

# BEHAVIOUR CHANGE IN A CHANGING CLIMATE

Scoping paper in support of  
missions-based research and  
innovation for the BWA Consortium

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This report uses both numbered references (shown as<sup>1</sup>): with citation details found in the references section at the end of the report; and roman numeral footnotes (shown as<sup>i</sup>), with a comment or text found on the same page.

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# EXECUTIVE SUMMARY

The Behaviour Works Australia Consortium produced this report to investigate how behavioural public policy could potentially help with climate adaptation, and the risks and opportunities this presents. It is a scoping aid for a proposed collaborative research and innovation mission. We found that systemic behavioural public policy experiments could have a substantial positive impact on climate adaptation. Achieving that impact requires:

1. Careful problem definition to refine the focus for intervention with a clear line of sight between the intervention and impact on (publicly valued) outcomes
2. Applying frameworks that identify behaviour changes with incremental through to transformative potential
3. Prioritising transformative behaviour changes over more incremental, but addressing a portfolio of both to hedge chances, via a 'multi-level' strategy connecting changes across scales.
4. Taking smart risks to make a difference, and therefore anticipating potentially upsetting incumbent interests, at least initially
5. Adopting a pro-actively participatory, transparent and co-design orientated approach to manage risks and realise opportunities

**Problem definition:** Our review of the evidence and stakeholder views recommends a focus on behaviour changes related to the combined, cumulative impacts of multiple climate stressors on vulnerable populations. For example: the elderly, low income households, children and/or people with pre-existing health conditions. This would ideally be place based – e.g. one or more communities in regional Australia, and/or the disadvantaged inland fringe of major cities. Further work is required to specify how many populations, which climate impacts, and what harms, however we feel this follows fairly directly from identifying a priority combination of people, problem and place. The proposed prioritisation process can help identify this.

**Multi-level strategy:** Target behaviours would include a mix of behaviours with individual and collective benefits and visibility, and therefore with the potential to contribute to adaptive capacity increases at multiple levels. This focus would fit the approach outlined above and detailed in the paper. This could include exploring the potential of nature-based solutions depending on behaviour change to succeed – for example engaging residents of an urban fringe low income estate to plant street verge indigenous food gardens that reduce heat stress, encourage social connection, reduce water consumption and enhance food security, while also generating feedback loops to powerful actors. Similarly facilitating a voluntary collective agreement for a 'planned retreat' informed by behavioural public policy techniques would require engaging with individual, group, institutional and societal dynamics to succeed.

**Taking smart risks:** This focus on multi-level changes and potentially gaining the attention of powerful interests can maximise the opportunity, and minimize the risks, by having a clear public value case, drawing on the four points above. For example – by engaging with legal, infrastructure and resourcing barriers to street verge planting, species availability or learning from traditional owners and rural food producers in the nature-based example, and/or managing conflicting priorities and interests in development, land use, revenue bases etc raised by planned retreats from climate exposed locations.

**Pro-active participation and co-design:** Involving a broad base of stakeholders in the development of the program, via the activities proposed below, can help achieve these goals. Linking community groups, charities, researchers, levels of government, and pro-active industry will all be important in this via the prioritisation process, and participation in the co-design bootcamp.

# ABOUT THIS REPORT

## SUPPORTING DECISION MAKING FOR MISSIONS BASED RESEARCH AND INNOVATION

This report explores where behaviour change approaches might help with climate adaptation, drawing on system mapping, as rapid evidence review and interviews.

### Missions based research and innovation, with a behavioural focus

Mission-oriented policies can be defined as systemic public policies that draw on frontier knowledge to attain specific goals or “big science deployed to meet big problems”<sup>1</sup>. Missions provide a solution, an opportunity and an approach to address the numerous challenges that people face in their daily lives. Such challenges might include having clean air to breathe in congested cities, living a healthy and independent life at all ages, having access to digital technologies that improve public services, or having to better and cheaper treatment of diseases like cancer or obesity that continue to affect billions of people across the globe. To engage research and innovation in meeting such challenges, a clear direction must be given, and bottom-up solutions enabled.

Within these agendas, there are specific behavioural public policy problems that can form part of, but not the entirety of the solution. We define behavioural public policy as including ‘bottom up’, tailored problem-solving interventions focused on individual and group behaviour, and also considering opportunities to improve the influence of ‘top down’ contextual factors on behaviour and decisions. This can include traditional policy tools, service delivery and governance; economics, technology, infrastructure and the biophysical environment. The overall aim is achieving public goods through linking individual and systems change.

### Steps towards implementing a mission:

- 1. Agree on a shared grand challenge**  
Funders and core partners agree on a ‘grand challenge’ of broad societal significance and ambition to address with a mission-based approach
- 2. Identify one or more ‘missions’ within the grand challenge**  
Identify one or more mission goals. This should be a clear, inspiring but tractable narrative goal, and a SMART metric, that participants can align their shared investment and effort behind.
- 3. Build a coalition of sectors, stakeholders and disciplines around the mission**  
With a clear mission, funders and partners work together to build an impactful coalition around the mission. This can include new funders, but also stakeholders and contributors with valuable perspectives, networks, access and insights to offer. They are likely to be co-designers and co-deliverers in the next phase.
- 4. Design ‘bottom’ up research and innovation experiments aligned with the mission**  
Co-design with partners and stakeholders to generate a number of ambitious but achievable interventions into the problem that identify, develop and test likely impactful solutions. Behaviour change may be central, important or peripheral to a given intervention, depending on its focus.
- 5. Implement projects, adaptively manage, learn from what “works” and scale it.**  
Implement, steer and manage experiments, learning from both what works, and what doesn’t; ensuring projects have the best chance for impact and learning. Upfront scaling assessment and follow up ensures experiments with transformative potential are mainstreamed, replicated and transferred.

## Pursuing a missions based research agenda within the BehaviourWorks Australia Consortium Partnership

This report expands on the chosen grand challenge of climate adaptation. It seeks to provide advice to the BWA board on an approach to progress through steps 2. (Mission focus) and 3 (Coalitions), and begin to indicate what steps 4 (Designing experiments) and 5 (Delivery) could look like.

We review current literature, research and practice to explore the state of knowledge and thinking to explore :

- a. the case for action, risks and opportunities, and where behavioural public policy approaches may be advised
- b. identify potential examples and opportunities for 'bottom up' behavioural public policy experiments that are likely to contribute to the mission goal, and/or opportunities for behavioural research to improve 'top down' traditional policy tools or other contextual drivers.
- c. recommend important sectors, stakeholders and disciplines raised by the mission focus which later stages can engage with

### Application

Both elements are intended to facilitate the BWA Advisory Board's April 2021 meeting:

- making an overall decision on progressing each mission, or not, based on this information.
- deciding on the broader co-design and engagement model (3.), and
- identify priorities for further development in later phases 4. and 5.

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*“We don't have all the answers. We know there will be further reduction of rainfall, increase in temperatures etc. What are the capabilities we need to consider now to prepare us for the future? Crisis events get a lot of attention, we need to go deeper for systematic change”*

– BWA Advisory Board Member, November 2020.

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# INTRODUCTION

Science is providing an increasingly clear picture of current and future climate change and variability due to anthropogenic greenhouse gas emissions. Our understanding of the likely impacts on lives, liveability and livelihoods is also increasing and climate adaptation plans and vulnerability assessments are occurring at all levels of Australian society. Climate impacts so far are most consistently impacting disadvantaged parts of the community, but also highlight a changing pattern of exposure and harm across fire, floods, extreme weather, droughts, disease and pests, coastal management and more - revealing previously under considered vulnerabilities.

To be able to protect valued aspects of living in Australia, we need to anticipate and prevent harm through building what Adger et al (2007) define as **adaptive capacity**: “the ability or potential of a system to respond successfully to climate variability and change, which includes adjustments in both behaviour and in resources and technologies.”<sup>2</sup>

This discussion paper aims to understand if and how behavioural public policy approaches could be useful in building adaptive capacity overall, and particularly where its most needed. In this paper, we focus on aspects of adaptive capacity that apply to longer term, chronic climate impacts. This could include preventative, pro-active aspects of adaptive capacity as well as the responses to the combined and cascading impacts of multiple climate impacts over time, such as natural hazards. It does not centrally focus on the role of behaviour change approaches in reducing harm during a disaster event itself.

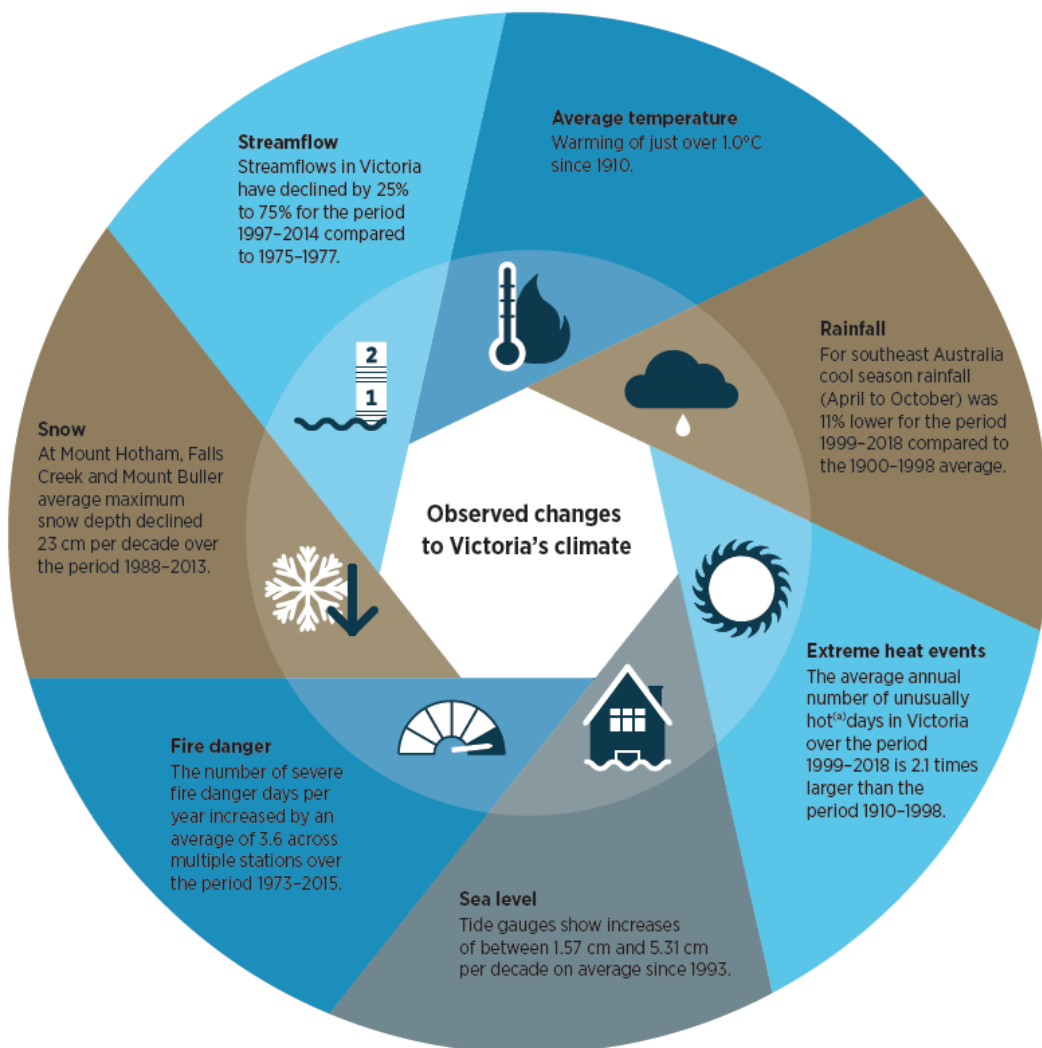
Our definition of **behavioural public policy** includes tailored problem-solving interventions focused on behaviour. Further, it can also involve improving traditional policy design, implementation and governance, often by understanding and managing the co-evolving interactions of behaviour and context. This can entail taking account of the influence of technology, land use planning, design and infrastructure; the roles of societal and cultural contexts; and that of the biophysical environment. The overall aim of behavioural public policy is achieving public good outcomes through linking behaviour change and systems change.

