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An iconic approach for representing climate change

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ABSTRACT

International and national greenhouse gas emissions reduction goals implicitly rely in part on individuals undertaking voluntary emissions reductions through lifestyle decisions. Whilst there is widespread public recognition of climate change as an issue, there are many barriers – cognitive, psychological and social – preventing individuals from enacting lifestyle decarbonisation. More effective climate change communication approaches are needed which allow individuals to engage meaningfully with climate change, thus opening new prospects for lifestyle decarbonisation. This study presents an iconic approach to engagement, tested in the UK context, which allows individuals to approach climate change through their own personal values and experiences. The iconic approach harnesses the emotive and visual power of climate icons with a rigorous scientific analysis of climate impacts under a different climate future. Although some climate icons already exist – for example the Thermohaline Circulation shutdown – these 'expert-led' icons fail to effectively engage 'non-experts'. We demonstrate that the non-expert-led iconic approach helps overcome some of the cognitive and affective barriers that impede action towards lifestyle decarbonisation.

1. Introduction

The first legally binding international political effort to address climate change was the Kyoto Protocol. It was ratified in 2005 and for the UK requires a 12.5% reduction in six greenhouse gases (GHG) by 2010, relative to 1990. More stringent UK targets have been set in the Government's Climate Change Bill, which requires a reduction of 80% by 2050 relative to 1990 levels (DECC, 2008). Despite political agreements and targets such as these, UK GHG emissions have fallen only very slightly in recent years. In order to meet these targets, substantial reductions in GHG emissions are needed from all sectors. This includes contributions from domestic and personal emissions, which in the UK account for around a third of all GHG emissions (DEFRA, 2005).

Yet climate change is an issue that is difficult to connect with in a tangible way at an individual level. It is remote both in space and time; it is perceived as affecting other communities and future generations (Lorenzoni and Pidgeon, 2006). Climate change has been defined as a 'wicked issue': characterised by uncertainty over consequences, diverse and multiple engaged interests, conflicting knowledge claims, and high stakes (Lorenzoni et al., 2006). Lorenzoni et al. (2007) argue, however, that in order to meet emissions targets, individuals must be meaningfully engaged with climate change in order to undertake decarbonisation behaviours.

1.1. Citizen engagement with climate change

There is widespread public recognition of climate change in many countries (BBC World Service, 2007), including the USA and UK. In the UK, 99% of citizens recognise the terms 'climate change', 'greenhouse effect' or 'global warming' (DEFRA, 2007a). There is general agreement about climate change as a risk issue: for example, 71% of US citizens are personally convinced that climate change is happening (Leiserowitz, 2007). However, although many citizens can identify decarbonisation behaviours, only a minority actually undertake such actions (DEFRA, 2007a).

Government information campaigns have sought to inform the public about climate change, for example the UK '*Are you doing your bit*' campaign (DETR, 1999). The campaign was designed to reach a mass public audience through television advertisements showing different individuals taking small actions to help the environment. The campaign focussed on the personal and economic benefits of energy reduction. Yet only small consequent changes in personal attitudes or behaviour were found as a result of the campaign (DETR, 2000). Owens (2000) states that a top-down 'information deficit' model of communication, especially when it depends on a framing of the problem not shared by the

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public, is at best insufficient for changing behaviour. She calls for a more deliberative model, naming the 'civic model' as appropriate.

The civic model moves away from traditional uni-directional communication approaches towards multi-directional engagement approaches. Engagement has been defined by Lorenzoni et al. (2007) as a state of connection, comprising the three co-dependent spheres of cognition, affect and behaviour. In order to be meaningfully engaged, individuals need to know not only about climate change, but they need to be motivated and able to take action. Cognitive engagement is imperative in climate change; if individuals do not have an adequate understanding of the issue, any mitigation policy risks being ineffective or being rejected. Affective engagement refers to how an individual understands the issue through an emotional connection. Whilst the emotional processing system has been much maligned in Western society as inferior to a more analytic risk processing, a significant proportion of our ability to react to risk stems from experiential rather than analytical processing (Slovic et al., 2004). The behavioural sphere of engagement refers to the actions an individual may take.

These three facets to engagement may work independent of each other. For example, climate mitigation strategies can be successful through 'piggybacking', or the promotion of other messages besides carbon reduction, whilst also achieving decarbonisation. For example, Stern (2000) argues that energy conservation does not require knowledge of climate change, as householders may be receptive to messages framed around reduction in energy bills. However, Whitmarsh (2005) notes how these sorts of messages based on a 'rational actor' model are not always effective. For example, widely used economics-based or 'thrifty' engagement approaches have limitations. Unless a new behavioural habit has been formed, when the stimulus of the piggyback is removed – if a new pattern of behaviour becomes more expensive for instance – the individual is likely to revert to the original behaviour (Dobson, 2003). Furthermore, consideration of the affective aspect to engagement is needed. Individuals enact particular behaviours not only due to economic factors but also because of social norms, habitual behaviours or because the behaviour represents a cherished activity (Whitmarsh, 2005). In the energy-saving example above, the very engagement approach used may act to disengage some individuals: the 'thrifty' behaviour is perceived as 'penny-pinching', a negative behavioural attribute. Thus, approaches promoting behavioural change without a connection to individuals' underlying cognitive and affective values in relation to climate change are unlikely to lead to meaningful and long-lasting behavioural change.

