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Between adaptive capacity and action: new insights into climate change adaptation at the household scale

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Between adaptive capacity and action: new insights into climate change adaptation at the household scale

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Abstract

Research on social vulnerability and adaptation to climate change assumes that increasing amounts of adaptive capacity increase the likelihood of actions to adapt to climate change. We test this assumption as it applies at the scale of households, through a study of the relationship between adaptive capacity and household actions to adapt to wildfire risk in Mount Dandenong, Australia. Here we show a weak relationship exists between adaptive capacity and adaptation, such that high adaptive capacity does not clearly result in a correspondingly high level of adaptation. Three factors appear to mediate the relationship between household adaptive capacity and adaptation: their attitude to risk, their experience of risk, and their expectations of authorities. The findings suggest that to understand the adaptation practices of households, greater attention needs to be paid to socio-psychological factors that trigger people to apply their available capacities.

Introduction

A major challenge in climate adaptation is the difficulty in knowing if adaptation has happened, or is happening (Tompkins *et al* 2010, Ford *et al* 2013, Dilling *et al* 2019). Assessing adaptation is difficult, for it is an evolving process to which there is no clear end point (Eriksen and Kelly 2007). Adaptation is also socially and politically mediated, involving diverse human experiences, intentions and behaviours such that it is intrinsically complex and unpredictable (Adger *et al* 2013, Dilling *et al* 2019). By way of a proxy, much vulnerability and adaptation research assesses adaptive capacity (as opposed to actual adaptation behaviours) (Yohe and Tol 2002, Alberini *et al* 2006, Hinkel 2011). Adaptive capacity is defined as 'the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences' (IPCC 2014: 1758). Though there are many theories about what constitutes capacity, and these vary according to the nature and scale of the actor, most theories assume that the conditions associated with wealthy liberal democracies such as high

human capital, information, infrastructure, social networks, and wealth, confer greater adaptive capacity (Mortreux and Barnett 2017, Siders 2018).

However, it is unclear if adaptation action can be inferred from the capacity to act, at least as presently theorised (Engle 2011, Malone and Engle 2011, Juhola and Kruse 2015, Siders 2018). Indeed, the literature provides several examples that demonstrate that adaptive capacity does not necessarily lead to adaptation (Vickers 2018). In industrialised countries such as Norway and the USA, where levels of wealth and health would suggest high adaptive capacity, political resistance and the division of responsibilities and funding across government have seriously undermined adaptation (O'Brien *et al* 2006, Repetto 2008, Hinkel 2011). And, when adaptation does take place, it seems less to be a function of access to resources and more about experience of extreme events, place attachment, and trust in authorities (Amundsen *et al* 2010, Koerth *et al* 2013, Eakin *et al* 2016, Elrick-Barr *et al* 2017, Stoll *et al* 2017, Torres *et al* 2018). Conversely, adaptation is occurring in social systems with seemingly low adaptive capacity. A study of artisanal fisheries in South India demonstrates that the most

