What do we know about UK household adaptation to climate change? A systematic review

James J. Porter, Suraje Dessai, and Emma L. Tompkins

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ICAD Project, Informing Climate Adaptation Decision Making, is funded by the ERC and began April 2012.

Adaptation to climate variability and change represents an important challenge for the sustainable development of society. Informing climate-related decisions will require new kinds of information and new ways of thinking and learning to function effectively in a changing climate. Adaptation research requires integration across disciplines and across research methodologies. Currently, we lack the critical understanding of which kinds of knowledge systems can most effectively harness science and technology for long-term sustainable adaptation. This interdisciplinary research programme aims to significantly advance knowledge systems to enable society to adapt effectively to an uncertain climate. The programme is divided into two domains: 1. Understanding climate information needs across society and 2. The social status of techno-scientific knowledge in adaptation to climate change.

The whole programme will be applied to the UK context given the sophistication of existing knowledge systems (such as probabilistic climate scenarios) and the progressive climate policy landscape (that requires public authorities to regularly report on adaptation activities).

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Abstract

The UK Government’s first National Adaptation Programme seeks to create a ‘climate-ready society’ capable of making well-informed and far-sighted decisions to address risks and opportunities posed by a changing climate, where individual households are expected to adapt if it is in their interest to do so. How, and to what extent, households are able to adapt to a changing climate remains unclear. Like other developed countries, research on UK adaptation has focused predominately on public and private organisations. To fill that gap, a systematic review was conducted to understand what actions UK households have taken in response to, or in anticipation of, a changing climate; what drives or impedes these actions; and whether households will act autonomously. We found that UK households struggle to build long-term adaptive capacity and are reliant upon intuitive reactive coping responses. That split is concerning because coping responses are less effective for some climate risks (e.g. flooding); cost more over the long-term; and fail to create household capacity to adapt to other stresses. Low-cost, low-skill coping responses were already being implemented whereas the adoption of more permanent physical measures, behavioural changes and acceptance of new responsibilities are unlikely to occur autonomously without financial or further government support. If public policy on household adaptation to climate change is to be better informed, more high-quality empirical research is urgently needed.

**Keywords**: climate adaptation, households, UK, systematic literature review, national adaptation policy

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1. Introduction

Changes to the UK’s climate are unavoidable (Murphy et al., 2009). If the UK is to adapt, it needs to become a ‘climate-ready society’ capable of making ‘timely, far-sighted and well-informed decisions to address the risks and opportunities posed by a changing climate’ (Defra 2013: 11). That vision is neatly encapsulated in the UK Government’s first National Adaptation Programme (NAP). But it has very little to say about the role of households. This is somewhat surprising as households are places where adaptation happens and where it is needed. Households can take actions themselves to adapt, suffer the consequences of other’s actions such as through higher water bills or taxes, and exert pressure on local and/or national public policy as well as businesses to take further action. Besides private benefits, household actions can also provide adaptation public goods as well turning impermeable surfaces, like paved gardens, back into vegetated areas where runoff can be reduced after heavy downpours, for example (Tompkins and Eakin, 2012). The NAP does state that ‘if adaptation to climate change is in the private interests of an individual… then it should occur naturally and without government’s intervention’ (Defra 2013: 7), placing the onus on individuals, and therein households, to get on with adapting themselves. How, and to what extent, households are able to adapt to a changing climate remains unclear.

Home to 26 million households, the scale and extent of changes to the UK’s climate may not be realised for many decades but the UK’s sensitivity to climate-related risks: floods, heatwaves, cold spells, droughts, and water scarcity, is already being felt. Yet like other developed countries, research on UK adaptation has focused predominately on the actions of public and private organisations (Arnell and Delaney, 2006; Berkhout et al., 2006; Tompkins et al., 2010). A systematic review of adaptation actions, by Ford et al (2011) of academic literature published from 2006-09, found only 3 papers that documented household-level adaptation in developed nations, while UK activities dominated European adaptation publications. Since then, the UK government has increased its support for adaptation by passing the Climate Change Act 2008, funding climate information programmes under the UK Climate Impact Programme and then the Environment Agency’s Climate Ready Support Service for England, releasing new climate projections (Murphy et al., 2009), and delivering its first national Climate Change Risk Assessment (Defra, 2012), all of which suggests that the UK is a hive of climate change adaptation research activity (Mullan et al. 2013).