The previous paragraph touches on just some of the barriers individuals may have in relation to the cognitive, behavioural and affective engagement aspects of climate change. Lorenzoni et al. (2007) have categorised the barriers to climate change at two levels, social-level and individual-level barriers. Social barriers include a lack of substantive political action, or action by business, as well as overcoming difficulties such as free riders and social norms. Individual barriers include a lack of knowledge of the issue, but also a lack of desire to find out information and a lack of locally and personally relevant or accessible information.

We note here that there is a conceptual difference between a lack of engagement and disengagement. An engagement approach may fail to engage an individual: there is no discernable impact on an individual's level of engagement. However, engagement approaches may also impact negatively; i.e. they cause an active disengagement with the issue. This is an important distinction, for if an individual is not merely unengaged, but is actively disengaged by an approach, this may act to increase future barriers to engagement (e.g. a lack of desire to interact with future information).

1.2. Expert and non-expert conceptualisations

There are obviously some individuals, or groups of individuals (e.g. scientists), who are privileged in their contributions to the framing of climate change and hence help set the dominant discourses on the issue. These individuals gain such privileged positions through their perceived expertise on the subject: what Collins and Evans (2007, p. 14) would define as specialist tacit knowledge. Jasanoff (2003) goes further than Collins and Evans, arguing that expertise goes beyond the deep familiarity of the issue held by skilled people. She states that one acquires and uses expertise within particular historical, political and cultural contexts and, hence, who is considered an expert may vary depending on the context. This is not the place for a deep discussion on the formal definitions of expertise. We simply note that in this context we adopt the position that there are stable and plausible groups of individuals in society who hold 'more' or 'less' privilege in terms of their contribution to the framing of the climate change issue. These groups are subsequently referred to, respectively, as 'expert' and 'non-expert'.

Moser and Dilling (2007) note that a major barrier to engagement is that information is often inaccessible or irrelevant to individual non-experts. The 'public', then, may be defined in terms of '*alienation from dominant political or knowledge regimes in a particular context*' (Blake, 1999, p. 271). Expert-led information, for example, can obstruct meaningful individual engagement, as it conflicts with individuals' values and experiences.

This paper presents a more deliberative approach for non-expert engagement with climate change through an exploration of non-experts' conceptualisations, values and experiences. Whilst significant changes to climate communication are in progress on some practitioner-led levels,[1] the research described here provides empirical evidence of the need to engage individuals more meaningfully with climate change in order to promote attitudinal and cognitive change. We describe an engagement approach using climate 'icons' and compare the effectiveness of both expert and non-expert icons in engaging lay members of the public with climate change.

An 'icon' is used here to refer to a tangible entity considered worthy of respect; something to which the viewer can relate and for which they feel empathy (a climate icon then being an icon which will be impacted by climate change). This definition is informed by the way the term is used in areas such as religious artistry, information technology, semiotics, and in the popular media. Saussure (1974) states there is no inherent relationship between a signifier (an icon) and the signified (the meaning of the icon). So, exploring engagement through icons implies that this study is interested in how things come to gain meaning for individuals, and how these meanings are a product of the cultures and worldviews from where they originated (Hodge and Kress, 1988). In common with the use of the term icon as a religious artefact (e.g. see Ramos-Poqui, 1990), a climate icon as defined here is a symbolic representation of more than what is immediately apparent. Thus a climate icon represents more than simply an image, narrative or probability describing the entity which is being represented – an icon is the entity itself, bound up with how the viewer relates to that entity through their individual cultural values, world view and sense of place. So, for example, a particular image of a drowning polar bear is not an icon (it is a representation of the icon); it is the conceptualisation of a polar bear (as perceived by an individual) which is the icon.

[1] A new £12 million climate communication strategy, based upon recommendations from Futerra (2005) has been undertaken by the UK Government (DEFRA, 2007b). No analysis of this approach is yet available.

2. Methodology

The research was a sequential, multimethodological study, with each stage of the research building upon the conclusions of the previous stage. The research was designed to gather rich, exploratory data, with a large proportion of data being of a qualitative nature. This complements recent large-scale quantitative UK survey research by allowing individuals to more freely articulate their personal interpretations of climate change. The research was small in scale, and was not designed to be representative of a particular population. Instead, the aim of stages one and three was to gather data from a range of socio-demographic backgrounds, ages, cultural groupings, lifestyle stages and nationalities (as Mason, 1996).

The first stage explored through focus groups and an online survey the concept of non-expert climate icons. The second stage involved modelling a representative suite of the icons chosen by participants in the first stage under a specified climate scenario. The third stage then asked non-experts through a pre/post-test workshop to evaluate their engagement with both the non-expert icons arising from the research plus three expert icons.