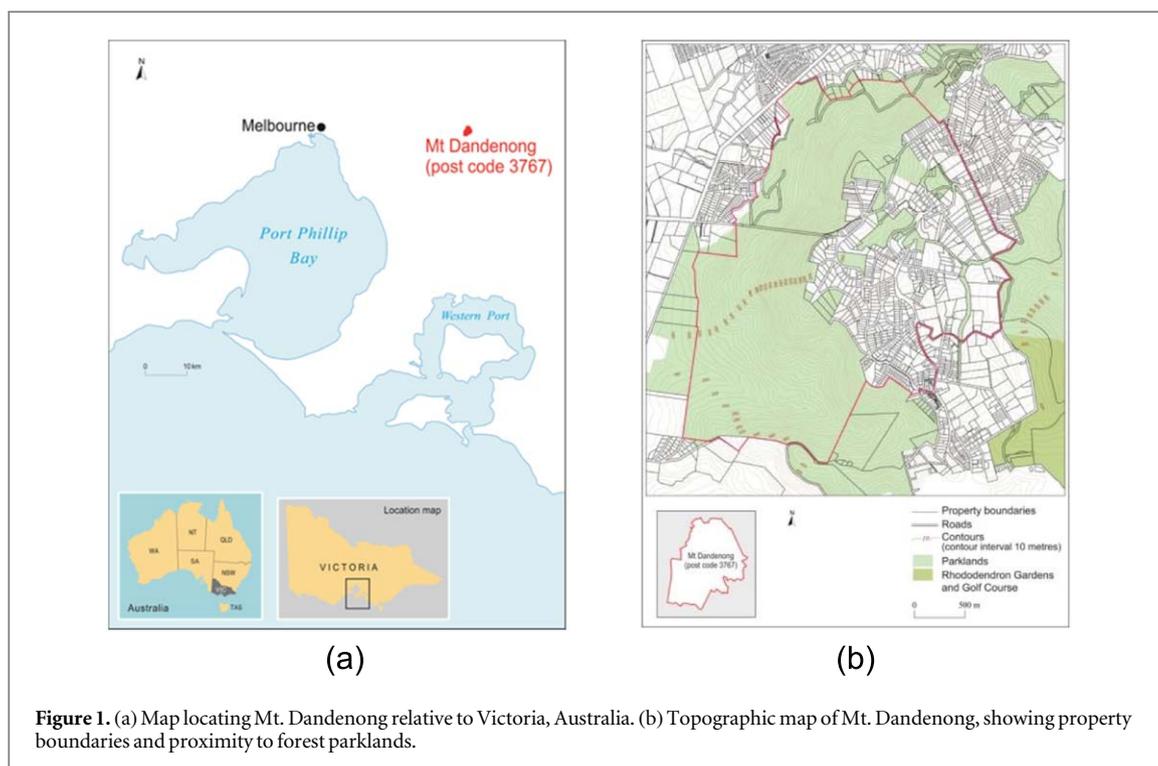


Figure 1. (a) Map locating Mt. Dandenong relative to Victoria, Australia. (b) Topographic map of Mt. Dandenong, showing property boundaries and proximity to forest parklands.

vulnerable households were not those that were poorest and so are assumed to have the lowest capacity, but rather those who were less willing to adopt new practices (Coulthard 2008). Similarly, a recent study that synthesised adaptive behaviours across fishing communities found that adaptive capacity is not merely about having resources, but more importantly about the willingness to deploy those resources (Cinner *et al* 2018). Similar results have been shown in pastoral areas in Burkina Faso (Nielsen and Reenberg 2010), and in informal settlements in Uganda (Waters and Adger 2017). So, if people with low adaptive capacity are adapting, and not all people with high adaptive capacity are adapting, it appears that adaptive capacity is limited in its ability to explain adaptation.

In this paper we report on empirical research that aimed to test the relationship between adaptive capacity and adaptation. We used a case study of household adaptation to wildfire in Mount Dandenong, Australia, which is a suburb characterised by both high wealth and high fire risk. As explained below, if adaptive capacity does explain adaptation, then there is arguably nowhere else where the relationship should be as obvious as in Mount Dandenong. If adaptation is not progressing well here, then knowledge about the reasons for this can help inform theories about adaptation, as well as policies and practices to help.

Study area and aims

Melbourne's urban-rural interface is described as one of the highest wildfire risk areas in the world (Boura 1994, Buxton *et al* 2011). It has a long history of wildfires that have caused death and injury

(AGDDD 2011). The most dramatic wildfire in recent years was the Black Saturday wildfires in 2009, which killed 173 people. Within this urban-rural interface sits Mount Dandenong (35 km from Melbourne's central business district, figure 1(a)). The township sits at the top of a mountain and is almost completely surrounded by dense sclerophyll forest (figure 1(b)). At the time of the survey, the population of Mount Dandenong was just over 1200 people, in an estimated 489 households (ABS 2011). The combination of high fuel loading (fuel availability in the surrounding forest), topography, and the high number of dwellings means that the township is classified by the state-level (Victorian) fire authority as an extreme wildfire risk area, their highest risk category (CFA 2011).

The risk of wildfire in this area may already be elevated due to climate change, and is expected to increase further for this reason (Lucas *et al* 2007, Hughes and Fenwick 2015). Climate modelling suggests that the number of warm nights, heat waves, and dry spells will increase in the region (Alexander and Arblaster 2009), leading to a marked increase in the frequency, duration and intensity of wildfires (Hennessy *et al* 2006, Lucas *et al* 2007, Hughes and Fenwick, 2015). The frequency of fire danger days rated as 'extreme' (FFDI of 50+) at Melbourne's airport could increase from the current average of 2.5 days per year (based on data from 1973 to 2007) to 3.4 d by 2020 and 5.8 days per year in 2050 (Lucas *et al* 2007). These changes are likely to decrease the opportunities for management of fire risk (such as pre-season fuel reduction burns) and increase the resources required for wildfire management (Lucas *et al* 2007). Wildfire authorities in this region currently manage

Table 1. Adaptive capacity indicators of Mt. Dandenong compared to national levels.

| Proxy indicators of adaptive capacity | Mt. Dandenong | Australia |
|--|---------------|-----------|
| <i>Wealth</i> | | |
| Median weekly household income (\$) | 1344 | 1234 |
| Population employed (%) | 89.5 | 88.4 |
| Households with 2 + motor vehicles (%) | 65.7 | 52.6 |
| <i>Skills</i> | | |
| Population with post-secondary school qualifications (%) | 87 | 61 |
| Population speaking English at home (%) | 91.7 | 76.8 |
| <i>Social capital</i> | | |
| Population that volunteered in last 12 months (%) | 25.5 | 17.8 |

smaller wildfires quite well, but complex wildfire events are less well understood and managed. It is these extreme, high-risk events that are likely to become more frequent as a result of climate change (O'Neill and Handmer 2012).

This increased wildfire risk is compounded by social changes in Mount Dandenong. There is considerable housing pressure in Melbourne driven by a growing population and a development model of expansion rather than consolidation (Hughes and Mercer 2009). This housing pressure, and the amenity value of living in a forest landscape close to the city of Melbourne, is attracting a growing number of people into high wildfire risk areas (Boura 1994, Gurran 2005, Buxton and Low Choy 2008, McAneney *et al* 2009, Buxton *et al* 2011). This means that more people and more property (and other things that people value) are exposed to wildfire risk. It is critical therefore that those households in fire prone areas of Melbourne's urban-rural interface have the capacity to adapt to future wildfire, and that this capacity results in tangible adaptation outcomes.

