way to do this), but not trivializing the issue (i.e., by making links to the issue at large). Their study showed that images of local climate weather extreme impacts made people feel that climate change was more immediate and worrying—but there was a trade-off in that people felt like Western nations were more able to cope in the aftermath of impacts, and able to recover, unlike developing nations.

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Corner et al. (2015) also found that the presence of people is important in visually communicating climate change impacts, but that showing real people dealing with climate impacts, rather than staged photo-ops, was key. Images containing one or two people tended to elicit stronger reactions than images containing many people, as did stylistic-semiotic features of the image, such as the person pictured making direct eye contact with the camera. Stories featuring images connecting a personal story with large-scale destruction (in one case, **a man showing how a flood engulfed his home**) were likely to resonate with viewers.

A further subset of climate impacts imagery is the portrayal of **pristine landscapes and iconic species**, to illustrate what may be lost with climate change. The O'Neill et al. (2013) study found that pictures of climate impacts on iconic landscapes (**deforestation, coral reef**) promoted feelings of salience about the issue but undermined feelings of self-efficacy (results also echoed in Metag et al., 2016). Imagery depicting impacts on **Polar Regions** is particularly iconic in the visual climate change discourse. Rebich-Hespanha and Rice (2016) found that 6% of all images coded fell into the category of “impact on polar animals and landscapes.” **Polar bear** imagery has proved particularly divisive in terms of audience engagement with climate visuals (see Box 1 for further discussion).

Box 1. Iconic imagery: the polar bear

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The polar bear icon operates in a contested space. Ecologists brought the fate of polar bear populations under a changing climate to the fore in the early 1990s. As with all scientific endeavors, there is some contestation among experts about how polar bear populations will change under projected sea-ice decreases (O'Neill, Osborn, Hulme, Lorenzoni, & Watkinson, 2008). However, a review of the scientific evidence (Stirling & Derocher, 2012) states that, if sea-ice continues to decline as projected, polar bears will largely disappear from the southern portions of their range by mid-century, with the bears' long-term viability uncertain under this much reduced global population size and habitat range.

The use of polar bear imagery has become deeply political. Listing polar bears as "threatened" under the U.S. Endangered Species Act (ESA) drove calls for regulation of greenhouse gas emissions, prompting a statement from President Bush that the ESA was "never meant to regulate global climate change" (Bush, 2008). Advocacy groups continue to use polar bear iconography as a shorthand for demanding climate change action; polar bear imagery was very visible at the Copenhagen Conference of the Parties (COP15) through the Oxfam protesting bears and the Ice Bear Project, and it is a common site in climate protest marches (Figure 1).

In the media, polar bears have been called the "poster boys" of climate change, where "they pose unwittingly" (Garfield, 2007). Indeed, the polar bear image has become so clichéd in terms of climate change communication that an April Fool's Day article was published in a U.K. newspaper titled "Polar Bears Spotted in Scotland as Animals Flee Melting Arctic Ice Cap" (Piaf, 2017). Communicators disregard this at their peril. For example, a significant controversy ensued because of an editorial decision in the journal *Science* to display a (Photoshop altered) polar bear image alongside a letter from climate scientists (Gleick et al., 2010) asserting the integrity of climate science. The photo was subsequently changed by the editorial team.

Polar bear imagery has shifted semiotically (see also Tollmann, 2014), first as an early-warning symbol of impending climate change, to activist appropriation of the iconic polar bear, and now to a clichéd and stereotyped visual synecdoche—where the polar bear comes to stand in as "visual shorthand" to signify a particular set of ideas about climate change within a particular culture.

Empirical research has demonstrated diverse and divisive participant views on engagement with polar bear imagery. In a U.K.-based workshop setting testing engagement with six climate icons, O'Neill and Hulme (2009) found that although polar bears were considered the "least relevant" climate icon, a substantial number of participants had a strong affective connection to polar bear iconography. However, other participants found it highly clichéd, and completely disengaging. In their U.S., Australian and U.K.-based Q-method study, O'Neill et al. (2013) found polar bear imagery reasonably effective in terms of promoting feelings of issue salience (importance) across participant cohorts, but it did not promote feelings of self-efficacy. This finding appears consistent cross-culturally (at least, in the Western nations examined), as the same results regarding saliency and efficacy were found in the German, Austrian, and Swiss visual Q-method study of Metag et al. (2016). Finally,

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reflecting these divided views, a polar bear image garnered positive responses from participants in a Corner et al. (2015) U.S., German, and U.K.-based nationally representative survey, but when tested further in an in-depth discussion group setting, polar bear imagery was discovered likely to prompt cynicism and issue fatigue.

