Building a better future:

An exploration of beliefs about climate change and perceived need for adaptation within the building industry

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Abstract

The present research explored beliefs about climate change among an important yet relatively understudied population: representatives of the building industry. We also assessed the perceived adequacy of current climate-related actions within the industry and the perceived need for developing new practices. The results of a survey administered within a large engineering firm suggest a fairly high level of concern about climate issues within this sector: participants perceived climate change to be an important issue, current practices to be inadequate, and a need to develop new ways of addressing climate change. Despite this, there was notable and consequential variability in how participants thought about climate change. Higher levels of seniority were associated with greater satisfaction with current practices, and the belief that climate change was a natural rather than man made phenomena was associated with a reduced support for the idea that changes to current practices were necessary. In addition, when thinking about climate relevant actions (whether current practices or the alternatives) participants focussed almost exclusively on mitigation rather than adaptation. The implications of these patterns for innovation around climate change within the building industry are discussed.

Key words: Climate Change, Beliefs, Innovation, Organizational Change

1. INTRODUCTION

The aim of the present research was to explore how understandings of climate change relate to the perceived need for responsive action. Although a number of studies have investigated this issue among the general public, the novel aspect of the present research was to focus on an important, yet relatively understudied population: representatives of the building industry. For a number of reasons, climate change is a significant issue for the building industry [1]. First, climate change has real consequences for the longevity and utility of buildings, including private homes, workplaces, and public buildings like schools. Indeed, these consequences are already being seen in dramatic climatic events like flash floods, and other events like periods of overheating during summer, which can have serious implications for human health [2]. Second, many buildings in the UK and elsewhere were designed before issues of climate change became a commonplace concern. The energy inefficiency of these buildings contributes significantly to the carbon emissions that cause climate change.

Finally, although new buildings are now being designed with climate in mind, the extent to which this is considered it is usually with respect to making buildings more energy efficient and thus mitigating against climate change. The full range of possible climate changes receives less attention, making adaptive measures hard to implement. Specifically, modelling of the ability of building designs to withstand local climates in the places they will be built is currently based on test reference years (TRY) and design summer years (DSY). These test reference years are based on historical observations of weather and do not take into account the variety of future scenarios that are possible under climate change predictions. As a result, new buildings are essentially being

designed to withstand climatic conditions that are already out of date and that are expected to change further into the future [3, 4]. More generally, much has been written about how the buildings sector needs to mitigate against climate change, and whole academic journals are dedicated to energy efficiency in buildings, or renewables in general. However, the likely impact of climate change on buildings, and the need to design buildings that will be resilient to future climate, is less discussed within the industry despite it being an obvious and immediate challenge.

Against this backdrop, it would seem important to explore motivations within the building industry to engage with climate change and to re-evaluate current practices in light of future climate possibilities. However, surprisingly little research has systematically explored orientations toward climate change within the building sector. One recent study [5] considered the possible effects of climate change for the UK house-building sector. This analysis highlighted the competing pressures that guide decision-making in this sector, and the limited influence of climate change relative to other drivers of change, including changing technologies, shifting consumer expectations, emergence of new competitors, and changing regulations.

In the absence of strong external pressure to incorporate climate change issues into decision-making (i.e., regulation or taxation), and the existence of forces that directly work against this (i.e., the cost of climate-related measures combined with limited liability for future buildings), Hertin et al., [5] highlighted the problem of limited motivation within the sector to engage *proactively* with climate change. Indeed, these authors concluded that the currently loose incentive structure is likely to lead to questions of climate change adaptation being driving by principles of "*satisficing* rather than

optimising" [5, p. 288]. That is, climate relevant decisions are likely to be made in response to specific events and governed by the practical constraints that surround these (i.e., time, money, and regulation) rather than by more long-term goals and ideals (e.g., to design and construct buildings that will remain resilient and function given a changing future climate). This, in combinations with the inherent uncertainty of climate change, may leave some within the buildings sector to prefer to "wait and see" rather than take action now (see also [6]).

1. 1 Willingness to take action on climate change

From a social psychological perspective a key question is not just what position people adopt in response to the issue of climate change (e.g., "wait and see" versus "act now") but which factors distinguish between these positions (e.g., [7]). Previous work within the building sector has been informative about the broader regulatory, economic and practical context within which decisions about climate change are made—or, in practice, *not* made [5]. But this work provides little insight into the psychological aspects of responses to climate change in this sector. Such insight has practical importance. Given the limited requirement to incorporate climate change into building design and construction, understanding psychological orientations toward this issue would seem important for those who seek to encourage a more proactive approach. For example, advances in climate change prediction and the existence of better tools for the modelling of buildings early on in the design process (such as SUNtool: [8]; or VE Gaia:[9]) will only lead to practical innovations if the sector is broadly receptive to the climate change message. If the sector is unresponsive, innovation is only likely to occur in response to

explicit pressure rather than on a voluntary basis (see [10] for a similar discussion about public engagement with climate change). Investigating the beliefs, attitudes, and orientations toward climate change issues that currently exist within a sector helps to identify potential opportunities for creating change as well as the likely points of resistance.