Mount Dandenong is an excellent case study to test the relationship between adaptive capacity and adaptation. Consistent with the theoretical assumption that liberal democracies confer higher adaptive capacity, Australia ranks particularly highly in global adaptive capacity assessments (Haddad 2005, Krishnamurthy *et al* 2014) and Mount Dandenong enjoys higher levels of wealth and education compared to Australian averages (ABS 2011) (see table 1). This would suggest that households in this area have high adaptive capacity, making it a particularly good case study to test how effective adaptive capacity is in influencing adaptation.

There is evidence to suggest that households in Mount Dandenong are aware of the wildfire risks in their area and actions they can take to reduce those risks. Unlike other parts of the world, such as in parts of the USA, evacuation in the event of a wildfire is not mandatory in Australia (Stephens *et al* 2009). Individuals can choose to stay at home during a wildfire; and because of this, households share responsibility for managing wildfire risk, for they ultimately decide what to do and bear the consequences of their decisions. The Country Fire Authority (CFA) is particularly

active in communicating wildfire risks and the actions households can take to reduce wildfire risk through television and radio campaigns, newspaper features, township protection plans, local meetings, and letter-box drops. According to one study, over 93% of people living in Victoria's high wildfire risk areas have at some time received information about wildfire risk and safety (CFA 2007). Receiving information about wildfire risk does not necessarily translate into elevated risk perceptions or behaviours to reduce that risk, however it demonstrates that people in Mount Dandenong have access to a significant and purposeful supply of knowledge about wildfire risk and how to reduce it.

So, in Mount Dandenong, households have apparently high adaptive capacity in a country with apparently high adaptive capacity; they are located in an extreme wildfire risk area and this risk is highly sensitive to climate change; and they have easy access to high-quality information about wildfire risk and of the actions householders can take to reduce that risk. If adaptive capacity does explain adaptation, then the relationship should be detectable in Mount Dandenong. If adaptation is not progressing well in Mount Dandenong, then knowledge about the reasons for this can help inform theories about adaptation, as well as policies and practices to help improve adaptation in similar communities. Therefore, there were three aims for this study:

1. To assess the extent to which households in Mount Dandenong are adapting to wildfire risk.
2. To examine the extent to which adaptive capacity predicts adaptation in Mount Dandenong.
3. To examine other mediating factors that might help explain the results.

Method

We adopt an extreme case approach to testing the relationship between adaptive capacity and adaptation. The suburb of Mount Dandenong is an example where adaptive capacity is seemingly high and adaptive behaviours should be evident, because it is exposed to

Table 2. Adaptive capacity components and indicators.

| Adaptive capacity components | Indicators |
|------------------------------|--|
| Wealth | Income per household member Investments (property ownership, incl. multiple properties) Income streams per household |
| Social capital | Bonding capital (people to call on for assistance with tasks, and in times of emergency) Bridging capital (group memberships) Linking capital (participation in community meetings, petitions) |
| Knowledge | Sources of information used for wildfire risk Local knowledge (measured in time spent living in the area) Awareness of wildfire risk |
| Skills | Highest qualification attained Proficiency in English language (for understanding wildfire warnings) |
| Health | Number of people in household with health conditions Impact of health on wildfire adaptation |

very high risk of wildfire, and in theory it has high adaptive capacity because households there have high incomes and have been the subject of a great deal of information about the risk and strategies for its management.

The assessment of adaptive capacity used a quantitative survey. Questions were asked about each of the five components of adaptive capacity that are typically used for research of this kind at the household scale, which in turn borrow heavily from research on sustainable livelihoods (e.g. Paavola 2008, Osbahr *et al* 2010, Lemos *et al* 2013, Freduah *et al* 2019). These are shown in table 2, along with the indicators of capacity for each component, whose selection is also consistent with other adaptive capacity assessments (Siders 2018). Nevertheless, the survey questions were tailored specifically to the Mt. Dandenong community and the issue of wildfire preparedness. For example, to assess knowledge the survey asked questions about the information sources that households use to learn about wildfire risk (such as from local Country Fire Association meetings and the Victorian Wildfire Information Line). This approach allowed for a highly site-specific and relevant assessment of adaptive capacity. Components of adaptive capacity that were uniform across the township (such as access to institutions and infrastructure) were not assessed, as they would not provide differentiation of capacity within the sample.

The survey was hand delivered to every household in Mt. Dandenong ($n = 489$) in order to increase response rates (Dillman 1991). This was timed to take place in September 2012, to coincide with the lead up to the wildfire season, which usually runs from November to April. A total of 98 complete surveys were returned, giving a response rate of 20%, which is consistent with other wildfire research using household surveys (Kyle *et al* 2010, McFarlane *et al* 2011). Responses to the adaptive capacity survey were analysed such that a numerical score for each household was determined, by assigning a score from 1 (low level of capacity) to 3 (high level of capacity) to each of the five capacities in table 2. A three-point scale was chosen so as to ensure reliability across our judgements of

the data and so as not to convey spurious nuances in those judgements (Jacoby and Matell 1971). The minimum score was set at 1 in recognition that all households had some capacity. Combining all capacities, household adaptive capacity scores fell on a scale of 5–15 (reflecting the range of possible sums of the minimum and maximum scores for each of the five components).