Thus, polar bears are as much the subject of inverted semiotics and parody (Linder, 2006) as they are a climate icon for public engagement. Climate communication academics and practitioners have therefore called for efforts to move beyond polar bear imagery, and instead to visually represent climate change in more creative and meaningful ways (Slocum, 2004; Manzo, 2010; Corner et al., 2015).



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Figure 1. Polar bears as a climate icon during the “Walk against Warming” protest, Melbourne, Australia, 12 December 2009 (author’s photograph).

Energy, Emissions, and Pollution

Rebich-Hespanha and Rice (2016) found that 9% of all images coded fell into the category of “**industry impact on the environment.**” Expanding on this theme, Remillard (2011) examined the *National Geographic* photo-essay on the Canadian oil sands. He draws on the theoretical perspective provided by visual studies. In doing so, he posits that these images function as a picture of environmental risk that is both removed from everyday life and existent on a grand scale. Because of this, they may invoke a sense of importance in audiences but are also unlikely to engender a sense of self-efficacy.

Images of **smokestacks** feature relatively infrequently on average, though some outlets refer frequently to this visual trope (average 4%; ranging in individual newspapers between 1 and 15% of coverage; O’Neill, 2013). Rebich-Hespanha et al. (2015) found the strongest negatively valenced reaction to climate images was found for a photograph of smokestacks. O’Neill and Nicholson-Cole (2009) and O’Neill et al. (2013) also find especially strong negative emotions attached to smokestacks imagery. These studies found that while dramatic and potentially fear-inducing images like smokestacks can successfully capture people’s attention, they can also act to distance viewers, leaving them feeling overwhelmed or helpless. In contrast to these studies, Hart and Feldman (2016) found no evidence that exposure to a smokestacks image negatively influenced efficacy, or positively influenced perceived issue importance.

Images of **energy futures** feature fairly rarely (<7% in O’Neill, 2013; 9% in the category of “alternative energy and energy prices,” Rebich-Hespanha & Rice, 2016). However, there seems fairly universal levels of positive engagement with these types of image. For example, O’Neill et al.’s (2013) Q-method study found that images of energy futures (**solar panels, an electric car, traffic jam, wind farm**) promoted feelings of self-efficacy (although they had little effect on feelings of issue saliency). The Metag et al. (2016) study found largely similar results in terms of energy futures imagery (including imagery of **solar panels, wind farm, electric car, traffic jam, fuel pump**) strongly evoking feelings of self-efficacy. The U.S.-based study of Rebich-Hespanha (2011) found that an image of renewable energy (people installing **solar panels**) was the one that garnered the most consistent and intensely invoking positively valenced emotions. And in their large U.S.-based panel survey, Hart and Feldman (2016) found that an image of **solar panels**, alongside text that discussed actions to address climate change, did increase individuals’ perceptions of self-efficacy.

Imagery associated with **agriculture and food emissions** was rarely found in the 2011 Australian, U.S., and U.K. print media (O’Neill, 2013), though Rebich-Hespanha and Rice (2016) found that 10% of images coded under “food and agriculture.” This perhaps partly accounts for the low levels of engagement (and, indeed, confusion) between this sort of imagery and the climate change issue (see also Wellesley, Happer, & Froggatt, 2015). For example, Corner et al. (2015) found that a photo of a man in front of a plateful of (albeit, raw) **red meat** provoked confused reactions. People weren’t making, or couldn’t make,

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the connection to climate change. O'Neill et al. (2013) found an image of red meat invoked some (though not particularly strong) feelings of self-efficacy across the U.S., U.K., and Australian participants. In contrast, Metag et al. (2016) found a slightly stronger association between self-efficacy and an image of meat for sale.