2.1. Stage one

To provide the minimum necessary context for later discussion, an outline of this stage of the research is given here. A more in-depth account is available in O'Neill (2008). The non-expert icon selection procedure was opened to a wide and diverse audience in order to investigate cultural and spatial commonalities and differences in icon selection, and to investigate whether globally engaging icons of climate change existed. The research investigated on which spatial scales individuals selected their icons and the reasoning behind participants' icon choice. The three participant groups in this stage were Fellows from the Leadership for Environment And Development (LEAD) international network, parents of students at a local High School (the City of Norwich School, CNS), and participants in an online world-wide climate experiment community (the *ClimatePrediction.net* forum, *cp.net*). Two different methodologies, focus groups ($n = 27$) and online surveys ($n = 63$) were utilised in the non-expert icon selection process. The protocol for both the online survey and the focus groups were structured to provide a logical thought process, from imagining what climate change is and how it is communicated, to what icons represented to the various participants. Participants were then asked to consider what a climate icon might be and to select and explain the reasoning behind their own personal choice of climate icons. The focus groups and online survey were carried out between December 2005 and February 2006.

Participants named 141 diverse icons as their personally engaging climate icons. These ranged between impacts from sea level rise (SLR) or flooding on cities and towns, to impacts on health, food or water supplies, to impacts on winter sports or individual species. As the climate impacts on the icons were to be modelled in the second stage before being presented back to a non-expert audience in stage three, for practical purposes a representative suite of icons was required.

Coding was undertaken to explore the reasoning behind icon selection. The words used and context were considered, but also the frequency, extensiveness, specificity and intensity of comments (as Krueger, 1997). Three key themes arose from this coding regarding icon selection. These were

- The spatial scale of the icon (from local to distant).
- Pragmatic reasoning (analytic or logical justifications).
- Intangible reasoning (deeper, emotional or spiritual understandings that cannot necessarily be measured physically).

A rigorous and transparent semi-quantitative method was devised to select a representative icon suite. Based on the IPCC 'burning embers' diagram (figure SPM-2; McCarthy et al., 2001), icon trajectories were plotted against six criteria. These were the three themes in reasoning as described above, plus three practically based criteria: the ease of modelling the climate impacts on the icon, the sensitivity of the icon to climate impacts to 2050 (discussed in Section 2.2), and the frequency of icon selection by participants.

Thus three non-expert icons were selected to take forward into stage two. The Norfolk Broads[2] was a local icon, ranking highly on both the pragmatic and intangible lines of reasoning. London represented an icon that participants chose with mainly pragmatic reasonings. Lastly, polar bears were chosen as distant icons that were selected by participants entirely on intangible reasoning. For comparison, three expert icons were also selected. These were extracted from the salient dimensions of biogeophysical changes in climate presented at the Avoiding Dangerous Climate Change scientific conference in Exeter, 2005; and represent typical framings of climate change from an 'expert' discourse. The expert icons were the West Antarctic Ice Sheet (WAIS), ocean acidification and the Thermohaline Circulation (THC).

2.2. Stage two

In order to minimise the information to be shown to the participants in stage three, each icon was investigated under a set of constraints for both timescale and emissions scenario. These constraints were carefully considered from both a scientific and a social scientific viewpoint:

- *Timescale*. Climate change occurs on timescales much longer than the time horizons considered in everyday life (Stehr and von Storch, 1995). Lorenzoni et al. (2000) state that it is 'self-evident but rarely acknowledged' that individuals think on the basis of extremely short time horizons compared to that on which scientists project impacts of climate change. However, there is a need for a sufficient timescale to illustrate climatic impacts on the icons examined. For example, when investigating the impact of climate change on polar bears, the IUCN red list criteria states that any projection of climate change impacts on biodiversity must be over a minimum 10 years or three generations, whichever is longer (Akçakaya et al., 2006). Since polar bears live to an average of between 15 and 18 years (Polar Bear Specialist Group, 2006) there is a need to look over a timescale of at least 45 years.

  There is then a trade-off between, on the one hand, the timescale over which individuals can conceptualise (relatively short) and, on the other, the potential loss of saliency when using a long timescale and a sufficient timeframe needed to illustrate climatic impacts on the icons (relatively long). From the few studies that investigate this phenomenon (e.g. Tonn et al., 2006; Drottz-Sjöberg, 2006), it would appear that 50 years forms an upper limit of the ability to conceptualise distant times. Considering impacts to 2050 is therefore a compromise between these two opposing factors.

[2] The Norfolk Broads are Britain's largest protected wetland, and have the status of a national park. The Broads are a freshwater environment containing some of the rarest plants and animals in the UK (Broads Authority, 2008). The area is close to the sea, but is protected by a narrow sand dune belt. Overtopping of this belt from rising sea levels constitutes the major threat from climate change.

Scenario. The climate impacts on the icons were examined for anthropogenic emissions scenario SRES A1B (see Nakicenovic et al., 2000). Although it is generally good practice to use several emissions scenarios when assessing consequences of potential climate change (Nakicenovic et al., 2000), this set of impact assessments were carried out with a specific communications exercise in mind. SRES A1B was chosen as it presents a mid-range scenario, although it is noted that there is little divergence between the climatic consequences of the SRES scenario projections out to 2050.