To understand what adaptation actions UK households have taken in response to, or in anticipation of, a changing climate, three main questions were asked: 1) What actions can households take to adapt? 2) What are the drivers of, or barriers to, household actions? and 3) Will households act autonomously? To answer these research questions, a systematic review of the peer-reviewed literature was conducted. Still relatively novel in climate change research, systematic reviews offer a promising method to identify, analyse, and synthesise large amounts of literature. Unlike traditional literature reviews, where the search or selection criteria are often unclear and
rarely justified, systematic reviews are more transparent, accountable, and reproducible.

2. Data and Methods

Following Berrang-Ford et al. (2011), a systematic review methodology was applied to assess what adaptation actions UK households have taken in response to, or in anticipation of, a changing climate. Using ISI Web of Knowledge, the largest and most comprehensive research publication database, a keyword search was made for journal articles on UK household adaptation actions published between January 2006 and November 2012. Papers published prior to 2006 were excluded as they were captured in the review process for the IPCC’s Fourth Assessment Report, although there was relatively little research on households adaptation (Alcamo et al., 2007).

As ‘climate change’ can manifest itself in various ways – change, variability, and extremes – different keyword combinations were used to capture the fullness of the topic. ‘Adaptation’ is similarly complex – encompassing risk, resilience and vulnerability, hence additional searches were run. In total, 138 keyword combinations including climat*, chang*, adapt*, household*, home*, resilien* and risk* were used (see Supplementary Materials in Appendices for keyword list). 1235 documents were returned. Once imported into Endnote, inclusion and exclusion criterion were applied. Only empirical, peer-reviewed publications, written in English and focusing on present-day adaptive responses in the UK were included. Articles outside the scope of the study were excluded. That is, they examined adaptation in natural systems - biological responses, were conceptual, not peer-reviewed, only considered climate-mitigation, or focused on future impact studies. 48 UK-specific human adaptation papers were retained. To differentiate high-quality, empirically robust, publications from those using less rigorous research, these articles were graded from zero to five (see Supplementary Materials in Appendices). 15 papers (1.2% of the initial search) met the inclusion criteria, scoring three or above. An identifier number (#1-15) was assigned to each publication and is used to refer to each one individually (see Table 1). These 15 high-quality papers covered quantitative (n=5), qualitative (n=8), and mixed methods (n=5) approaches, and focused on one or more of three main climate risks: heatwaves and management of heat stress (n=7), cold spells and coping with winter extremes (n=6), and flood risk and coastal erosion (n=7).

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Paper Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Bichard, E. and Kazmierczak, A. 2012. Are homeowners willing to adapt to and...</td>
</tr>
</tbody>
</table>
To ensure consistency, a qualitative scorecard was developed to record the characteristics of each article – authorship, research focus, methods used. Three core questions were posed: (1) What actions can a household take to adapt to climate change?, (2) What are the drivers, triggers, and barriers to these actions?, and (3) Will these actions happen autonomously? Close reading of the papers revealed a series of emergent themes related to the description of household adaptation allowing each paper to be assessed and compared.

3. Results

3.1 What actions can households take to adapt?

Household responses have been grouped into two main types: intuitive, inexpensive, and accessible responses (which we term ‘coping responses’) and more complex, costly, and challenging anticipatory actions (which we term ‘adaptations’). Greater personal, financial, and technical investment is
required in the latter. No judgement is made about the efficacy of the action taken. Significantly hotter or colder weather was associated with reactive coping responses whereas the threat of flooding involved more proactive adaptations (see Supplementary Materials in Appendices).