Participants were asked at the end of the adaptive capacity survey if they would be interested in participating in an interview. This formed the sub-sample from which the adaptation interviews were conducted ($n = 39$). A qualitative structured interview protocol was developed to assess household adaptation. This is appropriate given the complexity of household adaptation and the need for consistency across each of the households. To assess actions in response to wildfire risk we identified thirty-eight actions through a review of publicly available books and guides on wildfire risk management (including Schaubel 2004, CFA 2012 and 2013, McNeill *et al* 2013, Whittaker *et al* 2013, Dunlop *et al* 2014). These were actions that all households could reasonably be expected to have done, and we grouped these into three broad classes of activity: property preparations (such as clearing leaves from gutters), household planning (such as leaving early on fire risk days), and strategic actions (such as home insurance) (table 3).

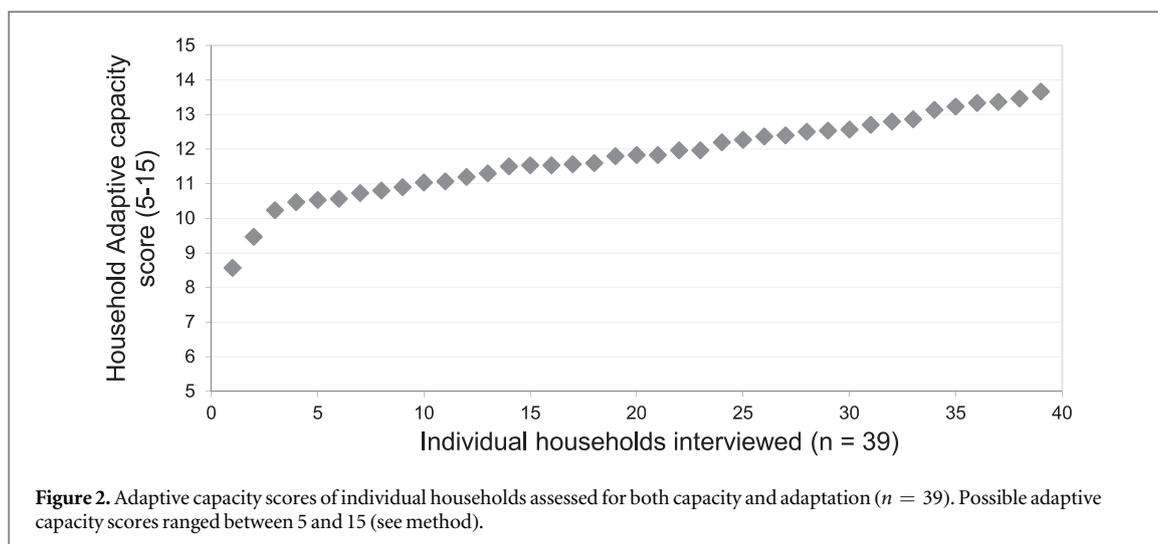
The interviews were conducted in the height of the wildfire season (January–March 2013) so as to capture household adaptations at their peak. Interviews took 60–80 min and included a tour of the property. This allowed the researcher to observe first-hand actions households had taken to prepare for wildfire, and meant that assessments could be adjusted where interviewees had downplayed or exaggerated their adaptation efforts. The interview recordings were transcribed and coded (using NVivo) as well as collated in a spreadsheet for comparison across households. This rich, qualitative data then guided the allocation of a numerical score for each household across three broad categories of adaptation activity: property preparedness, evidence and quality

Table 3. Criteria used to assess adaptation action.