Rebich-Hespanha and Rice (2016) found that 6% of all images coded fell into the category of “**energy efficiency**.” O'Neill (2013) comments on the rarity of any sort of **home-based adaptation or mitigation** imagery. However, despite its obscurity in the mass media, O'Neill et al. (2013) found that a particular image of energy futures, the **home insulation** image, was particularly effective in motivating feelings of self-efficacy, especially in the U.S. participant cohort. However, Corner et al. (2015) cautions that these sorts of individual-person action-based visuals need to be used with care, to avoid becoming clichéd. Their focus group study found that a photo of a whole family seemingly enjoying family seemingly enjoying installing insulation in their home was derided for its unrealistic portrayal of a mundane activity.

In contrast, images of **congestion and traffic** appear easily connected to the climate issue. O'Neill et al. (2013) found that an image of a traffic jam strongly promoted feelings of self-efficacy, particularly in the U.K. and Australian cohorts, although these images had much less impact on peoples' feelings of issue salience. Corner et al. (2015) found that these sorts of images had to be shown at scale, in part to avoid demonizing certain types of “normal” behavior (and hence isolating audiences). Thus, Corner et al. found that images of traffic congestion were readily connected to climate change, but an individual family in a car was not.

Protest Imagery

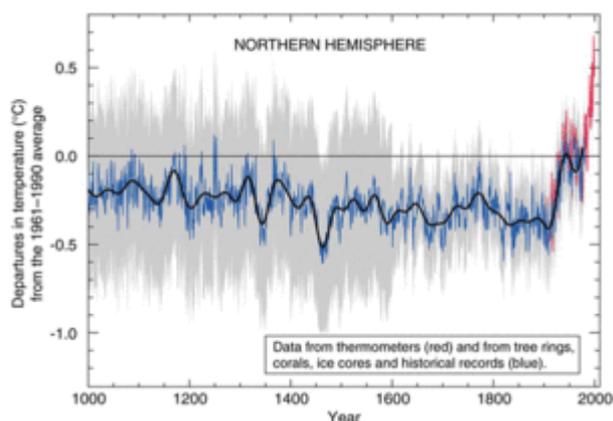
Protest imagery is relatively common (12% of coverage on average across U.S., U.K., and Australian newspapers, but as high as 26% of all coverage in *The Guardian*; O'Neill, 2013; note that Rebisch-Hespanha & Rice, 2016 did not use “protest” as a coding category). Protest imagery also appears to be fairly common on TV, appearing relatively frequently in visual shots on Spanish news about climate change (León & Erviti, 2013). Protest imagery garners mixed responses (O'Neill et al., 2013). In the United Kingdom, a **climate protest** image was reasonably effective in promoting feelings of issue salience (importance), but the effect appeared less marked in the U.S. and Australian participant cohorts. However, Rebich-Hespanha et al. (2015) did find that positively valenced emotions were associated with a photograph of a climate protest. In contrast, Hart and Feldman (2016) found no evidence that exposure to an image of climate protest (a march calling for climate action) influenced either saliency or efficacy. Corner et al. (2015) found reasons to be cautious in using protest imagery. In their four German and U.K.-based discussion groups, they found many participants viewed protest images as greenwash and had tired of the generic climate change protest visual trope. Yet, participants did not engage with, or understand, newer and more specific climate campaign jargon such as

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“divestment.” These feelings were consistent across the political spectrum, that is, a politically diverse participant sample disliked protest imagery, not just those who were more ideologically right-leaning, or those who were more skeptical about climate change.

Scientific Images

Scientific and technical images accounted for just 6%, on average, of all U.S., U.K., and Australian print media climate change visuals (O’Neill, 2013); although as much as 21% of the broader “climate science, research, and scientists” frame, and a further 21% in the (again, broader) frame of “monitoring and quantifying” in Rebich-Hespanha and Rice (2016) U.S. print media study. Scientific images implicitly become political images (Schneider, 2012) as they develop a life “beyond the lab,” not least by their reflexivity through the act of showing possible future worlds, making particular types of future more or less likely. O’Neill et al. (2015) found that scientific graphs and figures were particularly associated with the “Settled Science” climate news issue frame. This frame puts the emphasis on the science of climate change, and the considerable evidence of the need for action. It is a generic news frame that exists for other socio-technical issues. Its use by political figures can draw attention to the underlying science, and away from addressing political realities. Also, increasing attention to the science of climate change may or may not lead to an increase in knowledge—and certainly is unlikely to lead smoothly to a change in attitudes or behavior (Whitmarsh, O’Neill, & Lorenzoni, 2011).