## Climate adaptation as a challenge of societal significance to Australia

The current scientific consensus emphasises that even if the target of net zero global climate emissions by 2050 is achieved, we will still need to adapt to serious impacts. Australia is amongst the most exposed countries, with a range of climate change changes already observed in the last 20 years<sup>3,4</sup>. An example of observed changes for the state of Victoria is summarised in Figure 1,<sup>5</sup>. Climate change is already having an impact. Since 2000, it has significantly contributed to hundreds, potentially thousands, of ‘excess’ lives lost, across multiple natural hazard events, in Australia<sup>4,6,6</sup>; the collapse of ecosystems across the country<sup>7</sup>, and communities and sectors have suffered substantial impacts to liveability and livelihood<sup>8,9</sup>. If emission reduction targets are not achieved, increasingly catastrophic<sup>10</sup> and even potentially existential<sup>1</sup> threats are expected<sup>11</sup>.

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<sup>1</sup> i.e. permanently limiting, or ending, the potential of global human civilisation to flourish into the future.



Understanding, preparing for, and preventing harm where possible from these and future changes, while enhancing what we value, is the focus of widespread activity across government, the community, business and civil society. Climate change and variability has the potential to affect everything dependent on environmental public goods and services. At the same time, in every domain of impact, there are more immediate causes and influences of presenting problems that tend to dominate attention other than climate change<sup>12,13</sup>. It is perhaps not surprising therefore that many actors are concerned that the pace and scale of adaptive capacity building is not commensurate with the threat<sup>5,10</sup>.

Some of this gap reflects the complex nature of the problem. Many of the worst impacts fall in classic 'public good' areas often requiring government intervention, with more private sectoral interests and actors already adapting to challenges they experience and anticipate<sup>12</sup>. Indeed, as a wealthy, developed country Australia has a level of adaptive capacity in place for responding to natural hazards, yet the nature and intensity of hazards are changing in surprising ways<sup>4,10</sup>. Further, there are slow and cumulative effects that combine over time to form collective challenges of a more chronic and subtle nature. The climate has changed more in the last 200 years than at any time since the end of the last ice age<sup>14</sup>. We are continuously having to adapt our approach to protecting and enhancing lives, livelihoods and liveability to a rapidly changing climate and everything affected by it. The broader social, economic and environmental impacts of rapidly changing, interconnected systems is



impossible to fully predict in advance<sup>10,15</sup>, presenting a serious challenge to government and other actors responsible for steering sustainable development. This is presumably why Adger et al define adaptive capacity in terms of systems and a related concept, resilience.

But a further aspect of the challenge is the gap between the significance of the threat, and action. The second part of Adger's definition highlights the role of components of the system of human society in facilitating resilience – including but not limited to behaviour, technology and regulation. This is the focus of the primary contribution of this paper. As per our previous definition, what government (and other actors involved in governance) can do to intentionally steer systems change for the public good in systems incorporating human behaviour and decision-making is at the core of our analysis.

To develop this focus, section two introduces a range of methods, namely a system or 'cause and effect' mapping exercise, a literature review, and interviews with experts and practitioners. The results of each are presented in section 3 in turn. Section 4 integrates the results in a discussion of the three research aims, providing recommendations.

# AIMS AND METHODS

## RESEARCH AIMS

This paper has three main aims, which are to articulate:

1. What is the case for applying a behavioural public policy approach to building adaptive capacity in response to slow and cumulative stressors from climate change?
2. What important examples and perspectives already exist across different disciplines, sectors and stakeholders?

The resulting 'state of knowledge' summary informs advice on:

3. What are the risks, opportunities and priorities for engagement in developing bottom up behavioural public policy experiments to address climate adaptation?

Each of the methods below has relevant sub-questions motivating the method, and its contribution to the overall research aims.

## CAUSE AND EFFECT MAPPING

### Research question:

*What challenges are the slower and cumulative climate change stressors likely to cause in Australia?*

### Method

Staff from national and state government agencies participated in a system mapping exercise to help inform the focus of this discussion paper. The focus of the exercise was to elicit a long list or brainstorm combinations of climate stressors, associated harms, and the populations and places affected. This was translated into a system map by the research team, and subsequently iteratively developed with the research partners in producing this paper, and will be further developed in subsequent activities.

The diagrams are constructed from:

1. words and phrases that represent the key elements or variables of a system,
2. arrows that represent processes or mechanisms whereby one element affects another.

As well as producing a systems map, this exercise informed the identification of search terms for the literature review component, and informed interview question design.

## LITERATURE REVIEW APPROACH

### Aims

The review component explored the following review question and sub questions.

*How are governments helping potentially vulnerable populations make adaptive behaviour changes now to avoid harm from longer term, chronic impacts of climate change in the future?*

- *How and to what extent do governments, and governing actors, currently focus on behaviour change in adaptive capacity building?*
- *What stressors, populations, behaviours and outcomes are addressed, and where are there gaps?*

- *What barriers must be overcome to promote adaptive behaviour and decision making that contributes to long term adaptive capacity?*

### Method

We draw on three review methods in this work. Firstly, to articulate the scope and focus of the review, we generated the above review questions using problematisation considerations and methods<sup>16,17</sup>. Secondly, to operationalise these broader questions into search terms and to quickly identify relevant papers to our questions, we used scoping review methods<sup>18</sup> and rapid systematic review methods<sup>19-21</sup>. Finally, to explore and analyse the resulting set of focal papers, we applied critical interpretive synthesis techniques<sup>22,23</sup>.

Further details of the method and the review protocol can be seen in appendices.

## INTERVIEWS

### AIM

We conducted a stakeholder interview project to identify examples, perspectives, common barriers and understand the practice and policy context<sup>24</sup>.

Interviews cover four main topics:

1. *What is the case for applying a behavioural public policy approach to building adaptive capacity?*
2. *What important examples and perspectives already exist across different disciplines, sectors and stakeholders?*
3. *What does this suggest about the risks, opportunities and priorities for engagement in developing bottom up behavioural public policy experiments on this mission?*
4. *What interest in further collaboration exists amongst interviewees?*

### Method

See appendices.(p. ).

# RESULTS

## CAUSE AND EFFECT MAP

Generating a long list of 50 combinations of climate stressors, potential harms and vulnerabilities, and populations (Figure 2), our participants provided us with the entities to populate the cause and effect map (Figure 3, p. ). Iterative dialogue, including the drafting of this paper, further develops the map. Later stages of the project, if continued, will develop it further, particularly as decisions about where to focus next steps are made. The full list of stressors, harms, populations and interventions brainstormed can be seen on p..

### Stressors and populations of particular concern

Some of the populations thought to be most exposed include the elderly, low-income households (including renters and underinsured), those with pre-existing health conditions and children. The majority of other populations are place or industry determined. Stressors of high concern include bushfires, heatwaves, droughts, air quality, overall changed landscape ecological regimes (e.g. combined changes in water availability, temperature, biodiversity, soil health etc), and a range of exposures to hazards Figure 2. Note the below figure highlights only frequently listed and linked items from the brainstorm.

#### Slow and chronic climate stressors

#### Affected populations

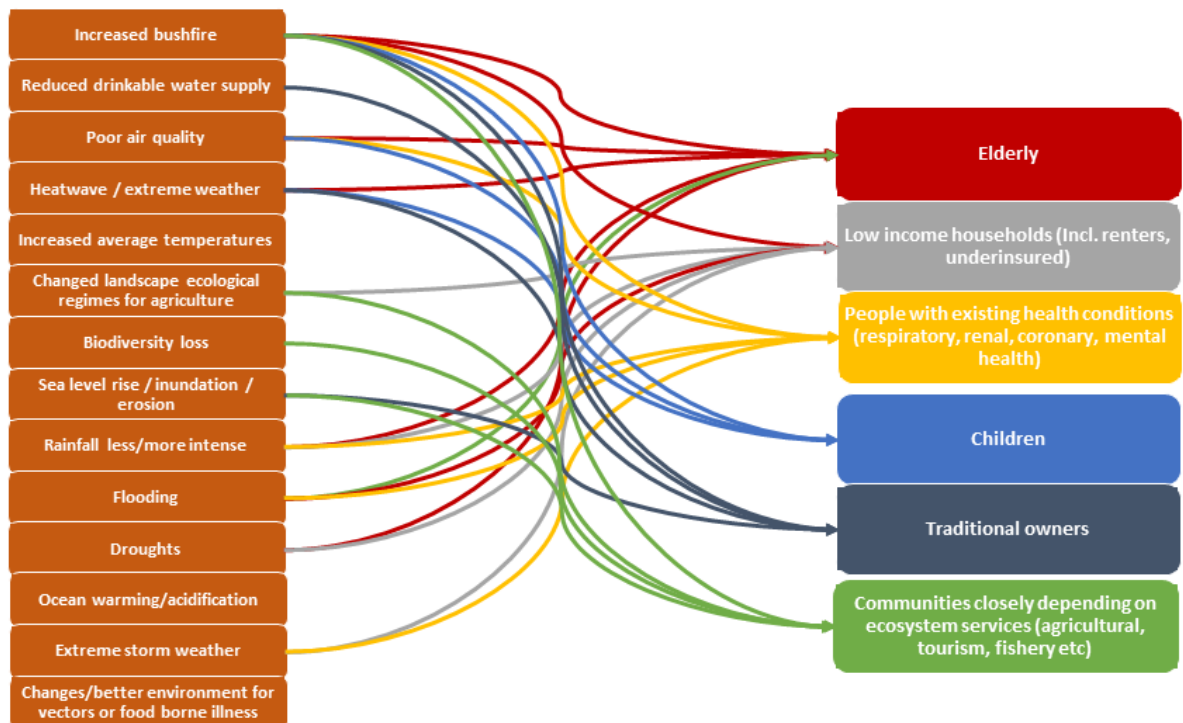


Figure 2: Climate stressors links to key populations from workshop with BWA Consortium partners.

## Systemic relationships

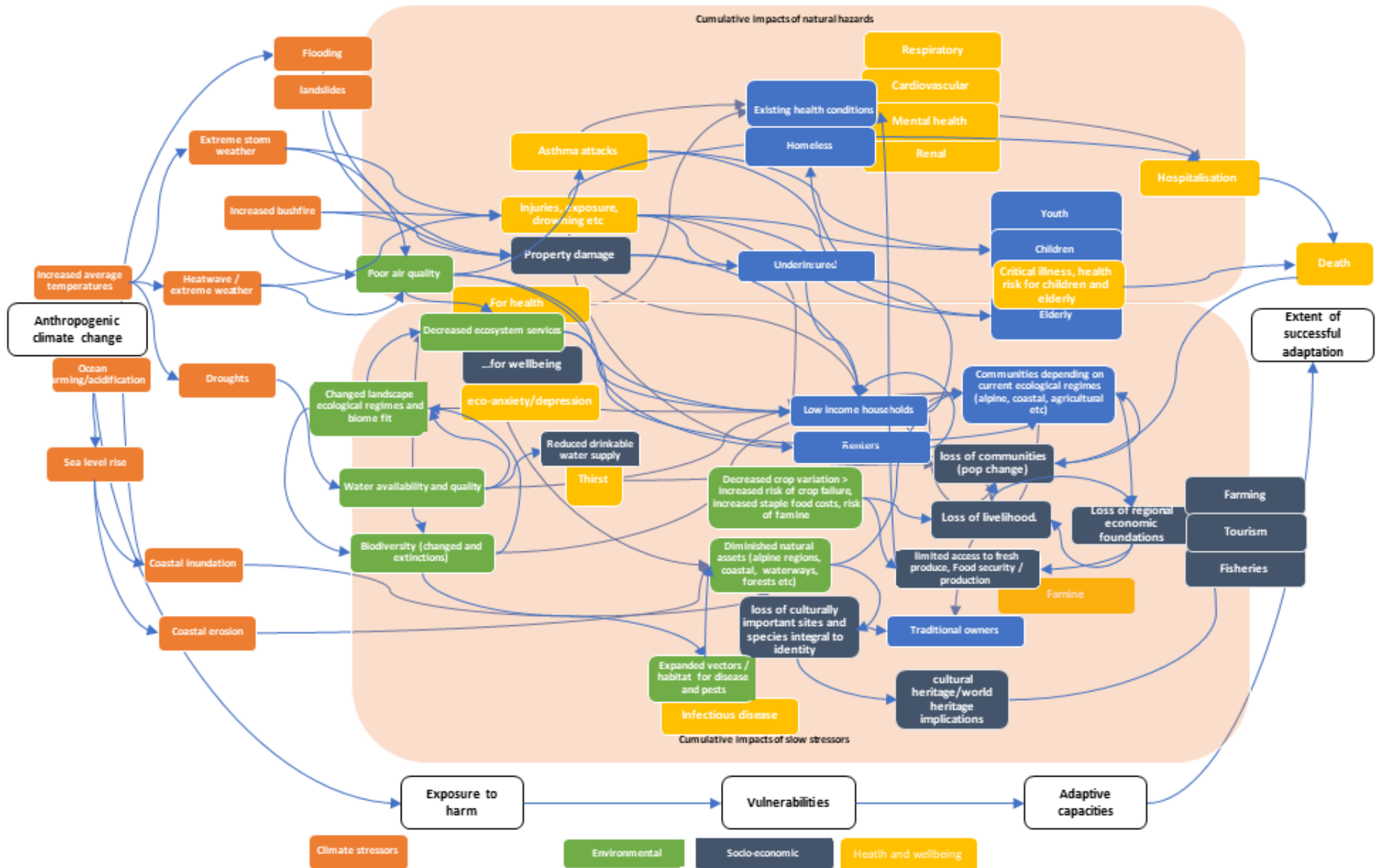
Cause-effect diagrams (also known as 'influence' or 'causal logic' diagrams) are a specific type of systems diagram designed to capture people's perceptions of the cause and effect of different elements within the system. This tool is not generally recognised as a 'full' systems analysis approach, but is a useful entry point. That is, it is a simplified, intermediate step towards systems thinking – it maintains some left-to-right linearity that helps people think through connections in a layout more familiar, using a straightforward causal logic in which most of us are familiar from an early age, which also aligns well with policy investment logics.<sup>10,25–27</sup>

This noted, analysis of the inputs (Figure 2) and map (Figure 3) suggests the following observations.