| Adaptation criteria | Long/short term actions |
|---|-------------------------|
| Property preparations | |
| <i>House preparation</i> | |
| • Maintained/improved external walls (painted house, filled gaps to prevent embers catching) | LT |
| • Maintained/improved roof (replaced broken tiles, filled gaps to prevent embers) | LT |
| • Maintained/improved windows/doors (put in wire screens, filled gaps to prevent embers) | LT |
| • Maintained/improved decking/under-floor areas (fire retardant timber, enclosed underfloor) | LT |
| • Maintained/improved gutters, pipes, vents (cleared leaves from gutters, metal pipes only, mesh over vents) | ST/LT |
| • Installed a fire refuge or upgraded a room for fire safety | LT |
| <i>Garden preparation</i> | |
| • Water the garden regularly | ST |
| • Cut back overhanging shrubs/trees | ST/LT |
| • Mowed the lawn and raked leaves | ST |
| • Chosen fire resistant plant species | LT |
| • Designed the garden to create firebreaks (gravel, ponds, lawn) | LT |
| • Moved flammable objects away from the house (gas bottles, woodpiles) | ST/LT |
| <i>Fire-fighting equipment</i> | |
| • A long hose or sprinkler system that reaches all areas (are the pipes underground) | LT |
| • A water tank or dam (water capacity should be min 10,000 L) | LT |
| • A water pump/ metal buckets (if electric water pump should have electricity generator) | LT |
| • Ladders, rakes, shovels, mops | LT |
| • Gutter plugs (tennis balls, sand bags) | LT |
| Household planning (fire plan) | |
| • Fire plan is written down and readily accessible | ST |
| • Given that household needs change over time, the fire plan is up to date | ST |
| • They monitor bushfire danger (i.e. CFA website, ABC radio, fire guard group) | ST |
| • They have a clear trigger to leave or defend | ST |
| • Their fire plan has detailed information about what actions household members will take under fire danger conditions (i.e. fill gutters with water, prime hoses, wear protective clothes) | ST |
| • They have a back-up plan (i.e. shelters, evacuation routes, defence) | ST |
| • Their fire plan is flexible to accommodate unexpected changes (i.e. if husband is not home) | ST |
| • Pets are included in the fire plan | ST |
| • Precious belongings stored away from the area or in a fire resistant safe | ST |
| • Emergency kit organised (torch, radio, water, wool blanket, first aid kit) | ST |
| • Protective clothing organised for each household member | ST |
| • The fire plan has been discussed with everyone in the household | ST |
| • There is consensus within the household on the fire plan | ST |
| • The fire plan has been discussed with friends/ neighbours | ST |
| • If they plan to stay: | ST |
| ○ They plan to actively defend as opposed to passively sheltering | |
| ○ They have sufficient people to help defend | |
| ○ There are no significant age or health issues that might make it difficult for them to defend | |
| ○ They have the equipment to defend | |
| • If they plan to leave: | ST |
| ○ They plan to leave early in the morning or night before | |
| Strategic actions | |
| <i>Property selection</i> | |
| • They initially selected the property due to its relatively low bushfire risk profile (distance of trees from house, fire resistant materials, concrete slab) | LT |
| • If they built the house, they strategically built it to be more fire resistant | LT |
| <i>Insurance</i> | |
| • They have adequate home and contents insurance | LT |
| <i>Advocacy</i> | |
| • They have advocated for better bushfire management (such as writing letters to local newspapers) | LT |
| <i>Relocation intentions</i> | |
| • They are intending/ considering permanently moving away from the Dandenong Ranges due to bushfire risk | LT |

of a household fireplan, and strategic actions. Each was assessed on a three point scale. A score of 0 was assigned to households who had taken few actions, and who had a poorly developed or non-existent fire plan. A score of 1

was assigned to households who had taken several actions, but who had some weaknesses in their fire planning. A score of 2 was assigned to households who had undertaken extensive actions and had detailed and up to



date fire plans. Given each household received a score of between 0 and 2 across the three broad categories of adaptation activity, the range of possible scores for household adaptation therefore fell on a scale of 0–6.

In anticipation that adaptation might not be wholly explained by adaptive capacity, data on possible drivers and constraints of adaptation were also collected during this same interview. Given the subtlety and richness of the alternative factors explored, a semi-structured qualitative approach was employed for this part of the interview. Questions focused on eight different factors that might explain adaptation, based on a comprehensive literature review of disaster risk reduction and climate change adaptation: perceptions of risk exposure and sensitivity, risk attitudes, hazard experience, trust in and expectations of authorities, lifestyle and environmental values, housing status and property attachment, household composition and dynamics, and competing concerns (e.g. Beringer 2000, Winter and Fried 2000, Lindell and Perry 2000, Grothmann and Patt 2005, Brenkert Smith 2006, Figueiredo *et al* 2009, McGee *et al* 2009, Amundsen *et al* 2010, Eriksen *et al* 2010, Eriksen and Gill 2010, Wolf *et al* 2010, Dillon *et al* 2011, Linnekamp *et al* 2011, O'Neill and Handmer 2012, Keeley *et al* 2013, Poussin *et al* 2014, Lazo *et al* 2015, Dilling *et al* 2017). The qualitative data was coded and analysed according to these themes.

The interview sample was broadly similar to the 2011 Mount Dandenong census data. Notable differences in the interview sample compared to the census data were: fewer younger adults (6% of interviewees compared to 14% in the census); more women (63% compared to 50%) and no single parent families (compared to 10% of households in the census). However, the nature of this study, focusing on the relationship between capacity and adaptation of participating households, rather than drawing conclusions on the township as a whole, renders these differences relatively minor.