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Figure 2. The “hockey stick” figure, as originally published in the IPCC Summary for Policymakers (2001, p. 3, Figure 1B) under the headline caption “Variations of the Earth’s surface temperature for the past 1,000 years.”

Box 2. Iconic imagery: the “hockey stick” graph

An iconic visual in the scientific imagery visual trope is the temperature graph, most notably, the “hockey stick” graph, a figure of reconstructed Northern Hemisphere

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temperature over the past millennium (Figure 2). Rebich-Hespanha and Rice (2016) found 15% of U.S. print media images coded into a frame of the “temperature record” (though note not all of these are solely composed of scientific/graphical images).

The “hockey stick” figure was originally based on the work of Mann, Bradley, and Hughes (1998), but came to prominence when it featured in the IPCC’s Third Assessment Report concluding overview section, known as the Summary for Policymakers (IPCC, 2001). The notoriety of the image increased after the 2009 hacking and release of emails from the Climatic Research Unit (CRU) email server (or, “Climategate”), timed to coincide with the 2009 Copenhagen Conference of the Parties (COP15). These emails showed Mann and other IPCC lead authors discussing how to present tree-ring data that did not fit neatly in with other data contained in the figure. The debate about this image has led directly to two books: climate science critic Andrew Montford’s *The Hockey Stick Illusion* (2010) and climate scientist Michael Mann’s *The Hockey Stick and the Climate Wars: Dispatches from the Front Lines* (2012).

This visual has become notorious because it has disrupted the commonly held view that the graph simply illustrated how the climate was changing over time, rather than being critically read as a socially constructed and complex visual device comprising multiple strands of scientific enquiry (Walsh, 2014). As Hulme (2012) states, in a review of Mann’s book, the controversy around the image stems from peoples’ different worldviews, beliefs, ideologies, and values about responding to the issue of climate change, which is not something that will be altered or reconciled by climate science and its graphical representation.

In terms of empirical research testing such images with audiences, a temperature graph similar to the IPCC hockey stick figure was found to have some consistent effect in promoting feelings of issue salience (importance) across U.S., U.K., and Australian participant cohorts, but it did not affect feelings of self-efficacy (O’Neill et al., 2013).

Rebich-Hespanha et al. (2015) tested other scientific images including a **map of receding Arctic sea-ice**, and a scientific **diagram of the greenhouse effect**. They found that both images provoked consistent and strong negatively valenced emotions in the U.S. participants surveyed.

There is a wider literature on public engagement with scientific images, including how experts and non-experts engage with **general climate science visuals**. Much of this work draws on established cognate fields, such as health communication, and provides useful general guidelines rather than empirically tested visuals with specific audiences. For example, Maess (2017) considers that there is a need to improve awareness and understanding of basic climate change knowledge in the world’s large populations with little to no literacy. Although he recognizes that “visual codes must be learnt” and that the health literature can help to identify what works, there is an overly simple assumption of scientific knowledge into attitudinal or behavioral change here (as unlike with health

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communication, there is often no direct link between climate change information acquisition and direct personal benefit to acting on climate change; e.g., see Whitmarsh et al., 2011).

A number of pitfalls for using scientific imagery in climate communication, drawing on theory from the cognitive and psychological sciences, is described by Harold, Lorenzoni, Shipley, and Coventry (2016). Key findings include the importance of tailoring graphics to particular cultural audiences, for example, in terms of assumptions about the direction in which scientific visuals will be read (from left to right in English-speaking cultures, but from right to left in Arabic cultures). Another important consideration is the color scale of scientific figures. For example, Harold et al. (2016) cautions against assuming that the red-blue color scale intuitively indicates a hot-cold scale for all audiences. Indeed, color scales are an important decision for scientific figure creators and users. Hawkins, McNeill, Stephenson, Williams, and Carlson (2014) call for an end to the “rainbow” color scale in climate science, as it can distort, mislead, and confuse viewers, as well as appearing illegible to those who are color blind (see also Light & Bartlein, 2004; Stauffer, Mayr, Dabernig, & Zeileis, 2015).