With respect to the question of what influences responsiveness to climate change, research among the general public suggests a number of factors that may be of importance. Unsurprisingly, one key predictor of willingness to take action on climate change is the extent to which people believe that this phenomenon is real. Defensiveness in the face of such an uncertain threat, or broader ideological positions, may lead people to deny the problem, which in turn negates the need for action [11, 7]. However, as the scientific community and international governments become increasingly forceful in asserting the existence of climate change, only a minority continues to deny the phenomenon. Accordingly, coarse distinctions between climate change "believers" and "deniers" may also become less useful for understanding (in)action in this domain. Instead, more fine-grained distinctions concerning how people understand the issue may be necessary. For example, even among people who believe that climate change is occurring, there is substantial variability in beliefs about why this is happening (i.e., whether it is anthropogenic) and what is actually understood by the term *climate change*.

Bord, O'Connor, and Fisher [12] suggested that accurate knowledge about the causes of climate change is vital for responsible decision-making. Indeed, in their study participants who were able to correctly identify causes of climate change reported more positive environmental intentions that those who attributed climate change to incorrect

causes. Importantly, these effects were independent of positive environmental attitudes—suggesting that accurate knowledge is not simply a proxy for environmental concern. In direct contrast, however, other research has found that specific beliefs about the causes of climate change (e.g., that it is anthropogenic rather than natural) are relatively unimportant for behavioural decision-making when compared to other psychologically relevant variables, (e.g., confidence in the efficacy of individual actions: [11]). Indeed, some have suggested that certain intuitive models of climate change, although factually incomplete, may be quite effective for mobilising action. For instance, Ungar [13] observes that, despite being an incomplete representation climate change, the image of an "ozone hole" has been relatively successful at mobilising the public because it readily connects to commonsense understandings and communicates a sense of urgency. More complete representations (e.g., "climate change" proper) may not share these attributes and therefore be less effective at stimulating action despite their completeness.

Along these lines, recent research in the U.K. [14] demonstrated differences in public understandings of "climate change" versus "global warming". Although these terms are often equated in everyday thinking, "global warming" (again an incomplete representation) was more strongly associated with anthropogenic causes and elicited higher levels of concern than "climate change". Importantly, individual and collective action was seen to be a more effective response to "global warming" than "climate change". Findings like this point to an important disjuncture between scientific goals and public responses in this area. Specifically, climate scientists increasingly prefer the language of "climate change" because this more accurately reflects the variable, and unpredictable, nature of the problem. Along side this, increasing emphasis is given to the

use of probabilities when communicating climate change, rather than clear statements about what "will happen". However, this goal of accuracy and completeness in scientific communication may actually undermine public action on climate change if it does not connect to commonsense understandings and/or undermines the ability to clearly imagine in the future being communicated [15, 16].

Only a limited number of studies have examined climate change beliefs and images among populations more specific than the "general public". Moreover, to our knowledge none have examined such issues specifically among representatives of the building industry. On the one hand, it seems likely that factors shown to influence public responses to climate change would also be relevant when trying to understand support for action about climate change in the building industry. Designers, engineers, and builders are, after all, ordinary people too and should be subject to similar psychological processes. However, the issue of action as it relates to the building industry is somewhat different to that faced by the population at large. While members of the public are generally limited to consideration of behaviours that mitigate their own contributions to climate change, actors within the building industry are faced with questions of adaptation as well as mitigation and the relevant responses are organisational rather than personal. As such, there is clearly scope for further exploration of these issues among representatives of the building industry specifically.

1.2 Evaluating different courses of action

Beyond the question of whether action *per se* is perceived to be necessary, there is also a question of what form this action should take. Expectancy value theories suggest

that when deliberating between different causes of action, people generally weigh-up the perceived costs and benefits of the behavioural options. Courses of action that are associated with few costs, and more benefits, should appear more attractive and elicit stronger intentions, than courses of action for which costs rather than benefits are relatively more salient. This basic idea has been expanded into various models of behavioural decision-making, for example the influential theories of reasoned action and planned behaviour [17, 18]. Empirical tests of these models have demonstrated support for the hypothesised links between perceived costs and benefits, supportive attitudes, and behavioural intentions. Importantly, these models of behaviour can also be applied to the task of behaviour change. For example, statements of the theory recommend attempts to encourage a given behaviour should begin with an elicitation of the salient beliefs (i.e., costs and benefits) on which that behaviour might be based [19]. Armed with this knowledge, change agents can craft persuasive messages that increase the salience of benefits relevant for behavioural performance, and addresses any salient costs that might currently mitigate against behaviour [20, 21].

Again, although past research has identified some relevant costs that might mitigate against a more proactive stance on climate change within the building industry, to our knowledge no research has done the belief elicitation work that might be used to inform attempts to persuade actors to adopt particular forms of action on this issue in the absence of any specific requirement to do so. As such, an additional exploratory goal of the present research was to examine the salient costs and benefits associated with current practices, and the perceived opportunities for different forms of action against which current practices might be compared.

1.3 Organisational factors and openness to change

Within an organisational context, decision-making is not just guided by individual preferences but is also framed by the perceived goals and interests of the organization itself. It is also the case that not all organisational members have the same capacity to make decisions about important issues like whether and how to adapt to climate change. Given this, in addition to exploring what people think about climate change and organisational change as individuals, it is also useful to explore these thoughts as a function of how people sit within the organization itself. Particularly in relation to questions about changing established practices, status within the organisation is likely to be a variable that both structures people's responses and has implications for the process of change itself: The opinion of people in positions of power and authority ultimately count most.