No adaptation. An assumption was also made of 'no adaptation' to climate change. Whilst research that ignores or assumes no adaptation is likely to overestimate residual or net impacts and vulnerabilities, studies that assume full and effective adaptation are likely to underestimate residual impacts and vulnerabilities (IPCC, 2007a). The assumption of 'no adaptation' was adopted because it is a baseline condition that can easily be projected for all icon impact assessments, and thus could allow effective comparison between the six icons in stage three of the research.

2.2.1. Investigating climate impacts on the icons

The expert icons had a significant body of scientific literature analysing them (this was part of the reasoning in selecting these icons as 'expert' icons). Thus, impacts were explored by undertaking an extensive review of the peer-reviewed literature and of existing assessments of the expert icons under the constraints expanded upon above.

The Norfolk Broads icon utilised data from the 'Coastal Simulator' (see Dawson et al., 2009; Nicholls et al., 2005). The Coastal Simulator presented an opportunity to use an integrated assessment model of both flooding and erosion risk for the Broads area. In the original Coastal Simulator project, a choice of three SLR futures (drawn from UKCIP02 data) and five coastal protection futures were available to investigate climate impacts on the region. The 'medium' relative SLR future and the 71% coastal protection future (the Coastal Simulator scenario 14) most closely fulfilled the requirements for investigating the Broads icon with 'no adaptation' under SRES A1B. A Geographical Information System (GIS) was used to map flood probability (a change in the return period) and flood risk (a change in the expected annual damage). Typical 'roadmap' features were added to these maps to aid participants in stage three of the research. Five categories were used in the flood risk legend, so participants easily distinguish the spatial pattern of flood risk.

The LISFLOOD-FP model developed by Dawson et al. (2005) was used to investigate the impact of SLR on the London icon. Although this model does not take into consideration fluvial flows from the River Thames catchment or the fine details of flooding wave propagation, the model is still a reasonable first approximation for gauging maximum flood extent (R. Dawson, University of Newcastle, personal communication, 2 March 2007). A GIS was used to map flood extent for both a 1:1000 year flood and a 1:10,000 year flood under the SLR calculated for SRES A1B, again with typical 'roadmap' features added.

No Arctic-wide models yet exist to formally quantify the relationship between climate change and polar bear population dynamics, although negative impacts of climatic warming on polar bears have been suggested (e.g. Derocher et al., 2004). Instead, a survey of expert opinion with participants from the IUCN Polar Bear Specialist Group was undertaken. Experts were provided with projections of sea-ice extent and duration to 2050 through maps and time-series, and were asked to provide projections of polar bear habitat range and population under current and 'best' conservation practice. Further details of this research are available in O'Neill et al. (2008).

2.3. Stage three

An evaluation workshop was designed to test whether the iconic approach engaged non-experts with climate change. It considered how non-experts engage with both the expert and non-expert icons and assessed whether the iconic approach alters non-experts cognitive or affective spheres of engagement with climate change. The evaluative workshop comprised three parts and was designed to yield both quantitative and qualitative data. The workshop utilised a pre/post-test approach. Pre/post-test methodologies are used throughout the medical, psychological and behavioural sciences for exploring changes after an input, referred to as the 'treatment'. A pre-test examines participants' views prior to any treatment, and provides a baseline on which to observe the impact of the treatment. The post-test questionnaire contains identical questions so changes in participants' views after treatment can be examined. Reference was made in the design of this study to the methodologies and structure of similar research (Lorenzoni et al., 2006; Lowe et al., 2006; Whitmarsh, 2005; Poortinga and Pidgeon, 2003; Henriksen and Jorde, 2000).

2.3.1. The pre/post-test workshop

The first part of the workshop involved a pre-test questionnaire to investigate current cognitive and affective engagement with climate change. The questionnaire contained four sections: general impressions of 'climate change', level of concern over climate change, general attitudes towards climate change and perceived personal vulnerability. The second part of the workshop involved viewing of a set of icon information sheets derived from the modelling research in stage two. The information sheets were designed to summarise the impact assessment information gained in stage two.

Significant divergence in information perception can occur through the use of differing communication devices (Sanfey and Hastie, 1998). In order to minimise apparent differences in icon engagement because of the communication device, each icon information sheet used the same format. The icon information sheets consisted of an obvious and informative title, an image, three short text paragraphs and a map arranged in the same layout throughout. As there is evidence that a significant proportion of people have difficulty understanding numerical risk (Lipkus and Hollands, 1999), probabilistic information was minimised. For example, the London icon showed a 1:1000 year flood extent for the present day and 2050, but this return period was referred to for the London icon sheet as an 'extreme' flood. A 1:1000 year value was chosen as it represents the timeframe to which the Thames Estuary 2100 Project/Espace considers a baseline flood risk (Reeder, 2007). Similarly in the Norfolk Broads icon sheet, the flood cells with a higher flood risk probability are indicated by increasingly dark blue colouring rather than the flood return periods. Particular care was taken to select images that did not depict the impact of climate change upon the icons, so that a particular impression of potential impacts on the icon entity was not forced on the participants (for example, the polar bear image did not show a polar bear struggling onto a melting ice floe). The icon pictures and maps all covered the same surface area. The three text paragraphs on the sheet were divided into a short introduction to the icon, an assessment of the vulnerability of the icon to climate change, and a statement regarding how the icon could be impacted due to climate change by 2050. All the information sheets displayed a maximum of 300 words, with technical language avoided where possible (see Supplementary Material for the icon information sheets).