- Overall, it is clear that intervening into any of the elements or relationships indicated in the map in isolation is likely to neglect important influences and complicating factors. At the same time, holistic perspectives that cannot identify simple but profound systemic relationships to focus on will also fail<sup>25,28</sup>.
- Climate stressors group relatively intuitively in to combined and cumulative impacts of natural hazards on the one hand (top light orange grouping box), and cumulative impacts of slower stressors on the other (second light orange grouping box).
- The vulnerability of certain populations, can be seen in the convergence of stressors and harms flowing from reduced ecosystem services, affecting particularly elderly, low income households, homeless, children and people with pre-existing health conditions.
- The bottom right corner of the chart suggests that, there is potentially a vicious cycle of changes in community structure, economic activity and viability, leading towards overall reduced adaptive capacity.
- The flow on effects of cumulative stressors (across the bottom of the map) may further undermine socio-economic capacities that might otherwise help mitigate those changes.

We found that classic formulation of resilience and adaptive capacity lends itself well to the cause and effect logic of the method, and it was been applied in similar projects<sup>10,25</sup> . i.e. Harm from climate change is not determined by changes in climate alone. Rather, exposure to a climate hazard, combined with a level of sensitivity or vulnerability, and a lack of adaptive capacity, mediates the extent to which harm results from climate changes and variability<sup>2,29</sup>.

C&E mapping also speaks to the kind of intervention logic or theory of change often used to explain the rationale for investing effort into a policy or program to tackle a problem in government and other public organisations <sup>26</sup> – the map could be further used to articulate the case and monitoring and evaluation framework for focus initiatives in later stages of this project.



## WHAT DID WE LEARN FROM INTERVIEWEES?

This section provides a brief overview of key themes that emerged in the interviews with practitioners, experts and researchers (Table 1), structured by research questions.

Table 1: Interviewees by organisation, role and perspective.

Organisation type	Role	Perspective
Government	In-house social researcher	Audience research
Government	Policy Lead	Whole of state adaptation
Research	Academic	Agriculture, Tourism
SME/NGO	Advocacy	Peak body for concerned medical practitioners
Government	In-house technical expert	Health sector
SME/NGO	Advocacy	Community Sector
Research	Academic	Financial climate risk

### The case for applying a behavioural public policy approach, according to our interviewees

All interviewees see a clear and urgent need for action on longer-term, slow and more cumulative stressors from climate change. It is evident that action is required across all segments of society – specifically mentioned actors were government (all levels), the private sector (especially the building sector & high-level decision makers), as well as individuals and communities (though these were less emphasized)

*“In Australia, (...) you get a particularly dark view of things. (...) [W]e're falling into a couple of traps. One is a complacency trap, and that is simply a factor of how time works in a sense that climate change would forever be in the future. That's a non-negotiable fact (...). But because every day we wake up, we say 'the future contains climate change', we just never break out of our temporal kind of movement to actually start doing it today. (...) And then I guess the things that adaptation is particularly needed for, the chronic, the long term, and sometimes the slow and imperceptible (...) the physical character of those changes is quite subtle, which means that we never get the trigger, we're never going to hear the whistle blow. Unless we actually create the sense of urgency for ourselves.” (Interview 6)*

### Housing development as focus area requiring change

Housing development emerged as a major theme and was the most prominently discussed area requiring behavioural and policy changes for climate adaptation to longer-term risk. Interviewees expressed concern about what they are currently observing and the risks this poses as is well-reflected in the quote by one interviewee:

*“I think the fact that new houses are being built in the spaces they're being built (...) and being built to the design that's not going to really be great for climate change. (...) You see that at both ends of the spectrum in Metro areas. You see suburban development that's encroaching on areas that just aren't safe when you look at flood maps and projections. But then you're also seeing urban areas like where I live, where the greening isn't enough to combat the heat Island effect. So we're seeing these dense areas of inner cities, particularly Melbourne, which has the lowest percentage of tree cover, where (...) I don't see any mass planting going on, which we need because we're gonna need those trees 10 and 20 years*

*from now to cool our streets. [I]t's really worrying. (...) And then we're seeing these large inefficient homes going up on cheap land and the land is compromised because (...)there's multiple different climatic effects that will affect the integrity of that land. And also place a lot of pressure on the public system in terms of emergency services. (...) [S]o it's just not asustainable model of development, unfortunately." (Interview 2)*

Specific areas mentioned by interviewees comprised

- The lack of tree/green cover in urban areas to mitigate urban heat island effects,
- Needed changes to housing developments in high-risk areas – including regulation, building codes or standards, and individuals purchasing/building in these high-risk areas (i.e. floodplains; less commonly they mentioned coastal erosion and bushfire prone areas).
- Houses maladapted to the climate and risk of overheating, which is particularly affecting disadvantages communities with no access to air conditioning, or to affordable renewable (especially solar) energy to cool down temperatures.

### *Private sector*

Multiple interviewees commented on changes required by actors in the private sector. While across interviewees, the role of the private sector was less often discussed, one interviewee, in particular, emphasised that the private sector plays an essential role and argued that it will be of primary importance for building adaptive capacity:

*"(...) Australia's ability to be a resilient society and a resilient economy into the future over the next 10, 20, 30, 50 years, let alone by the turn of the century, will be in so many ways dependent, on not what the government does, as the banker of last resort, to build resiliency (...), it will be really driven by the private sector ultimately." (Interview 1)*

The interviewee commented that many companies are very proactive and looking to engage in action to mitigate both near-term and long-term, as well as physical and transition, risks (Interview 1). Further, that several sectors have gone beyond their immediate climate risk to focussing on the adaptive capacity of customers *"and build resiliency to individuals, communities, infrastructure, and so forth."* (Interview 1). However, the interviewee also pointed to the important role of policy and legislation in accelerating change among the private sector, for example, through mandating or encouraging the Task Force for Financial Disclosure's framework for disclosure of climate-related financial risks. This might suggest a limited role for government delivering behavioural public policy approaches targeting businesses that are lagging and showing poor prudential governance in this respect. It also underlines the points made by Massetti et al (2018), that if industry is largely well incentivised to adapt, there is a case for focusing government efforts on market reform in climate exposed sectors, and in building resilience in threatened public goods and their consequences, especially ecosystem services, and human activity dependent on them<sup>12</sup>.

Multiple interviewees comment that behavioural changes are particularly required at a high-level by key decision-makers who are able to influence structures of the systems, in contrast to the those on lower levels in companies. This includes both political decision-makers as well as corporate boards or management, as the comment of one interviewee reflects:

*"behavioural changes (...) need to take place at the level of boards, so corporate boards... They have a huge responsibility for setting the agenda" (Interview 1)*

Another interviewee commented similarly, and also highlighted that there have been great examples of decision-makers prioritizing building adaptive capacity:

*"[U]ltimately to me, the people whose behaviour we need to change are the people who are in the system, that are in the structures, that are the ones that have the CEO in their job title etc. And part of that is saying that it's not just about the sustainability officer, who's six layers down and presents an annual report every year (...). Unless you actually change the stuff that's going on in boardrooms, in parliament, in the big decision-making centres. If we're not changing their behaviour, then we're stuffed." (Interview 6)*



### *Individuals and the community*

Behaviour changes by individuals or at a household level emerged as the least prominent group mentioned in the interviews. The behaviours that were mentioned include the need for self-protective action against the impacts from extreme heat and exposure to bushfire smoke, stemming from a lack of awareness of the health impacts of climate change and available protective measures. Overall, interviewee' comments reflect though, that they see potential for the building of adaptive capacity by engaging individuals, but that this should be with a view to the implications for building adaptive capacity in the systems around individuals also, as this quote illustrates:

*"I think there's lots of opportunities to do that at the local level through things like local food gardens and so on to enhance food security, but waste reduction programmes and other sustainability programmes, programmes around achieving energy, a set cost savings from energy, improving thermal comfort and safety, I think that can happen at the local level, but resonate upwards to drive the market and motivation for change.*

Two communities were specifically mentioned:

- Agricultural communities in particular as those whose behaviours have a comparatively high potential for impact, and who are also more exposed to climate impacts.
- The health care community, which one interviewee argues has high awareness and motivation to act on climate adaptation but is currently lacking implementation of required action.

### *Government*

All interviewees considered government action, at all levels of governments, of great - usually primary - importance for building adaptive capacity and saw potential for governments to play a stronger role in this regard. Some interviewees commented that research shows strong public support for stronger government action and expects government action of on this. One interviewee comment on the role of leadership for motivating required responses on all levels of society.

*"There's some leadership from some state and territory governments, but it's fragmented and it's insufficient. And I think local governments are doing what they can as well. But again, with inadequate resources, there's a limit to what they can do. (...) So we need that leadership at the federal government level and recognition and acknowledgement that it's a problem. So that sets the direction for the whole country to understand that this is a problem that's happening right now, and that it needs to be tackled right now." (Interview 5)*

Several key roles that government can play emerged in the interviews:

### *Supportive policy and regulatory environment*

Government's role facilitating proactive action to adapt to longer-term, more chronic aspects of climate change, including those that may be potentially more challenging was the most prominent subtheme, mentioned by multiple interviewees. For example:

*"I think that the government does have a huge role to play and I think in fact, it has the primary role to play as setting the policies, which set the structure for how people behave and act. I think the government is the most important actor in climate change adaptation, but I think what perhaps is lacking in government is the ability to talk about it, frankly, with businesses and communities. To get people on board, to then be able to start doing policy that's a little bit more difficult." (Interview 3)*

Several more specific areas that require action, and potential behavioural public policy focus areas, were mentioned here:

- Regulating housing development (red zones)
- Mandating or strongly encouraging the disclosure of climate-related financial risk (using the TCFD framework<sup>28</sup>)
- Taxation policy – both taxes and rebates as (dis)incentives
- The role of policy as market signals – setting expectations particularly for industries which operate in great uncertainty and close to margins.

### *Communicating the scale and urgency of the problem*

Another key subtheme mentioned by multiple interviewees is the need for government actors to provide information around the risk of climate change and need for (immediate) climate adaptation. As the quote above illustrated this includes awareness raising and open communication of climate risk with different sectors of society. Beyond awareness raising and risk communication, interviewees specifically mentioned a key role for government to provide robust, credible and actionable information for different sectors as well as for affected communities (such as in the Pacific) to guide decision-making. One interviewee recounted that their organisations' consultations with community and industry about what they needed to see in terms of a response showed : “(...) a lack of effective communication of risks, the availability of sector- specific information, and awareness of the problem and capacity to respond.” (Interview 5).

Another interviewee commented:

*“[W]e recognise this as a pressing need prompted by tangible market failure and the ability for the private sector to access this information from trusted sources with robust science to give them the best opportunity to make sound decisions about climate action.” (Interview 1)*

Other behaviours mentioned were the need for governments to support vulnerable communities proactively rather than focussing on crisis response (e.g. through resources for local community organisations), as well as providing research funding.