Results

Household adaptive capacity

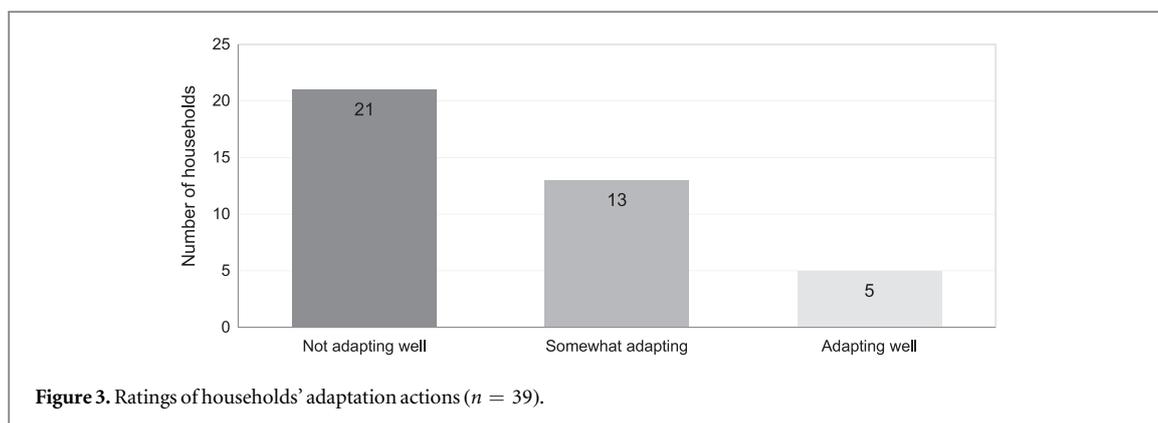
The mean adaptive capacity score of the sample households was 11.5 (on a scale of 5–15, see Method). Figure 2 shows that there is little variation in adaptive capacity across households (excepting two households with noticeably lower capacity), and that all households had significant capacities.

Household adaptation

Qualitative structured interviews enabled an assessment summary for each household to be developed and assessed against 38 criteria for wildfire adaptation (see Method). Households were categorised into one of three terciles: not adapting well, somewhat adapting, or adapting well. Those which were not 'adapting well' were those with a low consideration of wildfire risk and/or no fireplan, or one that was incomplete or flawed such that despite possible physical and/or strategic preparations their efforts were highly likely to be ineffective. Those who were categorised as 'somewhat adapting' were engaged with bushfire risk and had taken considerable actions to adapt, but with some weaknesses in their planning. Those who were 'adapting well' had undertaken extensive actions to adapt to bushfire risk in ways that correspond with bushfire planning advice (e.g. CFA 2013; Dunlop *et al* 2014), they had detailed and up to date fire plans and had taken some strategic actions.

Overall, the level of adaptation across the households was very low. Only a small proportion of the sample was found to be 'adapting well' with the majority of households 'not adapting well' (figure 3).

The 21 households who were 'not adapting well' consisted of 5 sub-groups: households that planned to passively shelter in the event of a wildfire; households that planned to defend but had a major flaw in their plan (such as defending alone, defending without sufficient physical preparations, or defending with significant health issues); households that planned to



leave late (for example, relying on fire authorities to visit their household and tell them in person to leave); households that planned to leave early but had a major flaw in their fire plan (such as no monitoring activities to alert them to leave early, or no guaranteed access to a vehicle); and households where there was not a clear plan and it was difficult to establish what their intentions were.

In contrast, the five households that were assessed as 'adapting well' had undertaken extensive actions to adapt to wildfire risk, had detailed and up-to-date fire plans (including proactive monitoring of wildfire risk, a clear trigger to act, a back-up plan), and had discussed their fire plan with the whole household. These households had a high level of physical preparations regardless of whether they intended to defend or leave early. They were the most likely in the sample to have a written fire plan (a written plan is advised over a verbal plan), and to have undertaken strategic actions such as selecting their property based on the low amount of trees on the property and ensuring adequate levels of insurance cover. These actions are consistent with those that The Victorian Bushfires Royal Commission found were associated with lower mortality risk during the 2009 Black Saturday bushfires in Victoria (Parliament of Victoria 2010, O'Neill and Handmer 2012).

The relationship between adaptive capacity and adaptation

If adaptive capacity has explanatory power for adaptation, a positive relationship between the two should be observed (i.e. as adaptive capacity increases, so does adaptation). However, if the scores for adaptive capacity are plotted against the adaptation scores, only a very weak positive relationship is observed (figure 4). These results suggest that adaptive capacity does not provide a strong explanation of adaptation here.

As previously discussed, if adaptation as a result of high adaptive capacity is likely to be seen anywhere, one would expect to see it in Mt. Dandenong—i.e. one would expect to find that households in Mt. Dandenong were adapting well to wildfire risk. The results demonstrate that this is not the case: adaptation to

wildfire risk in Mount Dandenong is limited, despite households' seemingly high capacity. These results challenge the prevailing assumption in the literature that adaptation should be occurring in places with high capacity.

Mediating factors in the capacity-adaptation relationship

If adaptation is not well explained by adaptive capacity, what alternative factors might help explain adaptation? The in-depth interviews also collected data on eight factors that may help to explain differences between capacity and adaptation (see Method). Three of these factors were found to be salient in shaping adaptation for households: *risk attitudes*, *personal experience*, and *expectations of authorities*.

All three factors can be understood as mediating the way in which capacity affects adaptation. If we expect that households have certain resources available to enable them to adapt to climate risks (adaptive capacity), then these mediating factors help to explain why some individuals within households are more or less likely to apply those resources. The factors that prevent households from applying their capacity to adapt is of particular theoretical and practical interest.

Table 4 outlines how these mediating factors differed between households not adapting well, and households adapting well. Quotations from the interviews help to illuminate these findings.