Coping responses dominated heat-stress management (6 of the 7 papers, strongly agreed, #1, 5, 8, 10, 12, 13). Changing one’s clothes, dietary intake, and keeping windows open at night, are all low cost, low tech, and quickly implementable fixes (#1, 5, 10). In contrast, less evidence was found of adaptations such as landscaping efforts to introduce shaded areas into gardens or modifications made to existing properties to accommodate air-conditioning (#11, 13).

A similar array of low cost, low-tech responses were found for minimising exposure to cold temperatures including changing clothes, diets, and routine (5 of the 6 papers, strongly agreed, #3, 5, 7, 12, 14). Rather than keeping homes warm all day, older people innovated by visiting friends/families or community venues where warmth was guaranteed. Some evidence of more demanding and costly alternatives included installing double-glazed windows, cavity/loft insulation, and efficient boilers. (#3, 12, 14) Flood risk responses, in contrast to heat-stress and cold extremes, required more high tech, complex responses (5 of the 7 papers, strongly agreed, #2, 3, 4, 9, 13). Reinstating porous surfaces (#9), introducing resilience measures by moving electricity fixtures up the wall or replacing carpeted areas with tiled floors (#3, 8), and acquiring specialized insurance were popular choices but required forward planning and investment (#2, 6).

3.2 What are the drivers of, and barriers to, household adaptation?

Three main drivers influence responses to all climate risks: previous exposure to weather extremes, pressure of social acceptability, and long-term financial rewards. Consciously or not, these drivers can spur on action as well as influence what actions are taken. For example, in colder weather older people may prefer to wear extra clothing or sit with blankets around them (#5, 7, 13, 14). Yet when hosting friends/family older people they may not want to concern visitors that they are cold or may want to provide a warm environment. Turning up the heating in these situations is the only socially acceptable option.

Barriers to household adaptation are more risk specific. The literature indicates that uptake of methods for minimising cold temperature exposure (e.g. double-glazing and cavity/loft insulation) is based on calculations about when, or by how much, these installations will provide financial returns - lowering fuel bills or protection from rising energy costs (#5, 13, 14). Other barriers included concern over: (i) finding qualified and reliable professionals, and (ii) home-life disruption whilst the work is done (#5, 13, 14) . Slow cost recovery, workmanship concerns, and installation disruption are also barriers for responding to heat stress. Air-conditioning units can cost around £10,000 to install and thereafter incur operational and maintenance costs (#1, 8, 11). Aesthetic and security considerations present further barriers. Fitting air-
conditioning can involve modifying window frames to accommodate units therein changing the property’s façade. If located in a conservation area, social and legal obstacles exist (#13). Modified window frames can also attract burglars, while leaving windows open at night is a safety hazard for small children and vulnerable groups (#1, 8, 10).

In response to flood risk, households appear to have two main aims: to preserve an appreciating asset and to avoid exposure to floodwaters. Insurers and lenders can play a key role incentivising homeowner action, either through insurers withdrawing cover/increasing premiums or excesses, or lenders declining mortgage applications (#2, 3, 4, 6). Homeownership, paradoxically, acts both as a driver and a barrier to responding to flood risk. Areas of mixed types of ownership - rental, owner-occupied, and social housing – experienced lower levels of flood management actions (#2, 3, 4, 13). Unable to afford or lacking the authority to make alterations to the building tenants can be left exposed. Even when flood risk reducing investments are made, if insurers fail to reward homeowners with lower premiums/excesses, the financial payoff acting as an incentive for further action is lost (#2, 3, 6, 9). Personal experience of flooding can also be a barrier to action. Unwilling to accept their home as unsafe, anxiety avoidance – an emotional response affecting an individual’s perception of responsibility and capacity to act – can be encountered (#4).

3.3 Will household act autonomously?

Households are already undertaking low-cost, low-skill, coping responses to hot and cold weather by changing dietary intake, clothing, and routines. Flood-proofing measures rolled out quickly and temporarily – doorguards, toilet plugs, and airbrick covers – have also been implemented (5 of the 7 papers, agreed, #2, 3, 4, 9, 13). This suggests that low-level coping can occur without government intervention (4 of the 9 papers, strongly agreed, #1, 5, 8, 13). More permanent measures – tiling floors, relocating electrical fittings, and removing impermeable surfaces – are expected to be adopted only if financial incentives are offered from government or insurers (#2, 3, 4, 9). Autonomous actions involving behavioural changes, acceptance of new responsibilities, or extensive-technical/resource-intensive actions are very unlikely to occur, however (8 of the 9 papers strongly agreed, #1, 2, 3, 4, 5, 8, 9, 13).