Interestingly, a number of lines of research suggest that those most embedded within the organisation are the ones who are likely to be least open to changing current practices. For example, studies have shown that people who identify most strongly with their organisation are most likely to resist changes to it [22], especially where change is seen to represent a departure from the group's traditional practices [23]. One explanation for these findings is that once people are socialised into the norms of a workplace, these norms become incorporated into their sense of who they are as a member of that organisation and thus potential changes to this can threaten their identity. At a more mundane level, having fallen into the habit of doing things in a particular way, people may simply find it hard to think about doing things differently (e.g., [24]).

However, people do not always resist changes to traditional practices—

particularly when change is perceived to be in the interests of the group, highly committed group members may embrace rather than resist it [25, 26]. Other lines of research have also demonstrated that once an individual has obtained a position of authority or leadership within their an organisation this can free them from pressures to conform to group norms and gives them license to innovate [27]. Taken together, these ideas suggest that embedded-ness within the organisation (e.g., in terms of psychological commitment, length of tenure or seniority) might have opposing implications for openness to organisational change—to the extent that they are committed to traditional practices or see no value in change it can make them resistant, but to the extent that it frees them from pressure by others or they perceive value in change it can make them more open. Irrespective of these competing possibilities, given the importance of seniority for actually creating organisational change, we also explored its role in shaping opinions about climate change and the building industry.

1.4 The present research

The aim of the present study was to provide a more detailed analysis of the psychological context that might influence responses to the issue of climate change within the building sector. Specifically we were interested in how representatives of the building industry understand climate change (i.e., their beliefs about and representations of this issue) and how this relates to the perceived need for innovation within the industry (i.e., support for the position of "act now" rather than "wait and see"). In an attempt to provide preliminary information that might inform persuasive attempts associated with new technologies and practices relevant to climate change adaptation, we also sought to

generate an initial impression of the perceived costs and benefits associated with current practices and the possible alternatives, as perceived by representatives of the industry. We were also interested in the effect organisational factors, specifically seniority, might have on these responses. To these ends, we surveyed employees of a large, international building organisation. The survey was administered online across all departments and levels of the organisation. It included open-ended questions designed to tap perceptions of/ beliefs about climate change, and the costs and benefits associated with current practices and future alternatives. We also included a number of scale-response questions to assess the perceived need for adaptive action in response to climate change.

2. METHOD

2.1 Participants and design

Employees from a large international engineering firm involved in the design and construction of building projects for a range of private and public sector clients were invited to participate in an online survey of issues concerning "weather, climate change, and the building industry". An invitation email was circulated via internal mailing lists in the British arm of this organisation. Although the organisation employs over 5000 people, the survey was sent to a smaller subset of approximately 650 consultants within the organisation. The invitation message included a link to an online survey that participants could access from their computer. As an incentive, participants were offered the chance to enter a prize draw for a cash prize of £100 (approx. equivalent to US$150). Particular effort was made to recruit participants from all sections of this organisation relevant to building design and construction.

A total of 147 employees accessed the survey, with 99 of these completing the survey to the end. Of those who completed the survey, the majority were male (77.6%), reflecting the overall gender distribution of the organisation. Participants were distributed across the organizational hierarchy. The majority described themselves as middle seniority (40.8%), with the remainder normally distributed around this middle level: very junior (3.4%), junior (17.7%), senior (34%), or very senior (4.1%). Participants ranged in age from 18 to 68 years old (mean age = 40.19, SD = 12.24). The sample was distributed across all sections of the organization, but mainly concentrated in the areas of civil engineering (14.3%), mechanical and electrical engineering (25.2%), and architecture (17.7%). The remainder reported working in environment (6.1%), modelling (2.7%), construction (7.5%) or sales (.7%). A further 25.9% reported working in some division other than these (i.e., "Other") .

2.2 Survey

After following the link embedded within the invitation email, respondents were directed to an information page. This page identified the affiliation of the researchers and gave a brief explanation of the purposes of the survey—which was described as an exploration of issues related to weather and building design. The survey that followed began with a series of open-ended questions designed to elicit participants' own understandings of climate change and their beliefs about the causes of climate change.

First, to explore participants' understandings of climate change, we asked "What do you think people mean when they talk about 'climate change'? What specifically is supposed to change?". Immediately below this a text box appeared into which

participants could type their response to the question. This question was followed by an additional question “Do you believe that climate change is real? Why or why not?”. The responses to these questions were inspected by the first and second authors for two things. First, following Whitmarsh (2009) we were interested in how people represented climate change in terms of the more simple concept of “global warming” versus the more complex concept of “climate change”. Second, we were interested in what people attributed climate change to, specifically whether they believed that climate change was man-made or natural. The two coders independently identified the dominant representation (global warming versus climate change) and perceived cause (human, natural, unsure). Where participants indicated a belief in the reality of climate change, but did not specify a cause, they were included within the human cause category because this is the dominant scientific representation of climate change and their response did not challenge or question this. The two coders displayed a high degree of agreement (95% and 84% respectively) with instances of disagreement were resolved through discussion.