At least one interviewee felt Australia's research contribution to adaptive capacity had significantly declined in recent years:

*““We had the climate change adaptation research centre. We had the national climate change adaptation research facility. These were world leading groups. We all came together and they just dismantled the whole thing. Sorry, we've gone from number one to 300 [in rankings]. So, there is that.”*

### **Key perspectives across different disciplines, sectors and stakeholders, according to interviewees.**

#### *Not just behaviour, nor individuals*

Behaviour change interventions were generally seen an important element of building adaptive by all interviewees, as is illustrated by one interviewees response to whether s/he believes it can be part of the solution:

*“Definitely. I think that they need to be targeted and they need to be accompanied by providing education and an increased awareness. So, I think that there's a lot of appetite for people to take action, but they need information and direction about what those actions are.” (Interview 5)*

However, all interviewees strongly emphasized the linkage between behaviour changes required at the individual level and structural, broader systemic factors shaping decision-making and behaviour. Multiple interviewees commented on the importance of changes “on a higher level” or “systems change” – including the policy, regulatory as well as the built environment and infrastructure which can facilitate (or impede) required individual behaviour change. For example:

*“Sometimes it's quite difficult for me to tease the two apart about what's kind of a behavioural intervention, or how behavioural intervention might work versus policy. (...) when I think about a programme, for example, about where people build their houses. We'd like people not to build houses in, for example, flood prone or bushfire prone areas. But how do you design a behaviour intervention policy that works without having existing laws and policies around where you should and shouldn't... Is it just easier to have a policy about where you should and shouldn't build? Or is there a problem if the government is focusing on how to get people to make better decisions without providing general guidance or laws about where you should and shouldn't build?” (Interview 3)*

Several key points emerged in interviewees’ reflections. Some interviewees hold that policy and legislative changes can be particularly effective in cases where a systems bias favours unsustainable behaviour, and that they can normalize desirable behaviours. Others argue for stronger regulation and legislation as an effective approach where individualized approaches are slow and ineffective, mentioning the recent example of face masks as Covid-19 pandemic response as successful example of rapid, high-percentage behaviour change. One interviewee commented: *“We need to be way less timid about regulation. There's no better way (Interview 2)*. Interviewees also mentioned the need for investment in the built environment and infrastructure which can change behavioural defaults, and taxation (and rebates) as effective (dis)incentives. One interviewee cautioned that behaviour change that imposes a cost may be limited among disadvantaged communities, for whom costs are a substantial barrier to implementing change.

Lastly, one interviewee expresses concern that individual approaches alone will not be sufficient for changes to occur as rapid as needed:

*“I don't think it can happen fast enough by just focusing on that individual behavioural level. It has to be harnessed- their attitudes and their support for bigger systems changes and do things like taxation or at the state level housing policy.” (Interview 2)*

Overall, these highlight various ways in which a behavioural public policy approach can complement interventions targeted at individual behaviour change by addressing factors that can significantly hinder behaviour change.

### **Risks, opportunities and priorities for engagement, according to interviewees.**

Interviewees emphasize that *who* needs to be involved in future public policy experiments intended to co-design solutions is highly issue-dependent.

At the same time, interviewees highlight the importance of interdisciplinary and cross-sectorial approaches, including a diverse set of voices, as the quote from one interviewee illustrates:

*“A really wide cross section of stakeholders. I think one of the challenges that we have at the moment is that things are happening in silos. And then when (...) they're rolled out more broadly, that's when unintended consequences or barriers are identified.” (Interview 5)*

Important stakeholders identified by interviewees were:

- The community sector including those *“that represent those voices that are less well heard” (Interview 5)*; examples mentioned were Neighbourhood Houses, Primary Care Partnerships, organizations that focus on CALD communities,
- Specific communities that are particularly exposed (e.g. agricultural communities),
- Governments (including local government),
- Businesses,

- A range of experts incl. researchers,
- Opinion leaders,
- Peak industry bodies (e.g. Financial Sector),
- Traditional Owners,
- The media

## WHAT DID WE LEARN FROM THE PUBLISHED LITERATURE?

### Overview of reviews by topic focus

This section provides a brief summary of the included papers, emphasizing the most relevant papers to the review questions. Included reviews on the role of behaviour change approaches in adaptation grouped in three main focal areas.

1. Behaviour and social change across multiple scales (5 reviews): two from a strongly psychological perspective, and three from a more interdisciplinary standpoint.
2. Adaptive capacity behaviour change in relation to specific climate stressors (10 reviews): three addressed heatwaves, four water scarcity, one extreme weather, one bushfires and one flood risks.
3. Interventions promoting adaptive capacity behaviours (5 reviews), including one on education, another on decision making processes, one on risk communication techniques (for extreme weather), communication for climate stress/mental health, and the last explored the contribution of mindfulness-based interventions.

Note that allocation to the three groups reflects the main focus of the papers by our interpretation, and many of them have insights relevant to their non-primary group, as well as wider topics, as is indicated in the extraction table. Table 2, below, provides an overview of the reviews retrieved.

Table 2: List of studies and simplified extraction details.

Author s/ year	Research question/Aim	Focus	Stu die s	Populations targeted	Outcomes targeted	Setting of intervention s	Scale of intervention
{Becht oldt, 2021 #82}	To integrate psychological concepts related to adaptation and integrate it into a broader context for a non-psychological audience to provide orientation and guidance for decision-makers	Individual and psycho-social drivers of behaviour	3	NS	Climate adaptation	NS	NS
{van Valken goed, 2019 #16}	To conduct a series of meta-analyses using data from 106 studies (90 papers) conducted in 23 different countries to examine how 13 motivational factors relate to various adaptation behaviours	Individual and psycho-social drivers of behaviour	90	Individuals and households	Climate change adaptation behaviour	NS	NS
{Wilson, 2020 #29}	To review of scholarship on individual behavioural adaptation to climate change	Individual and psycho-social drivers of behaviour	NA (75 papers)	Individuals	Adaptive responses to climate-exacerbated hazards	NS	From municipal to societal.
{Cologna, 2020 #32}	To examine the role of trust in institutions, scientists, industry, environmental groups and people in general, in relation to different climate-friendly behaviours	Individual and psycho-social drivers of behaviour	46	Individuals	Climate adaptation	NS	NS
{Mah, 2020 #40}	To identify three guiding insights for strategies to promote adaptive coping and resilience to climate change stress	Intervention: adaptive coping	NA	NS	Adaptive coping	NS	NS
{Wamsler, 2018 #7}	To assess current research on 'mindful climate adaptation', and explores how individual mindfulness is linked to climate adaptation	Intervention: Mindfulness	NA	Individuals	Mindfulness-based approaches to climate adaptation	NS	NS
{Mayrhuber, 2018 #21}	To assess how vulnerable groups are identified and reached in heat health interventions, to understand the effectiveness and efficiency of those interventions, and to identify research gaps in existing literature	Intervention: public health risk communication (extreme weather)	23	Vulnerable groups (e.g., elderly and diabetics)	Heat health outcomes	Developed countries	Different levels (federal level, state government level, city level, local level)
{Ryan, 2020 #39}	To present a systematic literature review that reports on the effect of community communication and engagement techniques that have been used in a hazard preparedness context.	Interventions: Communication and engagement (hazard preparedness)	41	Communities	Disaster preparedness	NS	Community
{Orlove, 2020 #47}	To examine numerous areas of between research on climate decision-making and climate action, including climate communications; choice architecture, nudges, and other behavioural interventions; corporate social responsibility; and Indigenous decision-making.	Interventions: decision making processes	NA	All, indigenous people are specifically mentioned and considered	Climate change related decisions and behaviour	NS	NS
{Monroe, 2020 #48}	To understand what research can contribute to our ideas about effective climate change education	Interventions: Education	49	From young students through to adults	Climate change related knowledge,	Developed countries	Groups

<b>2019 #67}</b>					attitude and behaviour		
<b>{Hintz, 2018 #6}</b>	To gain a better overview of solutions to heatwaves and their transferability	Stressor: (heatwave)	41	Urban populations	Heat stress resilience	AU, EU, US & CA	Cities
<b>{Hamilton, 2018 #23}</b>	To review scholarship on biophysical, psychological, and social factors that shape behavioural adaptation to climate change in wildfire-prone forests	Stressor: Bushfires	NA	Rural populations	Adaptation to wild-fires	NS	NS
<b>{Macintyre, 2019 #17}</b>	To review the evaluation of risk communication for extreme weather and climate change to inform local public health messaging	Stressor: Extreme Weather	43	NS	Risk communication related to extreme weather and climate change	US (14), EU (6), CA (5)	NS
<b>{Andráško, 2021 #49}</b>	To synthesize recent state of knowledge on flood risk perception and related human behaviours	Stressor: Floods	82	NS	Who takes responsibility and takes precautions for floods	NS	NS
<b>{Hatvani-Kovacs, 2018 #20}</b>	To review the research on heat stress adaptation measures, before presenting recommendations for a range of integrated policy measures to increase the heat stress resilience of urban populations in Australian cities	Stressor: heatwaves	NA	Urban populations	Heat stress resilience	Australia	Cities
<b>{Koop, 2019 #66}</b>	To review the empirically oriented literature in this field and aims to provide an up-to-date assessment that identifies eight different Behavioural Influencing Tactics (BITs) that target long-term water conservation behaviour within households.	Stressor: Water scarcity	52	NS	Domestic water conservation	NS	NS
<b>{Moglia, 2018 #22}</b>	To take stock of the current understanding of water conservation, in particular: what influences people's decision to conserve water, what influences whether people persist with water conservation behaviour and what contributes to awareness and familiarity of water conservation behaviours	Stressor: Water scarcity	NS	NS	Water Conservation	Developed countries, mostly Australia	Regional
<b>{Echeverria, 2020 #77}</b>	To understand the social dimensions driving the adoption of water saving behaviours in urban households	Stressor: Water scarcity	65	Urban consumers	Better water management	Appears to be mostly developed countries	NS, but appears to be city and national level
<b>{Lede, 2019 #69}</b>	To consider the application of three social influence strategies to encourage water conservation: social norms; social identity; and socially comparative feedback	Stressor: Water scarcity	NA	NS	Domestic water conservation	NS, but examples are mostly Europe and US	NS

## Reviews by focus:

### *Behaviour and social change across multiple scales*

#### *Psychological perspectives*

Bechtold et al 2021<sup>31</sup> provide a meta-analysis of psychological perspectives exploring the ‘adaptation puzzle’ – why, despite a clear market failure and the clear societal benefit of early action on climate adaptation, the level of investment into interventions and activities by multiple actors is inadequate. They aim to go beyond meta-analytical weighting of psychological concepts related to adaptation and integrates these findings into a broader context for a non-psychological audience to provide orientation and guidance for decision-makers.

This results in a multi-level framework of psycho-social drivers and barriers from the micro (individual), meso (group and organizational) and Macro (Society and culture) levels (see below), with associated recommendations for addressing the barriers at each level. The authors propose that this provides a missing perspective on the ‘adaptation puzzle’ in literature primarily analysing adaptation from a broader socio-economic analysis i.e.: including financial-, informational-, institutional-, political/regulatory-, technological- or socio-cultural barriers.

They conclude that the strongest predictors of adopting adaptation behaviours are:

On the individual level:

- people’s beliefs whether adaptive actions will be effective in protecting them from climate-related hazards (outcome expectancy), and their own ability to cope
- the degree to which people believe that they are able to engage in adaptive actions (self-efficacy) and;
- their (constructively negative) emotional reaction to climate change (guilt, fear and anger)
- Belief in climate change as a reality

On a meso level:

- behavioural norms (what is expected by people I care about – injunctive norm; what do I believe everyone does – descriptive norm), and;

On the macro level

- cultural aspects (long term versus short term orientation; ‘feminine’ (group, nurturing, inclusive) values versus ‘masculine’ (individual, demanding, exclusive), collectivist over individualist/libertarian values).

They recommend that decision-makers create more transparency about the cause–effect chain between adaptation activity and desired adaptation effects to strengthen individuals’ sense of efficacy. Furthermore, inducing reflection on social norms through communication-based interventions may contribute to motivate adaptive actions by individuals and organisations. They also advise considering and managing possible conflict with dominant cultural values of the relevant community.

Van Valkengoed and Steg (2019)<sup>32</sup> explore motivations for individual adaptation behaviour change in response to hazards. They conduct a series of meta-analyses using data from 106 studies (90 papers) conducted in 23 different countries to examine how 13 motivational factors relate to six meta categories of adaptation behaviours (Preparedness, Evacuation, Insurance, Information seeking, Policy support, Mixed). They conclude that the motivations of Descriptive norms, negative affect,



perceived self-efficacy and outcome efficacy of adaptive actions were most strongly associated with adaptive behaviour to hazards. In contrast, knowledge and experience, which are often assumed to be key barriers to adaptation, were relatively weakly related to adaptation. They also identify that research has disproportionately focused on studying experience and risk perception, flooding and hurricanes, and preparedness behaviours, while other motivational factors, hazards and adaptive behaviours have been understudied (see Figure 5 on p. – appendices).