Participants then completed a post-test questionnaire to test again for cognitive and affective engagement, both with climate change generally and the icons specifically. The questionnaire

contained the four sections of the pre-test, plus an additional three sections: a focussed icon engagement investigation, an open-ended icon engagement investigation and demographic questions. The question structure in the post-test was designed so that participants could consider a multi-faceted response to their engagement with each icon before selecting which icon they found most engaging overall. So, participants were asked for their responses on their understanding, emotional response and perceived relevancy of the icons viewed, *before* providing a response to which icon they were most engaged with. Similarly, participants were asked to consider separately the map and imagery elements of the icon information sheet before being asked for which icon they were most drawn to overall. This consideration was designed to compel participants to imagine the icon entity through their own conceptualisation (as described in Section 1.2), and to somewhat filter a response to the particular photographic or cartographic representation used on the icon information sheet.

A pilot workshop was held to test the pre- and post-test surveys, the icon information sheet content and workshop timing. Six non-expert participants with differing socio-demographic backgrounds took part, recruited through a snowball sample. Small changes were made to the Likert scale formatting but otherwise the procedure was considered clear.

The study workshop sessions were held on a Saturday in May 2007, in a busy public space in the centre of Norwich, UK. Members of the public were randomly approached and were provided with a minimum of information before they participated in the workshop. They were told that the workshop would take around 30 min, that it was about 'the environment', and that the first 100 participants allocated on an age/gender basis[3] would be given an honorarium of five pounds. The workshop facilitators identified themselves as from the University of East Anglia rather than from the Tyndall Centre for Climate Change Research. Individuals who agreed to participate were seated and handed the pre-test survey. The pre-test was collected before participants viewed the information sheets in order not to influence responses to the pre-test. To minimise the time commitment to the workshop, participants were shown a set of two expert and two non-expert icons rather than all six icons. Corresponding post-test surveys were then distributed so participants only gave responses to the icons they had viewed.

3. Evaluation of the icons

3.1. Icons aid in engaging individuals with climate change

Participants considered climate change a fairly serious threat to themselves, all humans and to animals and plants before the intervention took place (mean of 2.11, S.D. 0.80; 2.00, S.D. 0.78 and 1.71, S.D. 0.71 respectively on a 1–4 scale with 1 representing 'very serious' and 4 representing 'not at all serious'). It is noted that in common with the literature on unrealistic optimism (Weinstein, 1980) participants consistently regarded climate change as less threatening to themselves than to their local community, the UK or people in other countries.

Despite already considering climate change a serious threat, participants considered climate change was a more serious threat after viewing the icon information. This change in attitude towards the seriousness of climate change was particularly strong for 'people in your local community' (increasing from 2.23 to 1.91; Wilcoxon matched-pairs signed-rank test, $Z = -5.024$, $P < 0.001$, $n = 144$) and 'people in the UK' (increasing 2.08 to 1.79, Wilcoxon test $Z = -4.193$, $P < 0.001$, $n = 144$). The threat of climate change to nature was also considered more serious after viewing the icon information. The threat to animals and plants in other countries was considered the most serious, with the mean concern of the sample on the 1–4 point scale increasing from 1.36 (S.D. 0.53) to 1.23 (S.D. 0.46), a change in attitude significant to $P < 0.01$ (Wilcoxon test, $Z = -3.037$, $P < 0.01$, $n = 143$). The personal risk category experienced the smallest change in attitude after treatment, although the change is significant at $P < 0.10$.

Participants agreed more strongly after viewing the icon information that if they came across climate information, they would tend to look at it: the participant sample mean increased from 1.97 (S.D. 0.90) to 1.83 (S.D. 0.80) on a 1–5 scale from 'strongly agree' to 'strongly disagree'. Although this is a fairly small mean change in score, it is a statistically significant change (Wilcoxon test, $Z = -2.863$, $P < 0.01$, $n = 142$). This goes some way to demonstrating that an iconic approach utilising communications theory for icon presentation, as well as an imaginable timescale and mid-range emissions scenario (not even considering any differentiated impact of non-expert or expert icons) engaged this non-expert sample in viewing climate information.