The role of the state is unclear in motivating these actions. Those at risk of flooding tend to defer responsibility to government; believe the insurance safety-net will save them; and cite unfamiliarity with flood-proofing products as reasons for not taking action (5 of the 7 papers strongly agreed, #2, 3, 4, 9, 13). Yet lacking access to state provided resources to support anticipatory adaptations does not always appear to be a barrier to action (8 of the 9 papers strongly agreed, #1, 2, 3, 4, 5, 8, 9, 13). Less than a third of government grants for flood-proofing goods and home-insulation have been taken up, for example (#4, 14). While in relation to over-heating, a few households were found to have taken expensive adaptation decisions (e.g.
installing air-conditioning units, interior redesign, and reflective roofs), despite the lack of public funds available to support these actions (#1, 5).

4. Discussions and Conclusion

Our systematic review of the academic literature shows that the evidence-base for household adaptation in developed countries, particularly the UK, has grown steadily since 2006, as reported by Ford et al (2011). Yet still with only 15 high-quality empirical papers found, our research identifies an important gap in the literature, which will need to be filled if discussions on how, or to what extent, households are able and willing to adapt, are to be better informed. Of those papers reviewed, three key findings stand out.

First, whilst UK households routinely take small, low cost, low tech, intuitive, and quickly implementable actions such as changing diets, clothing, and opening/closing windows, as coping responses to existing climatic variability; more proactive adaptations to larger, systematic, climatic changes involving greater personal, financial, and technical investment including the installation of air-conditioning or porous surfaces were rarely found. Although short-term, ‘pay-as-you-go’, coping responses are voluntarily adopted they are often risk specific (e.g. cold-snaps, heat-waves) and temporary, many of which fail to generate longer-term capacity to adapt. This leads us to question the role of existing government schemes in promoting anticipatory adaptation. It is interesting to note that much of the research on household adaptation to climate change has been conducted in developing countries with a different livelihood context (see Hisali et al. 2011 on Uganda's agricultural production). The lack of a comparable body of literature in the UK makes any meaningful comparisons with our results difficult.

Second, past exposure to extreme weather, pressure of social acceptability and long-term financial rewards appear to be the main drivers of household adaptation. Extreme weather events/impacts and recognising opportunities have been identified in other work as key drivers of adaptation, for example, in the development of National Adaptation Strategies in Europe (Biesbroek et al., 2010), and in driving institutional adaptation action in the UK (Tompkins et al. 2010). Our findings showed that barriers to action were risk-specific, but included financial considerations as well as a preference for convenience and personal exposure to hazards. While there is a burgeoning literature on barriers to adaptation (Adger et al., 2009; Biesbroek et al., 2010), generic findings have remained elusive because of the small number of case studies, as context and scale are critical, making any meaningful comparisons with our results difficult.

Lastly, our findings suggest that long-term household adaptations are unlikely to happen autonomously. Short-term and low-cost coping responses are already being undertaken but more involved adaptations that require more time and investment need incentives if they are to be adopted. These results indicate that new initiatives may be needed from the state or the private sector (e.g., insurers) to encourage long-term household adaptations. Behavioural changes and acceptance of new responsibilities are also unlikely to occur
autonomously. While there is a growing research focus on transformational change, which describes shifts in social values, institutions, and technical practices (Pelling 2011); our research suggests that neither progressive adaptation nor transformational change/adaptation is likely to happen autonomously. Making social contracts and their renegotiations more explicit has been put forward as one way to facilitate autonomous adaptation and enable transformation (Adger et al., 2013), however there is a lack of empirical evidence to back this up.