#### *Post-initial review additions from interviewees, colleagues and partners*

Carman and Zint (2020)<sup>33</sup> usefully build on Van Valkengoed and Steg (2019) to conduct a content analysis of 75 publications identified through a systematic literature review to learn how researchers from a range of disciplines conceptualize adaptive behaviour by individuals and households in the and what kinds of specific actions they describe. They propose a comprehensive definition of personal and household adaptation behaviour that considers its purpose (i.e., preventing harm or gaining benefits), timing (i.e., proactive or reactive), time scale (i.e., short-term or long-term), as well as who acts (i.e., the individual alone or with others) and who is affected by those actions (i.e., the individual, other people, or the environment). They classify three additional specific individual adaptation behaviours categories to Van Valkengoed and Steg, namely, coping (psychologically to climate stress), consumption (pro-environmental behaviour with shorter term adaptation and/or mitigation benefits) and lifestyle changes (longer term benefits). And, largely validate the existing categories, with the identification of civic engagement, household protection, learning, migration, and self-protection as the other five.

#### *Interdisciplinary perspectives*

Wilson et al (2020)<sup>34</sup> similarly review literature on behavioural adaptation in response to hazards. They focus on integrating the dominant empirical focus on individual affective and cognitive drivers for private benefits, with perspectives on social factors moderating behaviour, and the potential for broader incremental, and transformational, social systems change with collective benefits. They review a range of individual level drivers and barriers (addressed in above studies also), but conclude that explicit measures of social factors (such as norms, cohesion, capital) are insufficiently studied, in particular when it comes to determining how social factors moderate or mediate the effects of intrapersonal factors or identifying potential feedbacks between intra- and interpersonal factors. They recommend that cultural evolutionary and complex adaptive systems perspectives might help integrate them.

They usefully distinguish between behaviours that might be individually rational or adaptive, versus collectively harmful or maladaptive, aligning with Carman and Zint above for example. Greater integration of these dimensions is thought to separate out behaviours that are more incremental, versus those with significant transformative potential – substantially changing adaptive capacity at scale. They suggest that understanding of transformative adaptation pathways would benefit from research that integrates both intrapersonal and interpersonal factors and recognizes the feedbacks between the two, while better understanding the behaviours that provide collective benefits, and those that are adaptive at multiple scales. They present a useful typology of more incremental through to more transformative behaviour changes (see Figure 7, p. ).

Also bridging individual and broader scales, Cologna and Siegrist (2020)<sup>35</sup> focus on the role of trust in institutions for influencing individual behaviour change for both climate mitigation and adaptation outcomes. They categorise beliefs in the trustworthiness of institutions in terms of general trust in others, non-specific trust in institutions, and then specific beliefs about government and authorities, and scientists, industry and environmental groups. They similarly distinguish between ‘private’ and ‘public’ behaviours. Trust in institutions seems to be important for the uptake of behaviours related to the public domain, such as the support for climate-related policies and taxes or infrastructure investment but less important for the uptake of private behaviours, such as individuals’ reductions of their carbon footprint, support for direct lifestyle taxes, or purchase of insurance. Interestingly, also trust in scientists seems to play a larger role for the uptake of public behaviours than private ones.

## Climate stressor-specific adaptive capacity building

### *Heatwaves*

Hintz (2018)<sup>36</sup> reviews adaptive solutions to heatwaves, with a focus on providing an overview of solution ‘types’ and their transferability across contexts. This results in a useful set of three general approaches being differentiated amongst 59 examples reviewed; ‘green and blue infrastructure’ (22 cases or 37%), ‘grey infra-structure’ (19 cases or 32%), and ‘behaviour of inhabitants’ (18 or 31%). The approach ‘green and blue infrastructure’ indicates that the recommended solution primarily focused on ecological structures that provide benefits for mitigating the impacts of urban heat waves, such as rivers, parks, gardens or wetlands. ‘Grey infrastructure’, includes recommended solutions that primarily focused on built infrastructure that is human engineered technology for instance structures made out of concrete that mitigate the impacts urban heat waves. ‘Behaviour of inhabitants’ captures suggestions, which primarily focused on behavioural changes or capacity building of inhabitants. The latter are new or modified habits for mitigating or adapting to the impacts of urban heat waves, such as changing habits in cooling patterns or spending more time in a park.

All recommended solutions were analysed with regard to measures of risk-reduction following a four-element categorisation: Prevention, Preparedness, Response and Recovery. The results show that measures to reduce risk of urban heat waves focus primarily on Preparedness, compared to Response as well as Recovery while Prevention is considered the least. All three general approaches reflect this distribution, but behaviour the most so (versus green or grey infrastructure). Increased usage of preventative measures may decrease the need for vulnerability reduction as well as preparedness to response and recovery, but the relatively lower valuing of prevention versus effective emergency response by politicians is seen as a barrier. Transdisciplinary integration is recommended.

Hatvani-Kovacs et al (2018)<sup>37</sup> also review heat stress adaptation measures research, but with a focus on integrated policy measures to increase the heat stress resilience of urban populations in Australian cities. Policy recommendations are categorised into the following four main classes; information dissemination and engagement, incentives and disincentives, government provision and demonstrations and regulations, and cut across the policy domains of public health, building, planning and infrastructure. Many of these are framed as ‘top down’ traditional policy tools rather than behavioural in focus but relate to public health and involve providing information and education, for example.

Maryhuber (2018)<sup>38</sup> assess how vulnerable groups are identified and reached in heat health interventions, to understand the effectiveness and efficiency of those interventions, and to identify research gaps in existing literature. Two main intervention types are identified. 1) interventions to detect and 2) interventions to influence risk and protective factors. The former includes: monitoring systems, exposure modelling, mapping of vulnerable people and local inter-organizational capacity as well as outreach programs; the latter include: heat exposure reduction measures which also entails awareness raising and educating patients as well as health care providers about protective heat behaviour. Behavioural change advice is given high priority in public health interventions. However, studies provide merely descriptions on heat advice (“stay hydrated”, “avoid heat”, “check on vulnerable people in your social network”) but the mechanisms of how exactly behaviour can be changed and what models could be used largely remain unexplained.<sup>38</sup> They report generally little evidence of effectiveness of interventions.

### *Water scarcity*

Kroop et al (2019)<sup>39</sup> provides a review of the empirically oriented literature on domestic water saving behaviour change for water suppliers, policy-makers and other practitioners, to better deal with drought-related challenges and provide them with means to achieve their sustainability ambitions. Acknowledging broader ‘top down’ policies such as economic incentives (e.g. water pricing), technical improvements (e.g. water-saving household appliances), or policy instruments and

regulation, they focus specifically on behaviour influencing as a way to enhance domestic water savings. They provide an assessment identifying eight different Behavioural Influencing Tactics (BITs) that target long-term water conservation behaviour within households. These are: Increasing self-efficacy; Social norms; Framing; Tailoring; Using emotional shortcuts; Priming; Nudging.

Similarly, Moglia 2018<sup>40</sup> reviews ‘demand side’ behaviour change options for water conservation, focusing on application in Australia. They note that further supply augmentation in Australian cities is likely to have a significant cost, as in most cases suitable natural water supply sources are already fully allocated, which means there would need to be further investment in desalination plants that are capital and energy intensive. For this reason, the use of water conservation programs to reduce demand should be fully used as a first line response to droughts. In addition to better modelling, they also advocate the use of new techniques employed in the behavioural sciences to “nudge” people towards better water use behaviour through strategic, targeted interventions<sup>40</sup>. Echeverria (2020) review literature to understand the social dimensions driving the adoption of water saving behaviours in urban households. Identification of social and behavioural drivers provide useful insights similar to those listed above, should this be a focus for future interventions. They note a gap in research on long-term challenges understanding of intention - behaviour -stable reduction gaps. Lede (2019) et al review the application of three social influence strategies to encourage water conservation: social norms; social identity; and socially comparative feedback.

#### *Extreme weather*

Macintyre et al 2019<sup>41</sup> provide a scoping literature review on the evaluation of risk communication for extreme weather and climate change (EWCC) to inform local public health messaging. Of 43 studies, 22 addressed climate change, 12 flooding, 5 hurricanes, and 2 extreme heat. Successful risk communication strategies grouped in three themes: targeting drivers of risk perception (and local action), understanding and responding to vulnerable populations needs, and using community-based strategies. The authors note that risk communication efforts during short-term extreme weather events appear to be more effective than efforts to communicate risk around climate change. This distinction could highlight an opportunity for public health to adapt strategies commonly used for extreme weather to climate change. A related practitioner workshop identified a number of needs for public health practitioners, including participatory modelling and vulnerability assessments, case studies, engaging with local networks, developing resources using appropriate language and concepts for vulnerable groups, and generating cross-sectional communities of practice. They present a conceptual framework to support EWCC risk communication, build adaptive capacity and coordinate recommended actions across short- and long-term timescales (See Figure 8, p. ).

#### *Bushfires*

Hamilton et al (2018)<sup>42</sup> reviews scholarship on biophysical, psychological, and social factors that shape behavioural adaptation to climate change in wildfire-prone forests. They focus on behavioural adaptations such as modification of structures such as homes or the reduction of flammable vegetation. They identify perceived risk, perceived response efficacy, perceived self-efficacy, personal responsibility, negative affect, social interaction as barriers. They conclude addressing gaps in our current understanding of behavioural adaptation to climate change in wildfire-prone forests will require more research on how individuals adjust their behaviour over time, as well as more rigorous measurement of variation in behaviour and hazard conditions. A better understanding of the process of behavioural adaptation can assist policy-makers in identifying conditions under which behaviours are adaptive from the perspective of the individuals implementing them, but are nevertheless maladaptive in terms of outcomes at the community or regional level.

#### *Flood risk (and responsibility shifting in risk management)*

Andráško et al (2021) review research on flood risk perception and related human behaviours. Notably for this paper, they are particularly interested in transfers of responsibility back and forth between agents (including its relegation to “somebody” or “something” else, top-down transfers often without corresponding transfers of power and resources), and particularly, misalignment between the

views of the public and the Governments and Authorities (G&A). They note a tension between public investment in structural measures and recovery on the one hand, with associated issues of it being financially unsustainable in low income countries; failing to provide full protection/ residual risk; false sense of security (the 'levee effect'), with more individual barriers like issues of costs and (un)affordability (including poverty/social justice/inequality concerns, unavailability of insurance), and confidence in recovery support having a 'charity hazard/crowding out effect'. These interact with a large number of barriers for factors at play, including risk perceptions, experiences with floods, emotions and relevant theories and concepts. Importantly, they also note conflicting evidence for all of the above<sup>2</sup>, and conclude that G&A necessarily must play a strong role in Flood Risk Management that considers these tensions.

## Methods for building adaptive capacity

### Education

Monroe et al (2019)<sup>44</sup> review research insights supporting effective climate change education. Two thematic strategies are identified as supporting increased program success, and are suggested to be generalisable to many environmental education programs on different topics. (1) The programs focused on making climate change information personally relevant and meaningful for learners. (2) The activities or educational interventions were designed to engage learners.

In terms of linking education to action, or behaviour change, the programs captured in this review found a number of ways to instil hopefulness and to motivate learners to take-action. Some programs matched the problem to a scale that learners could approach. Rather than exploring global change, they looked at community impacts and strategies that communities could use (4 programs). First-hand exposure to people who are currently experiencing climate change (1 program) and interaction with scientists who study climate change (3 programs) appears to help motivate students to learn more and empower them to take actions. For young learners, this often involves communicating information to other audiences (3 programs). In addition, several programs linked actions to climate change by conveying the connections that personal behaviours have to carbon emissions or adaptation efforts (6 programs).

They note a gap in translation between education practice, and disciplinary knowledge of climate change from both social and science disciplines (multidisciplinary, interdisciplinary, or transdisciplinary), and little evidence of embracing of the transformative potential of climate education as: 'the learning moment can be seized to think about what really and profoundly matters, to collectively envision a better future, and then to become practical visionaries in realizing that future'.