Risk attitudes

People's perception of the probability and severity of wildfire risk varied considerably, as did their perception of the efficacy of adaptation actions. A participant from an 'adapting well' household explained that he felt a responsibility to protect his grandchildren from wildfire: *'I want to make sure that there's nothing I haven't done to protect them, not only from death but from the trauma'*. He felt that his actions would have a big influence on how he could manage a wildfire and he had been highly proactive in preparing his property. In contrast, a participant from a 'somewhat adapting'

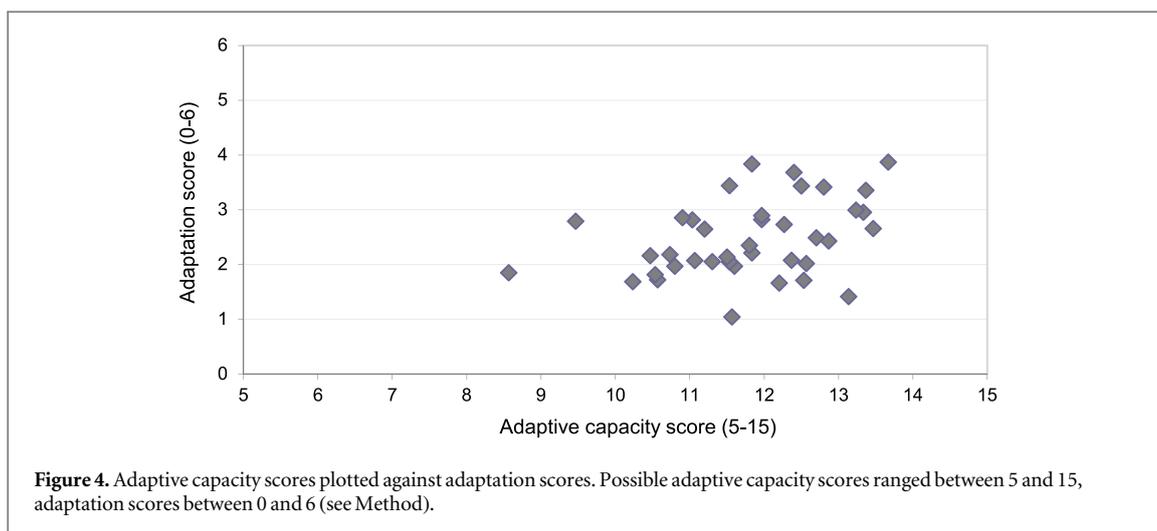


Table 4. Comparison of mediating factors between households not adapting well and adapting well. The number of households in each case is written in parenthesis.

| Mediating factor | Not adapting well (21 households) | Adapting well (5 households) |
|----------------------------|---|--|
| Risk attitudes | Dismissive of the risk of wildfire (18) | High levels of concern about wildfire risk, and high sense of self-efficacy (4) |
| Personal experience | No direct personal experience of wildfire (20) | Direct previous personal experience of wildfire (4) |
| Expectation of authorities | Expected to be able to rely upon assistance and protection of wildfire authorities in event of a wildfire (5) | Trusted the wildfire authorities, but were not expecting or relying upon their assistance in the event of a wildfire (5) |

household was concerned about wildfire risk but did not feel that his actions would make a difference: *‘I’d like to have the gutters cleaned, the downpipes replaced... [but] remedial works are meaningless. If a big fire comes... everything is going to go kaput.’* He perceived wildfire risk as random and uncontrollable, such that there was little point in preparing for wildfire. A participant from a ‘not adapting well’ household had a low level of concern for wildfire risk and had undertaken few adaptation measures: *‘I’m a pragmatist so yeah, it’s very much, deal with it as it happens... A lot of people up here have become quite paranoid. You know, over-reacting on certain levels.’*

Personal experience

People’s wildfire experience plays a significant role in shaping risk attitudes, with some studies showing that personal experience increases adaptation and others showing adaptation reduces with experience (Winter and Fried 2000, McGee and Russell 2003, McGee *et al* 2009, Brenkert-Smith *et al* 2012). Here, those who had direct personal experiences of wildfire tended to perceive the risk of wildfire to be high, whereas those with no direct personal experience were more likely to dismiss the risk. A participant in a ‘somewhat adapting’ household had an intense childhood experience with wildfire risk and was determined to defend her property. Her family’s past success in defending had strengthened her resolve to defend: *‘Maybe a seasoned fire fighter would say well you’re an idiot [to defend your*

property] but like I said, my father... how he survived that is quite incredible and when you look at the photos it’s just black everywhere and here’s this little weather-board, still sitting there because dad stayed with it.’ In contrast, a respondent from a ‘not adapting well’ household explained her wildfire complacency saying *‘part of me is nervous and then part of me is complacent... unless it happens to you, you don’t take it that... well I take it seriously, it’s certainly a concern, but it’s still a bit ‘out there’.*

Expectations of authorities

As explained earlier, in Victoria, the authorities cannot compel people to evacuate their property in the face of a wildfire. This contrasts with other areas in Australia (where mandatory evacuation is legally possible but not enforced) and particularly the US (where mandatory evacuation is legal and has been enforced). In Victoria then, it is ultimately the household’s responsibility to plan and prepare for wildfire. Nonetheless, households do receive wildfire warnings and advice from fire authorities, such that households often tend to defer responsibility for dealing with wildfire risk back to authorities. In this dataset, two broad attitudes towards expectations of authorities emerged.