If the UK Government is serious about evidence-based policymaking then much more high-quality empirical research is urgently needed on what drives household adaptation to aid climate adaptation policy-making.
Acknowledgements

We gratefully acknowledge financial support from the PREPARE programme, funded by the UK Department for Environment, Food and Rural Affairs and led by Ricardo-AEA Ltd. J.J.P. and S.D. are supported by the European Research Council (ERC) under the European Union’s Seventh Framework Programme for Research (FP7/2007–2013), ERC Grant agreement 284369. Nikki Kent and Nick Dale are thanked for initial discussions, and Stavros Affonis and Marta Bruno Soares for comments on an earlier draft. Any errors that remain are the sole responsibility of the authors.

References


Appendices: Supplementary Materials

Appendix 1. Methodology for Selecting Peer-Reviewed Publications

To ensure consistency, and defensibility, across the systematic literature review three interrelated stages were involved.

1. After selecting a consistent set of keywords, ISI Web of Knowledge was searched for peer review articles, between 1st January 2006 and 1st November 2012, corresponding to climate adaptation on an individual/household level.

2. A filtering framework was then applied to prioritise only UK-based empirical papers, and to differentiate the high-quality publications from less rigorous research; and

3. Finally, to structure the analysis a set of four core research questions were used to introduce consistency across the reviews: What actions are households taking to adapt to climate change? What are the drivers, triggers, and barriers to action? How effective are these actions? Will these actions happen autonomously?

Two searches were performed and the results of each were combined (see below). As climate change can manifest itself in a variety of ways, not just ‘change’ per se, to capture the fullness of the subject, and to gain an understanding ‘to what’ people are responding, different keyword variations were used.

**Search 1 – Variations of Climate Risk for Individuals/Households etc**

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climat*</td>
<td>Chang*</td>
<td>Resilien*</td>
</tr>
<tr>
<td>PLUS ONE OF THE FOLLOWING</td>
<td>Variab* Extreme*</td>
<td>Vulnerab* Risk* Adapt*</td>
</tr>
<tr>
<td>Level 4</td>
<td>Level 5</td>
<td></td>
</tr>
<tr>
<td>Individual*</td>
<td>Cost*</td>
<td>Economic*</td>
</tr>
<tr>
<td>Household*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home*</td>
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</table>

**Search 2 – Substitutions for Risk, Resilience, Adaptation and Vulnerability**

<table>
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<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
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</thead>
<tbody>
<tr>
<td>climate*</td>
<td>chang*</td>
<td>robust</td>
</tr>
<tr>
<td>PLUS ONE OF THE FOLLOWING</td>
<td>preparedness</td>
<td>preparedness</td>
</tr>
<tr>
<td>Level 4</td>
<td>Level 5</td>
<td></td>
</tr>
<tr>
<td>Individual*</td>
<td>Household*</td>
<td></td>
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</tbody>
</table>

The first search involved 72 different keyword combinations and delivered 1102 peer-reviewed publications. Using Endnote, these papers were filtered in relation to UK-specificity (cf. Great Britain, England, Northern Ireland, Scotland and Wales). The second search
involved 66 keyword combinations and returned an additional 133 papers. After combining the two samples, and applying the selection criteria (see below), 48 UK-specific papers were prioritised. That subset yielded 15 peer-reviewed publications, which met the 3* or above ranking and was put forward for full analysis.

Appendix 2. Selection Criteria for Systematic Evidence Review

- **Content.** Only *UK-based Research Papers* were analysed. Review articles and commentaries were excluded. That is, *empirically grounded research* is prioritized over conceptual work.

- **Methods.** As part of assessing the empirical fit of the methods used, priority was given to established quantitative and qualitative techniques. If a survey was used, what was the response rate? How appropriate was the target audience? Is it representative? What was asked? And what statistical techniques were used in the analysis (different methods have different levels of sophistication)? The same was asked of interview data. How consistent, or comparable, is the sample? Is the material collected exhaustive (triangulated with other textual sources etc) or convenient (small set of interviews)? And have proven analytical techniques been applied (content/discourse analysis)?