To explore evaluations of different courses of action, the next set of questions asked about current practices to address climate within their organisation, and the possible alternatives. Specifically, participants were asked “In terms of your current work practices, is there anything that you are doing in order to account for climate change?” After giving their response in the box provided, participants were then asked to identify any benefits of the things they had identified in their previous response and, separately, any limitations they perceived to these practices. The practices identified, their benefits and limitations were simply tallied and are summarised in the results section below.

After giving their answers to the open-ended questions, participants were asked to

rate how adequate they perceived current practices within their organisation to be for addressing climate change, and how adequate they perceived current practice within the industry more generally (1 = *Very inadequate*, 5 = *More than adequate*). An additional question asked them to rate the extent to which they personally think the building industry is currently addressing the issue of climate change (1 = *Not at all*, 5 = *Very much*). These three items formed an acceptably reliable scale ($\alpha = .61$) and were combined into a single index representing the *perceived adequacy of current practices* in relation to climate change.

After completing the section on current practices, participants were then asked "Is there anything you think that you, or your organization, could or should be doing differently in order to account for climate change?" After describing any alternatives to current practices they could think of, participants were again asked to identify the potential benefits of these and any costs/ limitations these would entail. These responses were tallied to give an impression of what the common themes were (reported below).

After giving their responses to the open ended questions, participants were asked to rate how willing they would be to adopt the specific changes that they had identified in the previous question (1 = *Very unwilling*, 5 = *Very willing*), and to indicate the degree to which they personally felt that it was important for the building industry to develop new practices in relation to climate change (1 = *Not at all*, 5 = *Extremely*). Although the responses to these questions were only weakly correlated ($r = .18$, $p = .077$), these items were nonetheless averaged into a single index of perceived *need for change*. Supplementary analyses indicated that the patterns on this variable reported below were also present when the individual items were treated separately, although they were

stronger and consistently significant on the second item.

A final section of the survey included a range of additional questions. To measure the perceived importance of climate change as an issue, we asked "All things considered, how important an issue do you think climate change is for the building industry at this point in time?" and "How important do you think this issue is likely to become in the near future?" (1 = *Not at all*, 5 = *Extremely*). These items were positively correlated (r = .40, $p < .001$) and were averaged to form an index of perceived *issue importance*. To have some indicator of how well-informed participants felt themselves to be about the issue of climate change, we asked them "How knowledgeable do you personally feel about the issues surrounding climate change and the building industry?" and "How confident are you in the accuracy of your knowledge?" (1 = *Not at all*, 5 = *Extremely*). Again, these two items were positively correlated (r = .61, $p < .001$) and were averaged into a single index of self-rated *knowledge*.

3. RESULTS

3.1 Representations and beliefs about climate change

Data analyses began by inspecting responses to the open ended questions. Our initial questions probed respondents for their understanding of climate change. Specifically, we asked people how they understood the term "climate change" and what they thought was supposed to be changing. Unsurprisingly, given public discourse around these issues (e.g., [14], participants tended to generate one of two representations revolving around either "global warming" (36.6% of participants who gave a response to this question) or "climate change" (the remaining 63.4%). When asked what was

changing, participants who focussed on global warming tended to reproduce ideas about rising temperatures, melting ice capes and rising sea levels. Those that did not focus specifically on global warming instead tended to reference ideas about extremity of temperatures and unpredictability of climate patterns.

In response to the question of whether or not climate change was real, relatively few participants actively rejected this notion (6% of those who responded to this question). Although the remainder indicated that they believed that climate change was happening, there was notable variation in the attributed causes of climate change. The majority of participants asserted that climate change was due to human activity or did not explicitly reject this position (65%). Of the remainder, a significant proportion (20%) expressed a belief that climate change was natural. This is typified by the comments provided by one participant:

> *The earth has been changing and evolving over millions of years and like anything that is living things change from time to time. I believe that climate change is an element to weather anomalies but other causes can be to be blame also. The earth itself emits harmful gases into the atmosphere, CO_2 produced by engines could be increasing this amount but it is nothing new to the planet.*
>
> 26 year old, male, civil engineer

The remaining 15% remained uncertain as to whether the true causes of climate change were natural or man made. This was typified by comments like:

> *I believe it is happening, how much of this is man made or natural is the difficult one.*
>
> 47 year old, male, mechanical and electrical engineer

Although, as some from this group of participants pointed out, in so far as responding to the issue was concerned, causes should matter less than whether or not change is happening:

> *Due to the highly complex nature of trying to monitor what is due to our activities and what is happening naturally, it is unclear in what proportions. What is clear is that it is changing, and we need to respond to it whatever the cause.*
>
> 22 year old, male, civil engineer

In sum, inspection of these open-ended questions revealed predictable variations in participants' representations of the issue (i.e., "climate change" versus "global warming") and the attributed causes of the phenomenon (i.e., humans versus nature versus undecided/ unsure). Further analyses revealed that neither representations nor attributed cause were contingent on organizational department, ps > .11, or correlated with organizational seniority, age, or gender, ps > .14.