There was an attitude of *‘the authorities will protect us’*, in which households felt that wildfire authorities would (and should) protect them. These households were doing little to adapt to wildfire risk. A participant from a ‘not adapting well’ household believed the

authorities would protect her: *'I'm pretty comfortable because we've got the fire brigade at the top of the hill... if I hear the [fire] siren go off I'll just turn on the computer, go outside, have a sniff and a look, and see where the fires are. That's about it, really.'* This household was in an area particularly exposed to wildfire, but expected a warning in sufficient time to evacuate if necessary. Participants also thought fire authorities not only could, but should, protect them. A participant from a 'somewhat adapting' household believed that wildfire authorities were not taking responsibility for wildfire risk. Again, his household was located in a particularly high fire risk area: *'surely the first duty of government is to look after the safety of its citizens. It's not happening...'* Rather than applying his household's capacity to adapt to wildfire risk he deferred that responsibility to the wildfire authorities.

In contrast, other households had an attitude of: *'we have to look out for ourselves'*. These households were mostly found to be 'adapting well'. The households trusted that wildfire authorities would be working to contain the risk but did not expect or rely upon their direct assistance. A participant from a 'somewhat adapting' household explained: *'[the CFA] will have a look at your properties, they will give you ideas, but ultimately you know it's up to you, it's not blaming them because they didn't give a siren, it's not blaming anybody because you weren't told, it's up to you when you live in an area like this'*.

In conclusion, households that were 'adapting well' were likely to have: high levels of concern about wildfire risk, a direct personal experience of wildfire, and were likely to trust wildfire authorities but not rely on their assistance. In contrast, households that were assessed as 'not adapting well' tended to be: dismissive of wildfire risk, have no direct personal experience of wildfire, and to hold high (and unrealistic) expectations of the wildfire authorities in the event of a fire. So, these socio-psychological attitudes of households have a significant influence on adaptation. Given qualitative methods were used to examine the mediating factors and quantitative methods were used to assess capacity, it is not possible to statistically compare whether capacity or mediating factors had greater influence on adaptation. Nonetheless, it is clear that these mediating factors were very important, and could well be more meaningful in understanding household adaptation than assessing adaptive capacity. Household attitudes are personal and complex, with multiple interacting factors which substantially influence adaptation.

These findings support the conclusions of Grothmann and Patt (2005) who show the importance of examining perceptions of adaptation efficacy and self-efficacy rather than perceptions of risk probability and severity alone. They also support findings from a number of studies on the importance of the intensity of experiences in shaping preparation for environmental hazards (Winter and Fried 2000, Gow 2008, McGee *et al* 2009,

Dillon *et al* 2011; Koerth *et al* 2013). With regard to trust and expectations in authorities, the findings confirm that a lack of trust can lead to low uptake of basic preparations advised by authorities (Figueiredo *et al* 2009), but also that high trust can result in low preparation as households expect authorities to be able to protect their properties (Beringer 2000, Winter and Fried 2000).

High capacity households that demonstrate complacency about known climate risk may prove to be a defining feature of adaptation in developed country contexts. Communities in developed contexts can feel so insulated from climate risks that they have little motivation to adapt. In Victoria, and Australia more broadly, there is a prevailing culture in which individuals regard government as responsible for protecting communities and reducing risk (Fisher 2008). One of the key messages from a Royal Commission investigation into the 2009 Victorian 'Black Saturday bushfires' (which resulted in 173 civilian deaths, had associated costs of over \$3.5 billion, and was proclaimed as Australia's worst wildfire disaster) was to ensure that responsibility for wildfire safety was shared not only between state and local governments, but with households and the individuals within them (McLennan and Handmer 2012). The research presented here has shown that many householders clearly still expect that wildfire authorities will protect households—to such an extent that householders do not even monitor wildfire risk themselves. This complacency towards risk is likely to be a significant barrier to adaptation in other high capacity communities also, and for other risks besides wildfire.

Conclusion

This paper demonstrates that the concept of adaptive capacity as conventionally defined has limited ability to explain adaptation behaviours, at least at the level of households. Households with seemingly high adaptive capacity such as those in Mount Dandenong may be vulnerable to climate risks because they fail to adapt. Reliance on assessments of adaptive capacity as proxies for adaptation, or to indicate that vulnerability is lower in places with seemingly high adaptive capacity may therefore be misguided. Assessments of adaptive capacity may still have a role to play, but how they are conducted—and in particular how they are verified—needs to be reconsidered.

Adaptation is a complex process mediated by socio-psychological factors. This study suggests the need for a deeper understanding of the drivers of adaptation that appreciates the multifaceted ways in which climate risk and adaptation decisions are negotiated and enacted by diverse actors. The findings from this research demonstrate that progress on adaptation remains a significant challenge. Understanding the ways in which households currently negotiate risk is

fundamental if we are to support and engage households to adapt well to climate change.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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