- **Scalability.** The capacity to scale up findings, whether they are from surveys or case study driven, from one location to other parts of the UK was key. Has a discrete sub-population been targeted (cf. older people, children, rural communities)? And could the methods/data be extended beyond it’s specific research site without distortion?

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**Inclusion/Exclusion Criteria for Selecting Documents**

**PHASE 1: Keyword Search**

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
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<tbody>
<tr>
<td>English Language</td>
<td>Non-English Language</td>
</tr>
<tr>
<td>1st January 2006 and 1st November 2012</td>
<td>Pre-2006 and after 1st November 2012</td>
</tr>
<tr>
<td>Indexed in ISI Web of Knowledge</td>
<td>Neither indexed nor available from ISI Web of Knowledge</td>
</tr>
<tr>
<td>Peer-reviewed publications</td>
<td>Others (editorials, reviews, book chapters, meetings etc)</td>
</tr>
</tbody>
</table>

**PHASE 2: Title and Abstract Review**

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>Human</td>
<td>Natural systems (cf. plants, animals, microbes)</td>
</tr>
<tr>
<td>Adaptive response(s)</td>
<td>Mitigation only</td>
</tr>
<tr>
<td>Practical/empirical focus</td>
<td>Conceptual focus only</td>
</tr>
<tr>
<td>Present-day</td>
<td>Prehistoric or future</td>
</tr>
<tr>
<td>UK-based</td>
<td>Non-UK</td>
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</table>
### Appendix 3. Ranking Criteria and Examples

<table>
<thead>
<tr>
<th>Star Rating</th>
<th>Assessment</th>
<th>Example</th>
</tr>
</thead>
</table>
| 5*          | **Methods** used are highly appropriate for the research at hand, clearly executed and critically justified, and cover a sufficiently large sample size. Questionnaires that survey over 200 subjects of a discrete population, or in-depth interviews with more than 50 participants would fit into this bracket, for example. Additionally, the application of multiple methods to provide triangulation is another mark of the highest quality evidence.  
- Choice of research site, question(s) explored, and presentation offer immediate scalability. Findings can be both scaled up from local to regional and even national scales and scaled back again.  
- Outlook of the research speaks directly to, and actually develops, the questions posed in the systematic literature review. | Wolf et al (2012) |
| 4*          | **Methods** used are appropriate for the research at hand, clearly presented and justified. Questionnaires that survey less than 200 subjects of a discrete population, or several, and in-depth interviews with less than 50 respondents would fit into this bracket, for example. Application of triangulation, even with lower sample sizes, is a good indication of high quality evidence.  
- Findings, either in the form of the research site chosen or questions asked, can more-or-less be scaled up to a number of places in the UK without much distortion.  
- Themes covered by the research are closely related to the questions posed in the systematic literature review. | Kazmierczak and Cavan (2012) |
| 3*          | **Methods** used are appropriate for the research at hand, and well justified, and the sample sizes are sufficient. Questionnaires that survey less than 50 subjects of a discrete population and in-depth interviews with less than 25 respondents fit into this bracket, for example.  
- Findings, either in the form of the research site chosen or questions asked, can more-or-less be scaled up to other places in the UK with the caveat that their applicability will vary.  
- Themes covered by the research are closely related to the questions posed in the systematic literature review. | Brown and Walker (2008) |
Figure 1: Document Selection Process
1 Figure 2: Examples of UK Household Actions as a function of climate risk (heatwaves, coldspells and flooding) and type of action (coping response, adapting to current and potential risks).