3.2 Perceived benefits and limitations of current practices

Next we explored participants' evaluations of current organisational practices and the alternatives. Interestingly, when asked about current organisational practices that are

relevant to climate change, overall very few responses listed actions that represented adaptation rather than mitigation (only around 11% of responses). The majority of participants (38%) indicated that the organisation was actively involved in considering possible future climate contingencies when planning projects and identifying more economic/ energy-efficient options for building materials and design. The most frequently listed benefits of this action were related to sustainability, including reducing CO_2 emissions (and running costs for clients) as well as longer-term benefits to the environment and the longevity of building designs. The most salient limitations associated with current practices were time and cost. Indeed, there was a clear feeling that clients associated environmental considerations with increased cost, and that they were unwilling to bear this cost except in so far as it was necessary to meet government requirements. For example, as one participant wrote:

> *The sustainable, low energy solution usually costs more and requires more design input/expertise. Client organisations still often want to spend the minimum time and money to achieve a suitable building to meet current regulations.*
>
> 47 year old, male, mechanical and electrical engineer

The next most commonly listed action being currently undertaken to account for climate change was "nothing" (26%). Unsurprisingly, this group perceived few benefits or costs of current actions.

Of the remainder, 18% indicated that they were either taking personal action within their workplace/ life to address climate change (e.g., car-sharing, reducing energy

use at work by switching off lights: 18%). The perceived benefit of this action was also to reduce carbon emissions and energy use and thereby mitigate against climate change, whereas the salient costs were mainly inconvenience (e.g., travel time when commuting and limited public transport services) and inefficiency of current systems (e.g., recycling being incomplete and not universally practiced).

The remaining participants (18%) indicated that the primary current activity to address climate change was to adhere to industry guidelines (e.g., BREEAM: 18%). The benefit of this were that guidelines provided clear standards, were effective, and made environmental issues more routine. In addition to the usual costs of time and money, participants who were focused on this form of action also saw limitations in the voluntary nature of regulation and their limited focus.

In sum, current organisational practices (whether these were interpreted with respect to the individual workplace or broader organisational/ industry goals) were seen to be effective at reducing carbon emissions and mitigating against climate change. Particularly in relation to organisational practices around building projects, however, the various actions were seen to be limited and associated with substantial (real or perceived) costs in terms of both time and money.

3.3 Perceived alternatives to current practice

Next, we asked participants what they thought could/ should be done differently in their organisation to address climate change/ weather issues. Again, very few responses to this question (around 5%) listed actions that clearly represented adaptation to climate change. Of those who responded to this question (n = 93), the most common

response, given by 23%, was that the organisation itself should lead the way by embodying green principles in their own workplace (e.g., encouraging staff to behave environmentally at work) and project this image to the outside world. The next most common response, given by 19%, was to be more forceful in encouraging clients to adopt or consider climate and environmental issues in their plans. Following these, the next most common responses were to increase the level of specific expertise on these issues (11%) and engage more closely with technological developments in this area (8%).

The primary benefit of doing things differently was seen to be environmental sustainability (e.g., reducing carbon footprints, increasing energy efficiency; 59% of responses). The most salient barrier associated with making changes to current practices was unsurprising given responses to the previous questions: 77% of respondents who answered this question listed costs (in terms of money or time) to the organisation or their clients as the primary barrier to change. To a lesser extent, respondents also identified a lack of willingness and attitudes as a further barrier to change (19%).

One surprising feature of these responses, other than the lack of attention given to adaptation rather than mitigation, is that very few respondents mentioned regulation as an alternative to current practices around climate change in the building industry, despite the voluntary nature of these being mentioned as a limitation of current practices in the previous responses. Given that concerns about client attitudes and cost were prominent, it is also surprising that the organisation itself was seen as an equally, if not more, important site for change (i.e., “leading the way”). This suggests that whatever alternative practices are considered for the building industry, its members see this change as more likely to come from within rather than through external agents such as regulatory

authorities or clients themselves.

3.4 Analysis of quantitative data

Our survey also included items assessing participants' organisational seniority, their self-perceived knowledge of climate change, the perceived adequacy of current organisational practice in relation to climate change, the need to develop alternative practices, and the continuing importance of this issue for the industry now and into the future. To explore these variables, we computed the means, standard deviations, and variable intercorrelations. In this analysis, we also included the dichotomously coded variable capturing participants *representation* of whether the issue was one of climate change (coded 1) or global warming (coded 2), and a scale representing the extent to which they attributed the *cause* of climate change to human or natural forces (1 = human, 2 = unsure, 3 = natural).

Table 1. Means, standard deviations, and variable intercorrelations.

Variable	Mean	SD	1	2	3	4	5	6	7
1. Organisational seniority	3.18	.89	1.00						
2. Representation	a	-	-.07	1.00					
3. Cause	a	-	-.09	-.06	1.00				
4. Knowledge	3.33	.77	.07	.02	.05	1.00			
5. Issue importance	3.95	.90	.00	.10	-.22*	.29**	1.00		
6. Adequacy of current practice	2.90	.65	.20*	.11	.01	.08	-.16	1.00	
7. Need for change	4.11	.83	.08	.03	-.35**	.14	.51**	-.12	1.00

Notes. a = categorical variable; *p< .05, ** p < .005

Inspection of the data presented in Table 1 reveals some interesting patterns. First, with respect to the variable means, it is clear that participants generally perceived a need for the building industry to develop new practices to address climate change: rated

adequacy of current practice fell below the scale mean (but not significantly, $p > .10$) and perceived need for change was significantly above the mean, $t\,(98) = 13.34$, $p < .001$. As such, there seems to be an "in principle" openness to change around the issue of climate change, at least within the organisation we surveyed. Assessment of the adequacy of current practices was, however, significantly related to organisational seniority: Participants higher in seniority were more likely to rate current practices as adequate. Further analyses indicated that the perceived adequacy of current practice, $F < 1$, and perceived need for change, $F\,(7, 91) = 1.75$, $p = .11$, were not affected by the specific department within which the participant worked. Also of interest was the role of understandings of climate change in shaping these assessments of organisational practice. Specifically, participants who understood climate change as a natural phenomenon were *less* inclined to see this issue as important for the building industry and were *less* convinced of the need to change current practices to account for climate change.