There was a significant change in participants' views towards climate change as an issue after viewing the icon information. Significantly more participants disagreed that too much fuss was made about climate change (Wilcoxon test, $Z = -3.192$, $P < 0.01$, $n = 143$; the sample mean decreased from 3.78, S.D. 1.26 to 4.01, S.D. 1.18 based on the 1–5 'strongly agree' to 'strongly disagree' scale). There was a slight change in the score of participants ranking the statement 'I don't think climate change is a real problem' with participants tending to disagree more after viewing the icon information, although with lower statistical significance and greater disagreement for this statement than in the pre-test (mean pre-test score 4.19, S.D. 1.06, to post-test mean 4.33, S.D. 0.91, Wilcoxon test, $Z = -1.748$, $P < 0.1$, $n = 143$). Taking these two results together, the use of climate icons for this sample group appears to impact on their affective and cognitive engagement with climate change.

3.2. Non-expert icons are more engaging than expert icons

Participants were asked to state how well they felt they had understood the information for the icons. Overall, the icon information sheets appeared quite well understood (mean 5.67, S.D. 1.27 on a 1–7 scale from 1 'understood none of it' to 7 'understood all of it'). The most obvious trend is the difference between expert and non-expert icons: participant felt they understood the non-expert icons much better (mean 6.10, S.D. 1.07) than the expert icons (mean 5.24, S.D. 1.48). The most well understood icon was polar bears. Participants were also asked to rate how they felt on three scales of uninterested to interested. Participants were most interested in the three non-expert icons (non-expert icons group mean 5.42, S.D. 1.63 on a 1–7 scale from 1 'un-interested' to 7 'interested') London, polar bears and Norfolk Broads. Participants were less interested in the expert icons (group mean 5.15, S.D. 1.76), and least interested in ocean acidification.

Fig. 1 illustrates which icon participants felt was most relevant to four different peoples: themselves, their local community, people in the UK and people in other countries. There was some variation in participants' choice of the most personally relevant icon, though the most popular choices were the non-expert icons Norfolk Broads and London. The least popular choices were the non-expert icon polar bears and the expert icon ocean acidification. A majority of the participants considered the most relevant icon for their local community to be the Norfolk Broads. There are

[3] In order to encourage a gender and age group spread, incentives were provided to the first seven male and female participants' in each age group. As noted, this stage was not designed to be representative of the wider population. However, comparison of the 2001 Census Data for the Norwich Non-Metropolitan District indicates workshop participant demographics were broadly comparative.

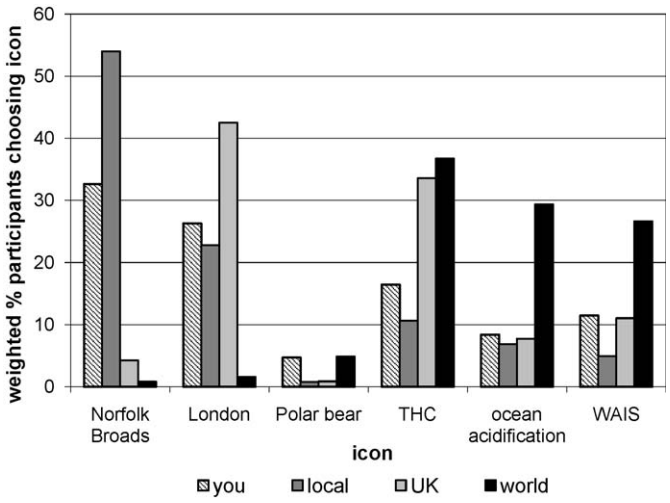

Fig. 1. Participant responses to 'what icon is most relevant to you, your local community, the UK and the world?' (weighted percentage based on the numbers of participants viewing each icon).

two clear selections for the icon most relevant to people in the UK, London and the Thermohaline Circulation. The icons considered most relevant to people in other countries are the three expert icons the THC, ocean acidification and the West Antarctic Ice Sheet. There are two interesting results here. First, participants generally considered the non-expert icons most relevant to them and their local community, and the expert icons more relevant for people in other countries. Second, polar bears were considered the least relevant icon across all groups scoring a maximum of just 7% in the personal and international categories.

The quantitative responses to the most and least engaging icons are presented in Table 1. The polar bear was the icon image participants were most drawn to. The Norfolk Broads and London icons were also selected by participants substantially more times than the three expert icons. The Norfolk Broads was the map which participants were most drawn to, followed by the London and THC map. Overall, participants were most drawn to the Norfolk Broads icon, followed by the polar bear icon. Participants selected the THC and ocean acidification icons substantially more than any of the other icons as the picture to which they were least drawn. The WAIS icon was selected considerably more than any of the other icons as the map to which participants were least drawn. Overall, participants stated they were least drawn to the ocean acidification icon, followed by WAIS. The qualitative reasoning behind icon selections is explored next.

3.2.1. Icons which engage

Participants were asked to state and explain which icon image they were most drawn to. The most common reasoning participants stated for selecting an icon image they were most drawn to was because they felt they could personally relate to the icon. Many participants who selected the Norfolk Broads used this form of reasoning: '*it's local and relevant to here*' or '*because I live in Norfolk and this is my area*'. Similarly, many participants felt that they were drawn to the London icon '*because I am familiar with the area*' and as it is: '*very identifiable, helps to understand enormity*'.