### Improving Climate Change Relevant Decision making

Orlove et al (2020)<sup>45</sup> discuss the emergence of the field of Climate Change Relevant Decision-making (CCRD) – adaptive and mitigative - as an area of research and practice by variety of actors, including individuals, but focusing on their interactions in groupings such as organizations, corporations, communities, Indigenous peoples, and state agencies. They conclude that CCR decision making processes would be overall improved by 1) expanding the temporal scale, and taking account of spill over<sup>3</sup> and, 2) through urgency, adding what can be called the temporal pressure as a partial antidote to organisational inertia and path dependency<sup>4</sup>; 3) by including formerly marginalized participants such as Indigenous peoples; and 4) by seeking not only improved action, but also broad transformation. In addition to these themes echoed in other reviews above, they also contribute a novel focus in this paper on research on Indigenous decision-making. Although there is an extensive

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<sup>2</sup> Note there is an extensive literature and public debate over the appropriate balance of public versus private risk responsibility and management. E.g. UK Better Regulation Commission report <sup>43</sup>.

<sup>3</sup> A phenomenon where adopting one behaviour leads to others being more likely to be adopted, which can have positive or negative implications for the relevant outcomes<sup>46,47</sup>.

<sup>4</sup> i.e. an organisational and institutional tendency to follow a path of least resistance determined by past decisions about socio-technical investments and structures, that can also lead to individual behavioural lock-in – limiting the range of feasible / easy behaviours.

literature on Indigenous knowledge in relation to climate change, as well as in relation to biodiversity and other environmental topics, there has been less work on Indigenous communities and peoples as decision-makers. The general issues of framing and of context apply to Indigenous climate decisions as they do to such decisions made by others. They propose three key features of Indigenous climate decision-making: the embeddedness of decisions in social and cultural contexts, orality (an emphasis on spoken face-to-face communication, often in Indigenous languages) and articulation of the power dynamics of interactions, whether equal or unequal, supportive or conflictive.

#### *Communication and engagement techniques for disaster preparedness*

Ryan et al (2020)<sup>48</sup> present a systematic literature review that reports on the effect of community communication and engagement techniques that have been used in a hazard preparedness context. They reviewed a range of different interventions: Workshops, Information campaigns/delivery, Drills/exercises, Community coalitions, Seminars (including community meetings), Community champions, Home visits, Gamification, Workshops, Seminars, Community coalitions, Home visits, School programs, Focus groups, Community champions, exercises, Storytelling. They note that the key finding of this literature review was that each of the community engagement technique types had some effect, some more than others. What was missing from the picture was an organised approach to measurement and evaluation of community engagement. They also found the language around preparedness to be interesting. The ultimate aim of all of these programs and interventions is to save lives and economic damage, yet all but two of the interventions that identified an aim discussed relatively incremental increased preparation activity, or even just increased community engagement; and not more transformative outcomes. I.e. When aims and/or objectives were set, they ranged from mostly weak to occasionally very powerful. This again picks up the incremental versus transformational change element discussed in other reviews.

Note that Macintyre et al 2019<sup>41</sup>, summarised above, on extreme weather, is also a review with a substantial focus on evaluating risk communication techniques.

#### *Communication for adaptive coping to climate stress*

Mah et al (2020)<sup>49</sup> review psychological research to identify three groupings of practical recommendations for strategies to promote adaptive coping and resilience to climate change stress. First, it is unlikely that one single “correct” or “best” way of communicating about adaptive coping with climate change exists, but there are established best practices communicators can follow. Second, in implementing these best practices, practitioners must attend to the impact of variability in the nature of different kinds of stress caused by climate change, as well as individual differences in how people chronically respond to stressors. Third, because individuals, communities, and ecosystems are interconnected, work on adaptive coping to climate change must address individual coping in the context of community and ecosystem resilience. Their focus on mental health and wellbeing is a useful addition amongst the included papers, and the implications extend to other outcomes of interest also.

#### *Mindfulness based strategies for individual and systemic climate adaptation*

Wamsler (2018)<sup>50</sup> review research exploring how individual mindfulness: “intentional, non-judgmental attentiveness to the present moment”<sup>50</sup> is linked to climate adaptation. They find evidence that it supports: 1. Private adaptation: for instance, by reducing vulnerability (e.g., psychological and physical well-being, and risk perception), improving post-disaster response, recovery, and growth (e.g., the ability to cope with stressful situations), and increasing motivation and action-taking for reducing risk (e.g., clarification of values, increased empathy and compassion, adaptive capacity, and environmental behaviours). 2. Public-private adaptation and governance: for instance, by improving climate change communication, climate policy support, and new social approaches, norms, and values that challenge the business-and-power-as-usual norm. Mindfulness can thus be seen as another pillar in institutional attempts to support transformation, which can complement other angles. 3. Adaptation policy integration and mainstreaming: for instance, by influencing organisational reliability (organisational learning and innovation), nurturing social capital (good

leadership and staff support), providing an ethical grounding, and a legitimate basis to negotiate adaptation objectives across cultures and inspire better practices (compassion for others, social activism, equity, and justice). 4. Adaptation science: for instance, by shaping new research questions, methodologies (deep listening, cross-hybrid learning, non-material causations) and, ultimately, knowledge production. This requires the incorporation of local knowledge, acknowledging and respecting humanity (including citizens, bureaucrats and even corrupt leaders), possibly leading to dialogue and positive change. They report some evidence of side effects, inappropriate use of the method, and appropriation for capitalist profit.

# DISCUSSION

We integrate insights from the systems mapping, review and interviews with reference to the three key research questions.

## The case for applying a behavioural public policy approach

A recurring theme across multiple reviews and interviews is a perceived gap between the scale and urgency of change needed in adaptation, and the level of adaptive capacity being achieved<sup>31,51</sup>. At face value, behavioural public policy has a lot to offer such topics – often being engaged when there are mismatches between what appears to be good for the individual in the short versus long term, between stated intentions and actual behaviour, or where there is conflict between individual and collective interests and goods<sup>52–55</sup>.

This noted, the reviews, for which our inclusion criteria prioritised papers mentioning behaviour change, did not generally focus on the need for government intervention specifically, and instead discussed the significance of a single climate stressor or all climate stressors and the need to intervene. Many did not specify different actors within the interventions they examined except by implication. Some ambivalence about the role of government in adaptation was evident where it was mentioned. Andráško (2020) discussed concerns that public ownership of risk, for example via infrastructure investment or the promise of emergency recovery and aid may actually displace private responsibility<sup>51</sup>. Others explored the notion that individual, private investment in risk controls (i.e. home insurance) might displace support for public action (building codes) and personal ownership of risk (ignoring vegetation clearing rules)<sup>33,34</sup>.

In contrast, all interviewees considered government action, at all levels, of great - usually primary - importance for building adaptive capacity and saw potential for governments to play a stronger role in this regard with some interviewees' commented that research shows strong public support for stronger government action and expects government action of on this. Interviewees noted many private sector companies are looking to engage in action to mitigate both near-term and long-term climate risks, both physical risk and transitional risk. This might suggest a limited role for government delivering behavioural public policy approaches targeting businesses that are lagging and showing poor prudential governance in this respect. It also underlines the points made by Massetti et al (2018), that if industry is largely well incentivised to adapt, there is a case for focusing government efforts on market reform in climate exposed sectors, and in building resilience in threatened public goods and their consequences, especially ecosystem services, and human activity dependent on them<sup>12</sup>. As is discussed further below, they also had some ambivalence about governments prioritising individual behaviour change within the broader mix of adaptive capacity (i.e. behaviour, regulation and technology<sup>2</sup>).

Of the reviews that did focus on the importance of government intervention Ryan et al (2020) make an economic argument for government to support preparedness, education and engagement<sup>48</sup>, while Hintz (2018) highlighted that governments are essential actors in reducing harm from urban heat waves<sup>36</sup>. Many address the role of employees of government and co-governors, for example, water authorities and utilities<sup>39,40,56</sup>, city administrators<sup>57</sup>, and public health risk communicators<sup>41</sup>. Overall across the reviews, there is little doubt that government and related actors have an important role to play, in building adaptive capacity but it is not a simple nor uncontested one.

The reviews did recommend a wide range of interventions involving behaviour change, many of which would, or could, be led by or involve government actors. Some mapped fairly directly to the approximately 200+ behaviours in 8 categories identified in some reviews<sup>32,33</sup> – e.g. property codes, evacuation orders or communication urging reducing physical activity. In terms of transformative adaptive capacity building, which could include an even wider range of behaviours and interventions

that may be only indirectly related to a specific climate impact, the scope is even wider. For example, interventions building social connections for mental health, social inclusion or economic development<sup>33,34</sup>; or interventions improving aspects of mobility, housing, food and consumption with a view to improving health, environment and social inclusion outcomes could all build adaptive capacity<sup>58,59</sup>.

Interviewees emphasised the need for government interventions in a number of areas that could include behavioural public policy dimensions, particularly housing, development and planning (i.e. green infrastructure/trees, development in climate risk exposed locations, building standards, and risk disclosure for buyers). Also highlighted were mandating financial disclosure of climate risk; taxes, rebates and perverse incentives; policy as a market signal, especially for highly exposed sectors. A strong call was made for more direct regulation where there was clear and proportionate case for preventing harm by banning, restricting or mandating specific actions or technologies, and there are many ways regulation can be optimised and supported from a behavioural science perspective<sup>54,55,60,61</sup>.

In terms of an evidence informed perspective on when a given intervention may be appropriate and effective, a synthesis view is difficult to establish. Reviews differed extensively in scope, specificity and comparability because the studies identified applied different theories to address different climate stressors. There is clearly sufficient research on some aspects that this could be established (i.e. preparedness for floods and extreme weather<sup>32</sup>), but some of the most important from a transformational perspective may be relatively under researched – i.e. for example those that are more socially mediated, and involving public rather than private benefits such as voluntary relocations<sup>33,34</sup>.

### **Important perspectives across different disciplines, sectors and stakeholders**

By our assessment, the primary disciplinary perspectives in the reviews were mostly environment / sustainability based, with a handful focused on social science or health. Not surprisingly given the search strategy, common research questions focused on behavioural adaptation, either in response to a specific stressor, or across all climate stressors/unspecified. A number of reviews identified a tendency for research to focus on individual, private adaptation to a limited number of hazards, and a number pointed to gaps in understanding and focus on social mediators, and the role of behaviours with collective, public implications, and transformative potential. There was also interesting variation on the temporality focus of research – i.e. prevention, preparation, during and after climate related incidents for example, and chronic versus acute risks. There are likely yet to be confirmed relationships between findings focusing on different points in time in relation to the impacts of climate stressors.

Generally speaking, less behaviourally orientated research attention appears to be paid to those areas with the most transformative potential to increase adaptive capacity – i.e. public and collective efforts. This may also reflect the disciplinary and empirical foci of research that considers the more ‘micro’ scale of behaviour and its drivers, versus those that focus more at the ‘meso’ and ‘macro’ scales of social and environmental phenomena. This appears to be an important gap, if individual behaviour changes and decision making is seen as a tractable point of entry to transforming the contribution to adaptive capacity by larger scale entities such as communities, organisations and institutions. As interviewees observed: *“we’re a little bit sceptical about individual behavioural approaches because we are more interested in what behavioural can tell us about... the big systemic change that’s needed.*

The behaviours examined in each study tended to be aligned with the reviews focus – such as outcomes, climate stressors or interventions. Reviews examining climate adaptation in general (5), and/or how to promote it (4) focused on the broad set of behaviours relating to this outcome. Reviews examining narrower outcomes (11), such as water conservation, examined behaviours contributing to this outcome (e.g., actions to conserve water). In general, reviews examined behaviour at a high level



of abstraction (e.g., what promotes what conservation behaviour) rather than at a narrower and more applied level (e.g., what is effective to promote shorter showers among teenagers).

Some interventions focused on behaviours believed to be driven by relatively universal and context-independent barriers such as biases, emotions and risk tolerance/aversion<sup>39,45,56</sup>. But, most nested any internal influences of behaviour in a wider range of context derived drivers and barriers. This logically leads to a range of more context and barrier sensitive, tailored interventions. Barriers differed extensively in scope, specificity and comparability because the studies identified applied different theories to address different climate stressors. The importance of several intrapersonal barriers was relatively strongly supported, namely, risk perception, perceived responsibility, norms (Injunctive and Descriptive), outcome expectations, self-efficacy, coping appraisal and threat appraisal. Many reviews relate behaviour change to broader context interventions also, for example Hintz usefully relates behaviour to infrastructure for heatwaves<sup>36</sup>, Andráško for floods<sup>51</sup>, and Hatvani-Kovacs to policies<sup>37</sup>, and Macyn tyre places behavioural risk response in an adaptive model of public health risk communication<sup>41</sup>.