There is also a growing literature examining the **modes and types of scientific device** most likely to meaningfully engage audiences. For example, van der Linden, Leiserowitz, Feinberg, and Maibach (2014) undertook an online survey using a nationally representative U.S.-based participant sample to test how to communicate the scientific consensus on climate change. They compared understanding of this information via pie charts, compared to factual statements, and to metaphors. Visual representation through pie charts appeared to be a particularly effective communication device. Similarly, Libarkin, Thomas, and Ruetenik (2017) undertook an experimental eye-tracking study, to examine how expert and non-expert audiences engaged with climate science imagery. They found that while expert scientists generally understood where to look in images, non-experts tended to ignore the figure’s legend and scale, and focus instead on the artistic yet unimportant elements of the image in random order. The authors demonstrate that carefully redesigning of scientific images can help non-experts to engage with scientific visuals more effectively.

Finally, the importance of empirically **testing scientific visuals with user communities** is shown by Lorenz, Dessai, Forster, and Paavola (2015). They used an online survey to examine how user communities of adaptation practitioners in the United Kingdom and Germany engaged with graphical visual representations of climate projections. This was a fairly homogeneous group (by expertise), and yet even within this, significant differences and preferences for scientific visual communication were found. They did not find a consistent association between assessed comprehension of the scientific images and participants’ self-perception of their comprehension of the images. This suggests that participants use the scientific imagery that they think they understand the best, rather than the imagery that they actually understand the best. This shows how

complex and challenging it is to tailor information-rich scientific visual imagery to an audience.

Conclusion: What Image Is Best for Climate Communication?

As the exploration of visual tropes for climate change engagement shows, there is no one “perfect” image or visual trope. While the evidence base for visual climate change communication currently remains small, a number of the studies referred to are empirical studies that assess “real-world” audience response to particular images. These studies can assist in compiling a number of best-practice guidelines for visual climate communication:

- *Engaging for increased saliency or efficacy?* Is the communication trying to interest people who have little previous engagement with climate change? If so, images that promote feelings of issue importance (saliency), such as pictures of climate impacts, may be more effective. On the other hand, is the audience already interested in climate change but images are needed that promote a sense of self-efficacy? If so, visuals of renewable energy futures may be more suitable (O’Neill et al., 2013 and see also Metag et al., 2016, though note the difference in saliency findings in Hart & Feldman, 2016). Few, if any, images appear to increase both a sense of importance (saliency) and a sense of being able to act on climate change (self-efficacy; O’Neill et al., 2013).
- *Using imagery of identifiable people carefully.* Pictures of politicians, businesspeople, or celebrities appear unlikely to engage audiences (with politicians, in particular, likely to decrease both saliency and self-efficacy; O’Neill et al., 2013; Corner et al., 2015; Metag et al., 2016). Imagery of “real people” in authentic situations are favored over staged photographs (Corner et al., 2015). And, images picturing one or two people directly impacted by climate change and making eye-contact with the viewer are often more engaging than generic images of many people (Corner et al., 2015).
- *Using innovative images and avoiding visual clichés.* New and dramatic narratives can make headlines through their high news-value (Bennett, 2011), and the same is true for climate visuals (e.g., the “disaster” framed imagery of O’Neill et al., 2015; Corner et al., 2015). Conversely, use iconic (and potentially clichéd) imagery cautiously (see Box 1 and 2).
- *Audience socio-demographics, such as political affiliation, matter.* As one might expect—from the diverse literature on climate values, attitudes, and beliefs (see Clayton et al., 2015)—political affiliation appears to influence how people engage with climate imagery. Corner et al. (2015), for example, found that local flooding images

effected higher levels of engagement from those on the political right than those on the left.

- *Sociocultural influences also play an important role.* There appears to be a dominant visual discourse on climate change imagery, which is read by most people in similar ways, at least in Western societies (O'Neill et al., 2013; Metag et al., 2016). However, it is clear that sociocultural influences do still play a critical role in how visuals are read, how they are understood, and, indeed, how they are perceived to be understood (Hall, 1980; Lorenz et al., 2015; Maess, 2017).
- *Visual creation and visual literacy are specific skills,* often demanding specialized and professional assistance (Maess, 2017). For example, the IPCC (2016, p. 20) is considering setting up a team of communications specialists in its Technical Support Units, including data visualists, in order to increase the visual clarity and readability of the Summary for Policymakers, and to increase accessibility of the Sixth Assessment Report (AR6). In some cases (perhaps especially for scientific imagery) a careful and iterative process of co-production of climate images, between developer and user communities, may be beneficial (Lorenz et al., 2015).

Further Research: Where to from Here?