Regression analysis in which all of the variables (seniority, representation, cause, knowledge and issue importance) were entered simultaneously as predictors explained a small but significant amount of variance perceived adequacy of current practices, $R^2 = .12$, $F(5, 90) = 2.46$, $p = .039$, and a more substantial portion of variance in perceived need for change $R^2 = .28$, $F\,(5, 90) = 7.02$, $p < .001$. The most important independent predictor of perceived adequacy of current practice was the ongoing importance of the issue, $\beta = -.25$, $t = 2.31$, $p = .02$. In the context of the regression analysis, the role of organisational seniority became less significant, $\beta = .19$, $t = 1.84$, $p = .07$, and participant's representation of climate change became somewhat more significant, $\beta = .18$, $t = 1.89$, $p = .063$. As such people who did not see climate change as an important

issue, who were higher in organisational seniority, and who endorsed a simpler representation of the issue as "global warming" (rather than the more complex "climate change"), were more likely to perceive current practices as adequate. None of the other variables contributed significantly to explaining variance on this measure.

Reflecting the same pattern as the zero-order correlations above, the most important predictors of perceived need for change were the ongoing importance of the issue, $\beta = .40$, $t = 4.12$, $p < .001$, and beliefs about the causes of climate change, $\beta = -.26$, $t = 2.74$, $p = .007$. Participant who saw climate change as an issue of ongoing importance to the industry and who believed that climate change was caused by human behaviour rather than natural forces were most likely to see a need for innovation and change within the industry in response to the issue. None of the other variables contributed significantly to explaining variance on this measure.

4. DISCUSSION

The aim of this study was to provide some exploration of thinking about climate change within the building industry, how members of this sector evaluate current practices and their possible alternatives, and how these things relate to each other. Given the role of the building industry in both mitigating against and adapting to possible future climate change, and the relative under-exploration of these themes in previous research, providing additional answers to these questions is both interesting and of potential practical importance. To the extent that people might seek to encourage (or force) this industry to engage in new practices around climate change, they would be best to do so with some understanding of the beliefs opinions prevalent within that sector. Although

this study was conducted on a limited sample from a single organisation, and therefore cannot hope to fully characterise an entire industry, it does provide some useful insights into these questions.

Our data suggest that the perceived causes of climate change are important to people's willingness to take action on this issue. As has been alluded to in some surveys of the general public, people who perceive climate change as a natural phenomenon are less likely to see changes in their behaviour as effective responses to this issue. Although this may make some sense in relation to public attitudes, particularly where mitigation is the dominant response, it does not in the current context of buildings and building design, where issues of adaptation should be as prominent as mitigation. As one of our participants put it "what is clear is that [the climate] is changing, and we need to respond to it whatever the cause". In addition to beliefs about climate change acting as a barrier to perceiving change as necessary, they also played a role in the assessment of current practices, albeit to a lesser degree. Representing climate change in fairly simple terms (i.e., as "global warming") rather than as a more complex, variable and unpredictable phenomenon was related to the assessment of current practices as being more adequate, although this effect was weak and emerged only when other predictors were controlled.

Together these findings suggests that those who wish to encourage the adoption of new practices, techniques, or technologies may need to address bigger questions about what climate change is and why it is occurring in order to be successful. Specifically, correcting the belief that climate change is simply a "natural process" might make people more open to the need for innovation and change around climate issues. To the extent that "global warming" is also an inadequate representation of the climate change phenomena,

correcting this notion and exposing people to the full variation in possible future weather might also lead them to be more inclined to recognise the limitations of current systems and practices. Given the weak predictive value of the latter variable, however, the importance of climate change representations should be treated as speculative in the absence of additional data. Nonetheless, these patterns suggest that providing people within the industry with accurate information about the nature of climate change, its causes and effects, is likely to facilitate attempts by change agents to encourage innovation in this domain. Indeed, respondents to our survey seemed to also recognise this—a number of participants identified that increasing expertise on climate issues within their organisation was a necessary response to climate change.

While the above discussion focuses on the possible barriers to action on climate change, it should be acknowledged that our research also revealed a considerable willingness to engage with new ideas to address climate change among those surveyed. Current practices were generally not perceived to be adequate (except by those with higher levels of seniority, a point returned to below) and participants generally rated change as necessary. Interestingly when asked about what kinds of changes could be made to organisational practice, the dominant response included suggestions to embed the issue of climate change more firmly within the organisation, its culture and identity. However, many respondents also indicated that clients attitudes would also need to change (either by force or persuasion)—reflecting the fact that the most salient costs associated with action of climate change were money and time, both things that clients were not perceived as being willing to bear. These responses reflect previous acknowledgements of the competing organisational demands that often impinge on

environmental decision-making in the building sector [5, 6].