Most reviews looked at general populations or didn't clearly state the population of focus. However, some reviews did focus on specific populations: urban populations (3), individuals (i.e., rather than groups or institutions ;3), students (1), communities (1), vulnerable groups (1), households (1) (see extraction table). Our interviewees specifically mentioned "agricultural communities" and the "health care community".

### Risks, opportunities and priorities for engagement in developing experiments

Overall, it is noteworthy that a number of the reviews noted a level of reticence in applying behaviour change approaches to climate adaptation, government lead or otherwise. These sentiments were echoed by some interviewees also (see p. ), and are also evidence in broader climate change and sustainability scholarship e.g. that focusing on behavioural adaptation primarily by the public and individuals (perhaps as opposed individuals in organisations/institutions) might variously:

- 'socialise costs and privatise benefits' e.g. 'individualise' responsibility for adaptation (or mitigation), and 'blame victims', distracting from internalising responsibility and costs created by actors benefiting from climate emissions, or simply with more power to act, <sup>62,63</sup>
- avoid responsibility for unintended side effects and disbenefits of otherwise public orientated policies and initiatives<sup>62,64,65</sup>.
- neglect the potential positive, and negative contributions, of aspects of context beyond the individual to adaptation (e.g. social, technological, policy/regulatory, economic, biophysical)<sup>2,31,34</sup>
- legitimate privately beneficial but harm displacing or collectively negative mal-adaptations, (e.g. flood levies creating downstream impacts, air conditioning contributing to local heat and emissions) or distract from 'win-win' adaptations that benefit multiple actors <sup>2,51,57</sup>
- oversimplify complex problems with multiple contributing factors, leading to problem misidentification and displacement in time, space or jurisdictions <sup>25,66,67</sup>.

These are legitimate concerns and many of them have been aired about behavioural public policy in general<sup>66,68,69</sup>. At the same time, it is hard to see how mitigation or adaptation can be achieved without changes in the decisions and behaviour of individuals in a wide range of contexts, and a range of important insights and promising leads are summarised above. We believe that rather than ruling out the contribution of behavioural approaches, they raise important considerations for successful responses to adaptation challenges, and indeed many are centrally important in public policy and administration more broadly. The definition of behavioural public policy we put forward at the beginning of this paper arguably has the potential to address the concerns listed above. I.e. by amplifying emerging approaches to behavioural public policy that focus on:

- 1) 'end user' experiences of policy and programs;

- 2) appreciate the ‘a-rationality’<sup>70</sup> or context dependent nature of human decisions and behaviour, and therefore
- 3) recognise a wide range of systemic influences<sup>71</sup> and thus the need for a diversity of intervention approaches addressing different elements of the system, and which
- 4) emphasise an experimental, participatory approach to developing possible solutions (see Kaufman et al 2019<sup>72</sup> and [forthcoming paper](#)).

This approach is consistent with the missions based approach to research and innovation motivating the program of work incorporating this paper<sup>1</sup>. Encouragingly, the material reviewed suggests that a behavioural public policy approach can navigate these challenges and accelerate building adaptive capacity, IF we proceed with such principles at the forefront.

## RECOMMENDATIONS FOR NEXT STEPS

### 1. First identify and prioritise Problems, Places and/or Peoples to state a clear, ambitious but achievable mission goal

The broad scope of the grand challenge of climate adaptation makes it necessary to focus in a well-defined mission goal. The system mapping exercise suggests the nature of some possible shared priorities – for example, it should be possible to identify a combination of people, problem and place that motivates a focused mission goal.

Problems, people and places are all what are sometimes called ‘boundary objects’ situations that connect potentially disparate perspectives and experiences of interconnected systems<sup>73–75</sup>. Both the initial system mapping exercise (p. ) and the review findings above highlight the multifaced nature of climate change, adaptive capacity, and within both, human behaviour and decision making. This suggests that behaviour change approaches will only ever be part of the solution, and in a highly context specific way in most cases. At the same time, examining behaviour in context and how to change it can identify and reveal the contribution of a wide range of contextual factors that can also be the focus of other types of intervention<sup>71,76,77</sup>. Having prioritised a given situation for attention in a missions-based approach can help identify where behaviour change elements can help and coordinate with other approaches.

### 2. Apply integrative behaviour change frameworks that connect behaviour to wider systems

Noting the importance of accounting for context, it is important that we use integrative approaches to behaviour change that support this. Wilson (2020) proposes a typology for classifying climate adaptation behaviour interventions as either i) incremental, but not transformative, ii) personally transformative and iii) socially transformative and provide a range of examples<sup>34</sup> (see Figure 7, p. ). Similarly, Carman and Zint’s (2021) comprehensive definition of personal and household adaptation behaviour considers its purpose (i.e., preventing harm or gaining benefits), timing (i.e., proactive or reactive), time scale (i.e., short-term or long-term), as well as who acts (i.e., the individual alone or with others) and who is affected by those actions (i.e., the individual, other people, or the environment). These seem likely to map to more generalised systemic models of behaviour change such as for ‘triple win’ environmental, social, economic and health outcomes used in the EU<sup>59</sup>, Darnton’s Individual, Social and Material framework for climate behaviour change (Scottish Government)<sup>77,78</sup>, and Akenji and Chen’s sustainable lifestyles framework for UNEP (and used by NSW Environment Trust)<sup>76</sup>, and Michie’s COM-B model, particularly as has been applied in socio-ecological approach to health<sup>79,80</sup>.

### 3. Prioritise building adaptive capacity to systemic risks over reducing individual harms from natural hazards

The main focus of the existing behavioural science research on climate adaptation is most directly applied to managing and reducing the harm caused by a small number of better understood natural

hazards. While some of these translate into systemic risks, it appears the bigger gap in knowledge, and opportunity, highlighted in this paper, is tackling social and transformative adaptive capacity building, and how behaviour change approaches can help with this. This will require more novel, participatory, experimental and therefore 'risky' research, but this is appropriate to a missions-based approach.

#### **4. Include at least one ambitious, challenging behaviour change focus**

The review findings suggest certain behaviours offer far greater potential to build adaptive capacity beyond the individual than others – for example those that are visible, social and increase community adaptive capacity, and delivered in areas with a high value / impact potential<sup>81</sup>. Elements of both the Carman and Zint and Wilson frameworks could be emphasised in prioritising what behaviours to focus on. Transformative as opposed to incremental behaviours changes are likely to be more complex, harder and riskier to implement<sup>82</sup>.

For example, instead of private property or garden improvements, promoting participatory nature-based interventions such as:

- the planting by groups of local residents of street verge, water sensitive, indigenous food gardens;
- in areas with high exposure to heat, flood and food scarcity,
- and population vulnerability, such as an inland/western city fringe development in major Australian cities

This could address identifying and facilitating the removal of individual, social, institutional, technological and environmental barriers to it happening – for example engaging with local nurseries and council by-laws or street utilities potentially affected, building connections with local farmers, growers and/or traditional owners etc.

Such an intervention might achieve a lot more adaptive capacity building and or teach us more, even if the behaviour change effort itself is unsuccessful.

A similarly challenging but different intervention might involve identifying means and mechanisms by which members of a community might willingly adapt in a way that imposes personal costs, but public benefits, such as 'planned retreat' out of a fire, flood or coastal inundation prone area. This would also be an ambitious but meaningful behavioural public policy experiment (note there are examples of planning and participation processes that have equitably and successfully encouraged communities to bid for hosting toxic waste facilities<sup>83,84</sup>).

An ambitious, significant and strategic initiative conducted in a learning focused way will ensure that whether or not the actual intervention is successful, we will contribute new knowledge and solutions. And, it will of course aim to be successful and drive substantial transformational change.

#### **5. Hedge bets with some more incremental but socially contagious and net-beneficial behaviour change targets**

Some of the same criteria can also be used to select a range of relatively straightforward behaviour change challenges that support adaptation outcomes, that still may be 'socially contagious' (i.e. normative and promoting spill-over from one behaviour to others experienced as 'similar') and at a minimum, doesn't reduce the adaptive capacity of others. Methods like the impact likelihood matrix approach to behaviour prioritisation<sup>85,86</sup>, appropriately incorporating some of the criteria suggested above, could be used to identify a portfolio of intervention foci. Achieving some 'low hanging fruit' will also generate insights and build credibility and political and social capital for the more challenging efforts. And, if chosen carefully, may promote new social norms and/or spill-over behaviour changes

that lead to cascading benefits. Scalability assessments can also ensure that even relatively easy and small changes can reach their full potential if delivered across whole populations.

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# APPENDICES

## LITERATURE REVIEW METHOD

### Development of review questions

Problematization helps to identify the presence and impact of key perspectives, and understand their significance (Alvesson & Sandberg, 2011; Sandberg & Alvesson, 2011). The method supports the generation of frameworks based on identifying, comparing, and synthesising assumptions in a body of work, rather than direct aggregation of findings (cf. a conventional systematic review) or to primarily map literature and its gaps (cf. a scoping review)<sup>87</sup>.

### Search strategy, screening and coding

To identify how behavioural public policy is represented in adaptation literature, we conducted a search of the Scopus academic database.

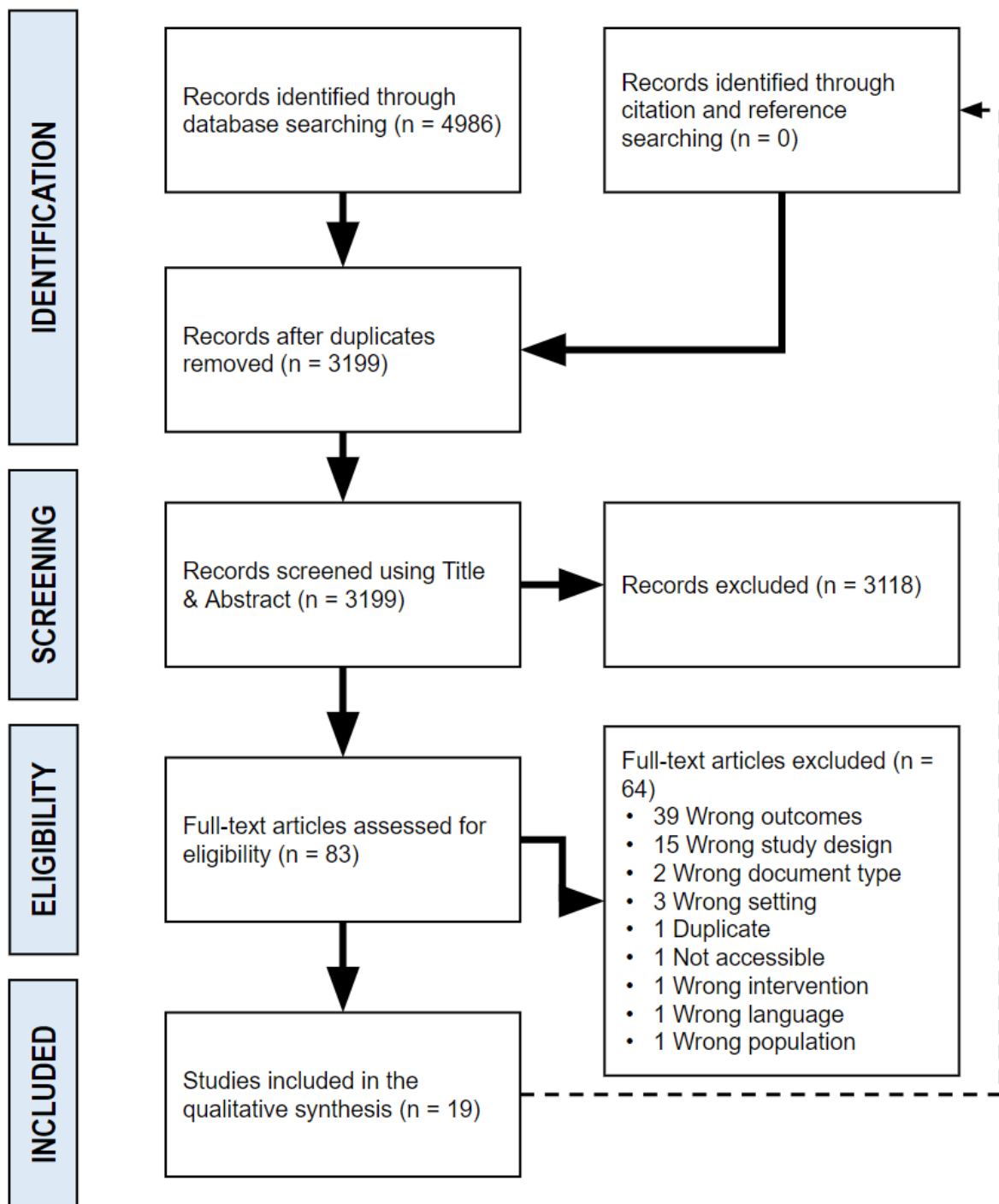
Our initial search string sought to comprehensively identify peer reviewed publications

Each review paper meeting the full text screening inclusion criteria was given a numerical score based on the first reviewers initial assessment of relevance to the review question. Scoring was validated by the lead author, with conflicts resolved by discussion. The final score was used to identify papers for focus in the interpretive synthesis, for instance informing the order of papers examined to identify clusters of review types, and informing the relative detail included about each one. A larger pool of full text reviewed papers (83) were retained as potentially relevant, and selectively referenced in the report where judged to be relevant, outside of the 'results' section only.