As stated, research at the site of consumption (engagement) with climate visuals is still nascent. Considerable research effort continues to focus on visual content of climate change communication, but can only hypothesize as to the effects of these visuals on audiences. As this interdisciplinary and many-disciplined field of research continues to attract interest and to grow, the following would provide fruitful sites for further research:

- *More empirical research with audiences.* Most climate visual research currently focuses on cataloging which types of visual exist in particular media (e.g., Manzo, 2010; Remillard, 2011; DiFrancesco & Young, 2011; León & Erviti, 2013; Nerlich & Jaspal, 2014). While doing this provides an indication of visual power, these studies can often only hypothesize about how people engage with climate visuals. Future studies could usefully examine how particular images, or image tropes, impact on people's engagement. Multimethodological work, and interdisciplinary projects, would be valuable. This would assist, for example, in illuminating the different findings on audience engagement with key climate imagery between O'Neill et al. (2013) and Metag et al. (2016), and Hart and Feldman (2016).

- *Widening the scope of audience engagement studies.* Much research to date has focused on print media, despite print's limited reach (most people do not use print media to access news: the majority of over-35s name television as their main source of news, whereas under-35s name social media; Newman & Levy, 2014). The reliance on print media is likely primarily due to reasons of data accessibility and ease of analysis (Schäfer & Schlichting, 2014). However, visual media is increasingly accessible. This can be through web portals, such as the social media sites Huffington Post, BuzzFeed, Instagram, and Snapchat, all visually rich sites of increasing importance for climate communication and engagement (Painter et al., 2016), but also through more traditional channels, such as the online versions of news stories posted on the websites of legacy newspapers (as utilized by O'Neill et al., 2013). And examining visuals, particularly in new and social media, is increasingly important: social media posts containing imagery are much more likely to be shared, and shared widely, than those without (Ipsos OTX, 2014). Vis and Goriunova (2015), in their study of the iconic Aylan Kurdi refugee crisis image, provide an exemplar of online visual media research for the social sciences. Other research avenues are available for television, including collecting the TV broadcast in real time, but also through archives such as the Vanderbilt Television News Archive in the United States (VTNA, 2017) and BoB in the United Kingdom (BoB, 2017). And of course, many other visual cultural items exist; for example, in museum exhibits, or in popular culture. Rose (2012) is a key reference point for those starting to work with visual materials and audiences.
- *Increasing the real-world qualities of the research.* Instead of unimodal (visual-only) studies, multimodal studies (visual plus other communicative devices) are more desirable. Such studies would more accurately reflect the experience of how people engage with climate change visuals in the real world. Multimodal studies do not examine images or texts in isolation but instead explore how the complete news item (or other cultural device) is interpreted as it is viewed, ideally in as close to a real-world context as is possible. This might mean that audiences are exposed to both images and text of a web page, or a hard-copy print newspaper (comprising several images alongside text including the headline, lede paragraph, and main news story), or a complete TV news item (including sound, visuals, and their transitions). Some emerging climate-themed work exists in this area, for example, Wozniak, Lück, and Wessler's (2015) work on multimodal content analysis, and O'Neill et al. (2015) climate change multimodal frame analysis. The approaches employed here could be applied to audience engagement studies.

In addition, both technological advances and innovative methods could assist in enhancing the real-world qualities of the research environment, for example, using eye-tracking to analyze how people engage with climate content in online situations (see Libarkin et al., 2017). Methods such as "think-aloud" can be useful, where participants describe how they are engaging with climate change material in real time. Wozniak (2016) shows how, in a small-scale study, think-aloud can help elucidate how people

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engage with imagery. Likewise, Schroth, Angel, Sheppard, and Dulic (2014) use the think-aloud method to understand how individuals engage with a climate computer game.

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Notes:

(1.) Q-method is a methodology used to explore the discourses that exist for a particular issue (Dryzek, 1994). Discourses are shaped by underlying attitudes and values. The purpose of Q-method is to elicit these discourses through the process of Q-sorts, whereby participants are asked to sort a number of items (e.g., statements) representing the whole concourse (the full representation of different points of view of the issue). Q-method is typically carried out using attitude statements, but more recent research has used visual images (e.g., Fairweather & Swaffield, 2001) including for investigating climate change (Nicholson-Cole, 2004; O'Neill et al., 2013; Metag et al., 2016).

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