Although we did not explicitly ask participants to differentiate between adaptive versus mitigating measures, it is again surprising how few responses listed adaptation-related activities when thinking about current practices or possible alternatives. There may actually be considerable activity in the industry in both areas, but this pattern suggests that mitigation is the first thing people think of when asked about climate change and that adaptation may be a secondary consideration if at all. In both their personal and professional lives respondents focussed on reducing energy consumption and the need to improve efficiency, rather than the need to design and create buildings for a very different climate. For those primarily involved in energy provision such a stance would be rational. For the industry as a whole, however, it is less so. Buildings should be as energy efficient as possible, for most structures it will be possible to reduce their carbon emissions in future by switching to alternative fuels or greening the electricity supply. In most regards a building heated by biomass will have the same form and construction as one heated by natural gas. However a building designed to deal with peak summer temperatures of 28°C is likely to be very different to one built to withstand 38°C, particularly if it is to do so without the increased use of air conditioning. A similar observation can be made about resilience to flooding: fitting photovoltaic panels to a building is relatively simple, protecting it against sea-level rise probably less so.

This is a particularly interesting finding in light of recent experiences of extreme weather in Europe. In August 2003, 14,800 heat-related deaths occurred in Paris [28] during what is considered the warmest summer since at least 1500 [29, 30]. These deaths resulted not only from unusually high peak temperatures and a reduction in the diurnal

temperature swing, but also from a failure of buildings to successfully modify the external environment. Hence the deaths can to some degree for consider to have caused by a failure of architecture. Yet, it would seem that individual designers are more concerned about the impact of the emissions from the buildings they are personally involved with, which in the global sense can only be minor, than the direct risk to occupants their creations pose. It would seem important that issues of adaptation become more prominent in the consciousness of building industry representatives when thinking about climate change, along side the ongoing importance of mitigation.

A purely psychological analysis suggests that it would possible to foster a more proactive stance on environmental issues by increasing the salience of benefits relative to costs. Indeed, the most salient benefit of actions on climate change was improving the efficiency of buildings and thereby reducing running costs for clients. However, such benefits are cumulative and delayed and may not by sufficient to alleviate the substantial and immediate costs of more climate-aware design [31]. As such, although people may be open to taking action on climate change in their working lives, they may feel that it is easier to do so within the organisation itself rather than in relation to clients and the products they seek. Again, this was reflected in the ways in which people responded to questions about organisational practices and their alternatives. Often these referenced internal systems (e.g., office recycling and car-sharing) rather than systems specifically to do with the products they create and sell. Perhaps because of the structural constraints (time, cost, etc) many of our participants seemed to think of climate change more in terms of their own individual working lives rather than as an issue of importance to the industry as a whole.

Finally, it is interesting to reflect on the role of organisational factors—specifically seniority—in openness to change around climate issues. We chose to focus on organisational seniority in recognition that, while many individuals within an organisation might be open to change, not all organisational members have the same capacity to affect this. Ultimately the beliefs and opinions of people in positions of power and authority matter most when it comes to questions of change. From this point of view, it may be somewhat concerning to note that higher seniority in the organisation we surveyed was associated with a perception that current practices were adequate. Although the effect of seniority was weakened in the context of other predictors, it was still apparent. It may be tempting to attribute this to generational shifts (i.e., younger people being more aware of climate issues), however controlling for age did not reduce the effect of seniority on perceived adequacy of current practice. Thus, it seems that embedded-ness with the organisation may partly be responsible for this effect rather than age *per se*. The tendency of those most embedded within an organisation to be most supportive of current practices is a common finding in group research [25]. While this suggests that most organisations will suffer from an inevitable inertia, resistance to change even among the most highly committed group members is not inevitable [26]. Emphasising the ways in which new practices might help the organisation realise its goals (rather than threaten these) can help to overcome such resistance. At the very least, this finding highlights the particular efforts that change agents may need to direct towards those higher in the organisational hierarchy if their efforts are to be successful.

Obviously, the survey presented in this paper has its limitations. The limited sample, and the fact that it was recruited from a single organisation, would caution any

generalisations from the present research to the industry as a whole. In addition the questions that were included in the survey were fairly open and general. That is, we did not ask all participants to evaluate a specific current practice and to compare this to a viable alternative. Having provided this initial exploration, it would be useful for future research to explore how the concepts identified relate to willingness to engage with and uptake specific innovations, and whether there are ways of framing those innovations that increase the likelihood of adoption. It is also worth noting that our findings are correlational. Thus while the belief that climate change is natural was associated with a reduced need for change, it is unclear from the present data whether this relationship is causal. Notwithstanding these limitations, the research highlights some key forces (perceived costs and benefits, beliefs about climate change and its causes, and organisational seniority) that may impinge on efforts to encourage innovation and change around the issue of climate change within the building sector. Given the relatively limited research in this area, hopefully future research will further elaborate on the ideas presented here and their practical relevance and importance.

References

[1] Chartered Institution of Building Services Engineers (CIBSE). Climate change and the indoor environment: impacts and adaptation; 2005.

[2] Johnson H, Kovats RS, McGregor G, Stedman J, Gibbs M, Walton H. The impact of the 2003 heat wave on daily mortality in England and Wales and the use of rapid weekly mortality estimates. Eurosurveillance 2005;10,7-9:168-171.