<table>
<thead>
<tr>
<th></th>
<th>Coping Responses</th>
<th>Adapting to Current Risks</th>
<th>Adapting to Potential Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heatwaves</strong></td>
<td>• Take regular cool showers, baths or body washes</td>
<td>• Purchase lockable limiters on windows to allow them to remain open yet secure at night</td>
<td>• Install air-conditioning /active cooling units</td>
</tr>
<tr>
<td></td>
<td>• Seek shade outside the home</td>
<td>• Install ceiling fans in bedrooms</td>
<td>• Paint external walls white or fitting a reflective roof to increase albedo</td>
</tr>
<tr>
<td></td>
<td>• Change dietary intake (e.g. salads)</td>
<td>• Erect canopies for shade</td>
<td>• Purchase external shutters</td>
</tr>
<tr>
<td></td>
<td>• Keep windows open at night to aid natural ventilation</td>
<td>• Wear less and lighter clothing</td>
<td>• Plant trees and plants for shade</td>
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<tr>
<td></td>
<td>• Wear less and lighter clothing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cold Spells</strong></td>
<td>• Wear extra and heavier clothing</td>
<td>• Replace single or cold glazed windows with new double glazing</td>
<td>• Relocate away from areas that can become isolated or cut off during heavy snowfall</td>
</tr>
<tr>
<td></td>
<td>• Change dietary intake (e.g. hot meals and drinks)</td>
<td>• Install cavity-wall and loft insulation for heat retention</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Turn up, or keep on for longer, heating</td>
<td>• Purchase draft-proofing measures to window seals and external facing doors</td>
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<tr>
<td></td>
<td></td>
<td>• Use the Government's winter fuel allowance (&gt;65 years)</td>
<td></td>
</tr>
<tr>
<td><strong>Flooding</strong></td>
<td>• Turn off gas water and electricity mains</td>
<td>• Use doorguards. Gates, and toilet plugs to prevent water getting in</td>
<td>• Move electricity fixtures up the wall</td>
</tr>
<tr>
<td></td>
<td>• Move valuables and sentimental items upstairs</td>
<td>• Seal entry points, water/sewage and electricity pipes</td>
<td>• Tiling/water resistant paint for lower ground floor areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Waterproof external walls, doors</td>
<td>• Relocate white goods above flood levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Raise thresholds, floors</td>
<td>• Removal of non-porous surfaces (e.g. driveways)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subscribe to the Environment Agency's flood warning service</td>
<td>• Plant vegetation rich spaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Take out appropriate flood insurance policies</td>
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</tr>
</tbody>
</table>

Source: Kent et al (2013: 54/55)
Appendix 4. Example of Scorecard for Recording Article Characteristics