Participants also stated an emotional connection with the icon as their reasoning. For example, several people stated the Broads as the icon picture they were most drawn to as it depicted an '*idyllic scene*' to which they could relate. Polar bears were cited most as the icon image participants were drawn to. Two rather different strands of reasoning were attached to this choice. One line of reasoning was empathy with this charismatic mega fauna, for example, '*because it is a big fluffy polar bear*'. Others reasoned that they selected polar bears because they represented '*the idea of pure environment and fragile environment most affected by change*'.

Of the participants' that saw the Broads information sheet, almost half chose it as the icon map they were most drawn to. Typical reasons for choosing this map echoed the reasons for choosing the Broads or London icon images: '*I can imagine these areas water covered*', or because '*it is of local interest and concern*'.

It is of note that a significant proportion of respondents were most drawn to the THC or ocean acidification maps, despite them both representing expert-led icons (both maps were reproduced from the Fourth Assessment Report; IPCC, 2007b). A small proportion of participants selected the map as it demonstrated the global impact of the icon, using reasoning such as it represented a '*clear world effect*'. However the majority of participant explanations were due to both maps' red colours representing danger: '*looks so hot, really really bad*'. This reasoning exemplifies why the post-test protocol asked for opinions on the image and map first, and why participants were asked to explain why they chose particular icons. In some cases, participants responded directly to the presentation device of the icon information (in this case, red signalling 'danger') rather than to what the icon may represent to the participant, despite attempts to minimise the impact of the communication devices.

Overall, participants were more drawn to the non-expert icons, although a significant proportion of participants were drawn to the expert icons. Participants who chose the Broads and London followed similar lines of reasoning to that seen in the earlier responses, such as '*because it is our home and one day it will affect my children and my friends' children*'. Participants chose polar bears again for similar reasons: because the icon was easily understandable and tangible. Although a significant proportion of participants chose the THC it again was primarily because of the perceived dramatic nature of the icon as shown in the THC map.

Table 1
Responses to icons 'most drawn to' and 'least drawn to'. Figures in bold highlight the highest icon percentage per category.

%	Norfolk Broads	London	Polar bears	THC	Ocean acidification	WAIS
Most drawn to:						
Picture	34	31	**42**	10	16	18
Map	**47**	35	13	30	17	5
Overall	**36**	27	34	24	17	11
Least drawn to:						
Picture	18	18	11	**41**	40	21
Map	16	15	28	22	25	**46**
Overall	25	23	18	12	**40**	32

3.2.2. Icons which disengage

The majority of participants were least drawn to the expert icon pictures, in particular the ocean acidification and THC icons. Participants felt that the icons were difficult to understand as they were '*too scientific*' or '*more complicated*'. Of contrast to the non-expert icons, participants considered that the expert icon images '*don't tell so much of a story*'. Participants felt the expert icons were '*too vast and global, feels remote and impersonal*' and '*more schematic, less real*'.

Of those that saw the WAIS information sheet, almost half of them chose it as the icon map they were least drawn to. Participants commented that the WAIS map was boring, and that they found it more difficult to understand. Some participants commented that the WAIS icon disengaged them as there was little climate impact on the icon through to 2050.

Participants also commented for all three expert icons that it was harder to engage with the icon because it was not perceived in a knowable spatial dimension: '*you can always put it to the back of*

your mind because of the distance' or as the icon was '*not specific to a place I recognise*'.

There is less variation in icon selection for the icon participants were least drawn to compared to the icon participants were most drawn to. The majority of participants stated an expert icon as the one to which they were least drawn, in particular, stating ocean acidification and WAIS. Reasoning was similar to that previously cited, stating the icon was more technical, complicated, or the climate impact was not immediate. Again, participants commented that there was '*nothing [...] to really connect people with the problem*'.

In correspondence with the literature (e.g. Lorenzoni and Pidgeon, 2005), it appears many participants felt an icon needs to connect them in knowable spatial dimensions in order to engage their interest. However, this reasoning was also used by participants to state why the icon was disengaging. A proportion of participants felt they were least drawn to the non-expert icons the Broads and London, with similar reasoning to this participant: '*will only affect locals, and is not as much of a global issue*'. Participants also commented that their selected non-expert icon '*seemed more manageable*'. It is hypothesised that this links to how much control participants feel they have (as Slovic, 1987) over the icon futures. In the case of the Norfolk Broads and London icons, a perception of control over the non-expert icon exists, which acts to make this icon less engaging for these participants.

A result which again emphasises the diversity in participants reasoning behind icon selection is revealed by the response to the polar bear icon. Several participants commented that although the loss of polar bears was sad, it called for an emotional response that did not resonate with them: '*works on sentiment (or not!)*' or '*sorry to lose them, but there are many more serious impacts to worry about*'.