[3] Kershaw T, Coley D. Characterising the response of buildings to climate change - the issue of overheating. Paper presented at the 5th Urban Research Symposium "Cities and Climate Change: Responding to an Urgent Agenda". Marseille; 2009.

[4] Kershaw T, Eames M, Coley D. Comparison of multi-year and reference year building simulations. Building Services Engineering Research & Technology: in press.

[5] Hertin J, Berkhout F, Gann D, Barlow J. Climate change and the UK house building sector: perceptions, impacts and adaptive capacity. Building Research & Information 2003;31:278-290.

[6] Steemers K. Towards a research agenda for adapting to climate change. Building Research & Information 2003;31:291-301.

[7] Swim JK, Clayton S, Doherty T, Gifford R, Howard G, Reser J, Stern P, Weber E. Psychology and Global Climate Change: Addressing a multi-faceted Phenomenon and St of Challenges. A Report by the American Psychological Association's Task Force on the Interface between Psychology and Global Climate Change; 2009.

[8] Robinson D, Campbell N, Gaiser W, Kabel K, Le-Mouel A, Morel N, Page J, Stankovic S, Stone A. SUNtool – A new modelling paradigm for simulating and

optimising urban sustainability. Solar Energy 2007;81:1196-1211.

[9] IES, Integrated Environmental Solutions, www.iesve.com; accessed on 28.7.10.

[10] Lorenzoni I, Nicholson-Cole S, Whitmarsh L. Barriers perceived to engaging with climate change among the UK public and their policy implications. Global Environmental Change 2007;17:445-459.

[11] Heath Y, Gifford R. Free-market ideology and environmental degradation: The case of beliefs in global climate change. Environment & Behavior 2006;38:48-71.

[12] Bord RJ, O'Connor RE, Fisher A. In what sense does the public need to understand global climate change? Public Understanding of Science 2000;9:205-218.

[13] Ungar S. Knowledge, ignorance and the popular culture: climate change versus the ozone hole. Public Understanding of Science 2000; 9:297-312.

[14] Whitmarsh L. What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming". Public Understanding of Science 2009;18:401–420.

[15] Budescu DV, Broomell S, Por H-H. Improving Communication of Uncertainty in the Reports of the Intergovernmental Panel on Climate Change. Psychological Science 2009;21:299-308.

[16] Morton TA, Rabinovich A, Marshall, D., Bretschneider P. (in press). The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications. Global Environmental Change.

[17] Ajzen I. The theory of planned behavior. Organizational Behavior and Human Decision Processes 1991;50:179-211.

[18] Fishbein M, Ajzen I. Belief, Attitude, Intention, and Behavior: An Introduction to

Theory and Research. Reading, MA: Addison-Wesley; 1975.

[19] Ajzen I. Theory of planned behavior. Retrieved February 8, 2007, from http://www.people.umass.edu/aizen/faq.html; 2006.

[20] Jimmieson NL, Peach M, White KM. Utilizing the theory of planned behavior to inform change management: An investigation of employee intentions to support organizational change. Journal of Applied Behavioral Science 2008;44:237-262.

[21] Gratton, L., Povey, R. Clark-Carter, D. Promoting children's fruit and vegetable consumption: Interventions using the Theory of Planned Behaviour as a framework. British Journal of Health Psychology, 2007; 12: 639-650.

[22] van Knippenberg D, van Knippenberg B, Monden L, de Lima F. Organizational identification after a merger: A social identity perspective. British Journal of Social Psychology 2002;41:233-252.

[23] Sani F. When subgroups secede: Extending and refining the social psychological model of schisms in groups. Personality and Social Psychology Bulletin 2005;31:1074–1086.

[24] Verplanken B, Wood W. Interventions to break and create consumer habits. Journal of Public Policy and Marketing: Special Issue: Helping consumers help themselves: Improving the quality of judgments and choices 2006;25:90-103.

[25] Morton,TA. Questions about leopards and spots: Evaluating deviance against a backdrop of threats to collective success. Chapter to appear in Jetten J, Hornsey M, editors, Rebels in Groups: Dissent, deviance, difference and defiance. Blackwell-Wiley. (in press).

[26] Morton TA, Postmes T, Jetten J. Playing the game: When group success is more

important than downgrading deviants. European Journal of Social Psychology 2007;37:599-616.

[27] Hollander EP. Conformity, status, and idiosyncracy credit. Psychological Review, 1958;65:117-127.

[28] Institut de Veille Sanitaire Impact Sanitaire de la Vague Chalaire d'Aout 2003 en France, http://www.invs.sante.fr/publications/2003/bilan_chaleur_1103/vf_invs_canicule.pdf.; 2003..

[29] Luterbacher J, Dietrich D, Xoplaki E, Grosjean M, Wanner H. European seasonal and annual temperature variability, trends, and extremes since 1500. Science 2004;303:1499–1503.

[30] Schär C, et al. The role of increasing temperature variability in European summer heatwaves. Nature 2004;427:332–336.

[31] Feldmen S. Why is it so hard to sell 'savings' as a reason for energy conservation? In Kempton W, Neiman M, editors, Energy efficiency: Perspectives on individual behavior Washington, DC: American Council for an Energy Efficient Economy; 1987:27-40..