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Social capital, individual responses to heat waves and climate change adaptation: An empirical study of two UK cities</td>
</tr>
<tr>
<td><strong>Review rating</strong></td>
<td>Five star.</td>
</tr>
<tr>
<td><strong>Climate hazard(s) covered</strong></td>
<td>Heat waves</td>
</tr>
<tr>
<td><strong>Climate risks or opportunities covered</strong></td>
<td>Vulnerability of elderly people</td>
</tr>
<tr>
<td><strong>Overview</strong></td>
<td>It has been claimed that high social capital contributes to both positive public health outcomes and to climate change adaptation. Strong social networks have been said to support individuals and collective initiatives of adaptation and enhance resilience. As a result, there is an expectation that social capital could reduce vulnerability to risks from the impacts of climate change in the health sector. This paper examines evidence on the role social networks play in individuals’ responses to heat wave risk in a case study in the UK. Based on interviews with independently living elderly people and their primary social contacts in London and Norwich, we suggest that strong bonding networks could potentially exacerbate rather than reduce the vulnerability of elderly people to the effects of heat waves. Most respondents interviewed did not feel that heat waves posed a significant risk to them personally, and most said that they would be able to cope with hot weather. Bonding networks could perpetuate rather than challenge these narratives and therefore contribute to vulnerability rather than ameliorating it. These results suggest a complex rather than uniformly positive relationship between social capital, health and adaptation to climate change.</td>
</tr>
<tr>
<td><strong>Methods:</strong></td>
<td>What methodological/empirical criteria does the paper meet?</td>
</tr>
<tr>
<td><strong>Scalability:</strong></td>
<td>Could the data/findings collected by scaled up to a national-scale?</td>
</tr>
<tr>
<td><strong>Question 1:</strong></td>
<td>What actions can an individual/household take to adapt to climate change?</td>
</tr>
<tr>
<td><strong>Response 1</strong></td>
<td>Older individuals/households, living independently without the assistance of a carer, had a number of actions available to them but the study focused mainly on immediate heat abatement strategies. For example, taking a cool shower, increasing the amount of water consumed, staying out of direct sunlight, and delaying activities such as shopping etc to cooler times of the day. If residents felt unable to cope they would contact friends/family for help.</td>
</tr>
<tr>
<td>Question 2</td>
<td>What are the drivers, triggers, and barriers to these actions?</td>
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<td>-----------</td>
<td>-------------------------------------------------------------</td>
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<tr>
<td>Response 2</td>
<td>The paper suggests that the main <strong>driver</strong> for action was an unplanned response to intense heat. Friends/family acted as an important factor in helping older individuals/households to cope with extreme heat events. A potential <strong>barrier</strong>, however, was knowledge about the effect heat risks on the health of older people varied considerably. An unwillingness to report problems, and be seen as a burden to friends/family or the health service, meant they do not always seek help when experiencing heat-related side effects and potentially exacerbated the seriousness of the problem. Many respondents did not perceive themselves to be at-risk from heat illness and had not made any plans to cope with such an event. As a result, some key risks missed by family/friends such as heat stress can go untreated. Here the seriousness and awareness to put plans in place of heat risks can act as a <strong>barrier</strong>.</td>
</tr>
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<table>
<thead>
<tr>
<th>Question 3</th>
<th>How effective are these actions?</th>
</tr>
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<tbody>
<tr>
<td>Response 3</td>
<td>It is argued in the paper that the <strong>effectiveness</strong> of those actions is often compromised because remedial measures are taken too late. Such actions are, therefore, only <strong>effective</strong> is taken early on and followed consistently during a heat wave. Dehydration is not always easy to identify, especially for family/friends who pop in and out during the day, and of course, the exposure from prolonged heat overnight. Implicit throughout the paper, it is assumed, these measures can be <strong>effective</strong> is implemented correctly.</td>
</tr>
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<table>
<thead>
<tr>
<th>Question 4</th>
<th>Will these actions happen autonomously?</th>
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<tbody>
<tr>
<td>Response 4</td>
<td>The authors suggest that there is a tension underlying this case study between the vulnerability of older individuals/householders and a need to be seen as independent, which impact on his/her perception of heat risk. Whilst there is evidence that those aged 75 or above are greater risk from heat, this seems to be at odds with commonsense perceptions of resilience. As a result, whilst these actions may happen <strong>autonomously</strong> persistent concerns over a lack of awareness or the necessity to take action means that more communication is needed from central/local government to convey not only the risks but what individuals/households can do about them.</td>
</tr>
</tbody>
</table>


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**Appendix 5. Excluded Papers by Category (n=1187)**

**Non-UK Specific (n=524)**


Dodson, J., T. Li, and N. Sipe, Urban Structure and Socioeconomic Barriers to Consumer Adoption of Energy-Efficient Automobile Technology in a Dispersed City Case Study of Brisbane, Australia. Transportation Research Record, 2010(2157): p. 111-118.


511. Willox, A.C., et al., "From this place and of this place": Climate change, sense of place, and health in Nunatsiavut, Canada. Social Science & Medicine, 2012. 75(3): p. 538-547.


Mitigation (n=24)


Conceptual (n=145)


Pre-Historic or Future-Orientated (n=46)


Natural Systems (n=295)


139. Hubert, P., et al., Ecological factors driving the higher hedgehog (Erinaceus europeaus) density in an urban area compared to the adjacent rural area. Landscape and Urban Planning, 2011. 103(1): p. 34-43.


186. Maazouzi, C., et al., Ecophysiological responses to temperature of the "killer shrimp" Dikerogammarus villosus: Is the invader really stronger than the native Gammarus pulex?


Books, Reviews, Editorials etc (n=153)


46. Ford, J.D. and T. Pearce, What we know, do not know, and need to know about climate change vulnerability in the western Canadian Arctic: a systematic literature review. Environmental Research Letters, 2010. 5(1).