3.2.3. Demographic variation in icon selection

Two themes emerged when stratifying the icon selection data by demographic variables. The age of participants appeared to influence the selection of icon on a spatial scale, with national or international icons favoured by some age group participants over local icons. The Norfolk Broads were selected by 40% of the 16–24 age group as the icon they were least drawn to. Participants in this age group were evenly spread over the other five icons as to the icon they were least drawn to. This result is especially interesting as the Norfolk Broads was selected by the greatest number of participants in all age categories as that to which they were most drawn to. Perhaps whilst local icons are salient to many, they resonate less well with younger participants.

The icon data was also examined in relation to participants' highest science qualification. Participants with no formal science qualifications were likely to pick a non-expert icon as the one they were most drawn to (73% of participants chose a non-expert icon). Participants with a vocational or academic degree in a science-related subject were more likely than those without such a qualification to pick an expert icon as that to which they were most drawn to (45% selected expert icons). Participants with no formal science qualifications were more likely to choose an expert icon as that to which they were least drawn (63% selecting an expert icon). Conversely, participants with a vocational or academic degree in a science-related subject were more likely to choose a non-expert icon as that to which they were least drawn (63% selected a non-expert icon).

4. Discussion and conclusions

4.1. The iconic approach helps overcome individual barriers

Moser and Dilling (2007) call for rigorous testing of potential engagement approaches. As yet though, evaluation of climate engagement approaches is rare, meaning that benefits and limitations to such approaches cannot be assessed. We have described and implemented an iconic approach to climate engagement, and provided a systematic and thorough evaluation of the approach. We provide empirical quantitative and qualitative evidence that such an approach addresses the following individual barriers to engagement with climate change (as Lorenzoni et al., 2007):

- perceived information overload and a lack of desire to seek further information,
- information presented in formats inaccessible to non-experts,
- frequent conflicts between information and the individual's values or experiences,
- a perceived lack of locally relevant information.

Information overload and the accessibility of the information provided was expressly considered in this iconic approach by using an imaginable timescale, limiting the amount of information provided and by using non-technical language. The iconic approach combined natural and social science knowledges *in conjunction* with an appreciation of non-expert values and experiences. It stimulated participants to find out more about climate change, to consider climate change as a serious issue and to view climate change as a real issue.

The importance of acknowledging non-expert conceptualisations of climate for effective engagement was highlighted by the engagement with the non-expert icons. The non-expert icons were key to engaging participants: they were perceived to be considerably better understood than the expert icons, and interest was higher in the non-expert icons than in the expert icons. Indeed, in some cases the expert icons may have actively disengaged individuals, because they invoked emotions such as helplessness or boredom; and participants stated that they were too scientific and complex to understand. Conversely, consideration of climate change impacts upon the non-expert icons invoked an emotional response and increased understanding because of their perceived closeness to individuals' daily lives, local area or nature. Expecting non-experts to be moved to engagement by expert conceptualisations of climate change is thus mistaken. The iconic approach shows that provision of more information, particularly 'expert' information, is unlikely to foster public engagement with climate change.

Some participants in stage one indicated that indeed locally relevant information was an important consideration in icon selection. Thus, the locally relevant Norfolk Broads icon was included in stage three. The evaluative stage demonstrated that more local icons did engage a large proportion of participants. However, there was an interesting exception to this general rule of thumb 'local is better': it appears that the role of affect can overrule it. Polar bears were considered the 'least relevant' icon to individuals, their communities and to people in other countries. Yet, because of a stated affective connection with the icon, there is evidence that a substantial number of participants found the polar bear icon very engaging.

4.2. Individual choices within the wider societal context

We have shown that no single global icon(s) of climate change are likely to exist. Knowing and targeting one's audience (see also Moser and Dilling, 2004) is a key part of any engagement approach – a goal which methodologies such as audience segmentation (see Maibach et al., 2008) can aid with. That the most effective engagement involves producing hundreds of small-scale approaches tailored to each audience might be viewed as an insurmountable challenge for communicators. Yet approaches

which move away from mass public campaigns and towards more targeted, community-led endeavours can be delivered. The UK's Climate Challenge Fund, for example, empowers community groups themselves, through funding and support, to create climate engagement opportunities. This sort of approach may also help overcome issues of trust associated with centralised government engagement approaches.

4.3. A 'carbon capable' society

This paper has presented an approach to communication where non-expert and scientific knowledge has been integrated to encourage individuals' engagement with climate change. We do however acknowledge the limits of individualised approaches to climate engagement. Whitmarsh et al. (2009) use the concept of 'carbon capability' to identify engaged individuals. The term recognises not only the ability of individuals to make informed judgements and to take effective decisions regarding the use and management of carbon, but also the importance of recognising a need for change in systems of provision and governance. Previous research suggests that tackling social barriers to engagement is imperative for lifestyle decarbonisation, as even the most cognitively and affectively engaged individuals failed to decarbonise their behaviour (Nicholson-Cole, 2005). Nicholson-Cole explains this conclusion by emphasising the many social barriers that affect an individual's sense of self-efficacy and which obstruct the links between concern, intention and action. We thus conclude from the analysis presented in this research (as others, e.g. Ockwell et al., 2009) by stressing the importance of addressing concurrently both individual *and* social barriers to engagement.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.gloenvcha.2009.07.004.

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