Finally, the advice was sought from partner agency staff, formal interviewees, and colleagues from BehaviourWorks Australia, Monash Sustainable Development Institute (MSDI), on missing papers and noteworthy grey literature upon a review of the included full texts.

### Data extraction

Data extracted from relevant studies included: author name/s, year published, context (e.g., climate stressors of interest, geographical/population setting), review type/questions, drivers/barriers, interventions to promote adoption, outcomes from adoption, policy learnings, and author conclusions. All data is presented in tables in Appendix B.



### Interpretive synthesis

Finally, the authors conducted a critical interpretive synthesis (Dixon-Woods et al., 2006) of prioritised papers, exploring them through the lens of the guiding questions (after Torrens et al., 2019). Typical structured reviews of the literature ideally use statistical meta-analysis, or failing this, systematic narrative or thematic analysis to answer precisely specified review questions (Gough et al., 2017). Such an analysis is most appropriate when the phenomenon of interest (i.e., behaviour change in adaptation) is already well defined and addressed in research and practice, and the aim of the review is to aggregate this information into existing, converging conceptual categories (e.g., positivist

behaviour science perspectives on whether researchers are “correctly” applying behaviour change). This was not our objective in the current paper: in contrast, we conducted this review with the intent to reveal both consistent *and* conflicting perspectives on human behaviour and behavioural public policy in adaptation.

## INTERVIEW METHOD

### Research questions

- *Problem definition / What do we know about the problem and its significance?*
  - *Why is the challenge and mission important?*
  - *Can they see the case for framing it as a behavioural public policy challenge?*
  - *What are some of the counterarguments and criticisms we should anticipate?*
- *How might behavioural public policy help?*
  - *What are the biggest 'top down' and 'bottom up' opportunities for intervention with a behavioural lens?*
- *How are governments responding?*
  - *Are there good examples out there we can learn from? Where are there gaps?*
- *Practical and logistical help to follow up*
  - *Post interview prioritisation: What are some of the most important aspects of the problem? What are some high priority barriers to action? What are some of the most promising intervention opportunities?*
  - *Where might there be partners/collaborators ready to work with us?*

The stakeholder interviews involved:

### Identifying relevant individuals.

We intend to interview three main groups thought to offer insights on the research questions.

Policy Makers

Researchers

Subject matter experts and thoughtleaders from NGOs and thinktanks

We built a judgement sample for this work, which is a non-random sample of respondents selected by the researchers and our policy partners based on our and their knowledge on the topic under investigation, with additional snow ball recruitment, via recommendations by initial interviewees (three of the final interviews) (Babbie, 2020) . Over 30 candidates were initially identified.

### 2. Conducting semi-structured interviews with relevant individuals.

This resulted in 7 interviews from a range of government, business and non-government bodies - see Table 1.

Table 1: Australian interviewee organisation types, roles and perspective

Organisation type	Role	Perspective
Government	In-house social researcher	Audience research
Government	Policy Lead	Whole of state adaptation
Research	Academic	Agriculture, Tourism
SME/NGO	Advocacy	Peak body for concerned medical practitioners
Government	In-house technical expert	Health sector
SME/NGO	Advocacy	Community Sector
Research	Academic	Financial climate risk

Before conducting the interviews, an interview guide was designed with questions aimed at seeking participants opinions about the problem, and where behavior change approaches might help. Interviews lasted between 30-45 min on average and were carried via telephone and videocalls. Anonymity was ensured in reporting since we believe that this approach helped us gain more trust and, thus, obtain additional insights (Babbie, 2020).

### 3. Reviewing interviews and relevant documents recommended by interviewees.

Semi-structured interviews meant the majority of interviewees answered the same set of questions. Interviews were transcribed by a third-party service, and annotated by the interviewer. We identified key themes by their prominence and frequency in response to each question. Thematic analysis (Braun and Clarke, 2006) was used to identify qualitative themes in interviewees' responses to each question, and in documents and resources they further provided (Spencer et al., 2003). This included nominating 'key barriers' as priorities, as well as more general observations.

## LONG LIST OF INPUTS TO THE CAUSE AND EFFECT MAPPING EXERCISE

Table 3: Long list of brainstormed climate stressors, populations, harms and possible interventions.

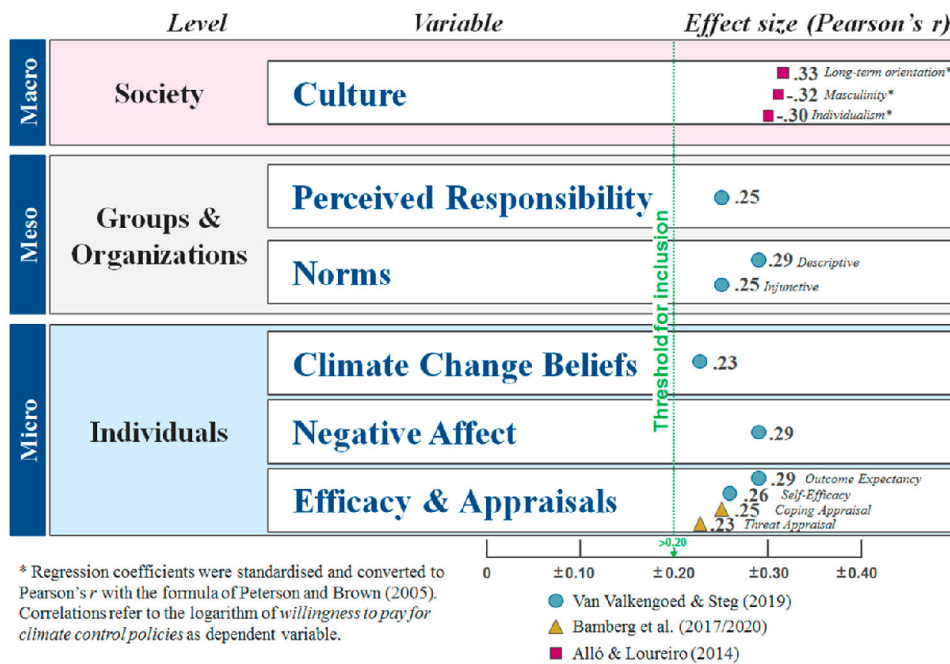
Climate stressors	Populations	Harms	Interventions
<p>Increased bushfire Reduced drinkable water supply Poor air quality Heatwave / extreme weather Increased average temperatures Changed landscape ecological regimes for agriculture Biodiversity loss Sea level rise Rainfall less/more intense Flooding Droughts Coastal inundation Coastal erosion Ocean warming/acidification Extreme storm weather Changes/better environment for vectors or food borne illness</p>	<p><b>Socio-Demographic:</b> Elderly Youth Children Traditional owners Low income households Underinsured Homeless Renters</p> <p><b>Health conditions/vulnerabilities:</b> People with existing health conditions (respiratory, renal, coronary, mental health)</p> <p><b>Places:</b> Communities that depend on marine environment Communities that live in flood-prone areas Communities that rely on tourism from skiing Communities in bushfire-prone areas Regional and remote communities Metro communities</p> <p><b>Sector/trades:</b> Agriculture, security, environment, insurance etc Farmers Tourism</p>	<p><b>Health:</b> Injuries, exposure, drowning etc eco-anxiety/depression Mental health Health Illness/disease Critical illness, health risk for children and elderly Respiratory Renal Cardiovascular Asthma Thunderstorm Asthma Hospitalisation Death Famine Thirst Loss of ecosystem services (supporting health)</p> <p><b>Environment</b> Contamination of ground water, increased variability in water availability for human consumption and the environment, etc Air Quality Biodiversity (changed and extinctions) Decreased ecosystem services</p>	<p><b>Support for policy/planning processes:</b> Vulnerability studies, research projects to enhance adaptive capacity Transitions plans (Understanding and acting on... acceptance of / attention to / incorporating into short term priorities) Changed behaviour/decisions that reduce risk (likelihood and scale of harm) from long term, chronic climate change stressor</p> <p><b>Fire/flood/weather</b> Promoting protective behaviours, Early warnings for schools, households and protection inside Proofing your home having multiple escape routes, PPE preventors/masks</p> <p><b>Air-quality:</b> Promoting protective behaviours, Safe air quality locations/buildings, filtration vents in homes, masks/ventilators/puffers,</p> <p><b>Coastal:</b> coastal management strategies</p> <p><b>Heat:</b> Promoting protective behaviours, A range have been looked at A LOT (e.g. elderly carrying a water bottle, thermal efficiency measures), but what about looking at home purchasing or rental behaviour and interventions to change decision-making on thermal</p>



		<p>environmental degradation Environmental impacts/cultural heritage/world heritage implications</p> <p><b>Food security</b> limited access to fresh produce, Food security / production Decreased crop variation &gt; increased risk of crop failure, increased staple food costs, risk of famine</p> <p><b>Economic:</b> damage to property, threat to agricultural viability, variability in water availability for human consumption and the environment, etc loss of reef/coastal communities. Decreased ecosystem services (productive) Loss of livelihoods relying on previous climate/weather Loss of farming Loss of fisheries Loss of tourism Threaten viability of regional economies, esp those relying on farming and tourism</p> <p><b>Social:</b> Loss of cultural values, loss of communities.</p>	<p>performance/energy efficiency of cooling in a home, housing availability/alternatives</p> <p><b>Food security:</b></p> <p><b>Water availability:</b> Water restrictions, rainwater tanks mandated, freshwater supplies, desalination</p> <p><b>Disease/illness:</b> Promoting protective behaviours, awareness of risk, repellents, eradication efforts</p> <p><b>Farming:</b> Find new/ innovative ways to farm Fire proofing your home</p> <p><b>Traditional owners:</b> Greater support for TO groups to participate in, and do, climate adaptation that protects their cultural values.</p> <p><b>Mental health:</b> Mental health supports specific to eco-anxiety, opportunities to take meaningful action reduce symptoms</p>
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		<p>Decreased ecosystem services (aesthetic, wellbeing etc)</p> <p>loss of culturally important sites and species integral to identity</p> <p>Loss of livelihood.</p> <p>loss of sacred sites,</p> <p>Environmental impacts/cultural heritage/world heritage implications</p>	
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## POTENTIALLY USEFUL FRAMEWORKS AND KEY FIGURES



	trust in measures	trust in government	experience	place attachment	knowledge	risk perception	climate change belief	responsibility	injunctive norms	self-efficacy	outcome efficacy	negative affect	descriptive norms	Total
Trust in measures	8	3	3	0	0	0	0	0	0	0	0	0	0	14
Trust in government	5	0	0	1	0	0	0	0	0	0	0	0	0	12
Experience	0	5	1	1	0	0	0	0	0	0	0	0	0	66
Place attachment	0	1	1	0	0	0	0	0	0	0	0	0	0	12
Knowledge	1	3	2	2	2	2	4	0	0	0	0	0	0	15
Risk perception	3	1	5	1	1	1	3	0	0	0	0	0	0	66
Climate change belief	1	0	0	0	0	1	0	0	0	0	0	0	0	6
Responsibility	4	3	3	0	0	0	4	0	0	0	0	0	0	14
Injunctive norms	1	0	1	0	0	0	0	0	0	0	0	0	0	7
Self-efficacy	4	1	2	0	0	1	2	0	0	0	0	0	0	11
Outcome efficacy	0	1	6	0	0	2	1	0	0	0	0	0	0	20
Negative affect	0	0	0	0	0	0	0	0	0	0	0	0	0	07
Descriptive norms	1	3	0	0	0	0	0	0	0	0	0	0	0	5

Fig. 2 | Types of climate-related hazards examined. Number of studies observed for each combination of climate-related hazard and motivational factor. Green cells indicate four or more observed studies. Yellow cells indicate one to three observed studies. Red cells indicate no observed studies.

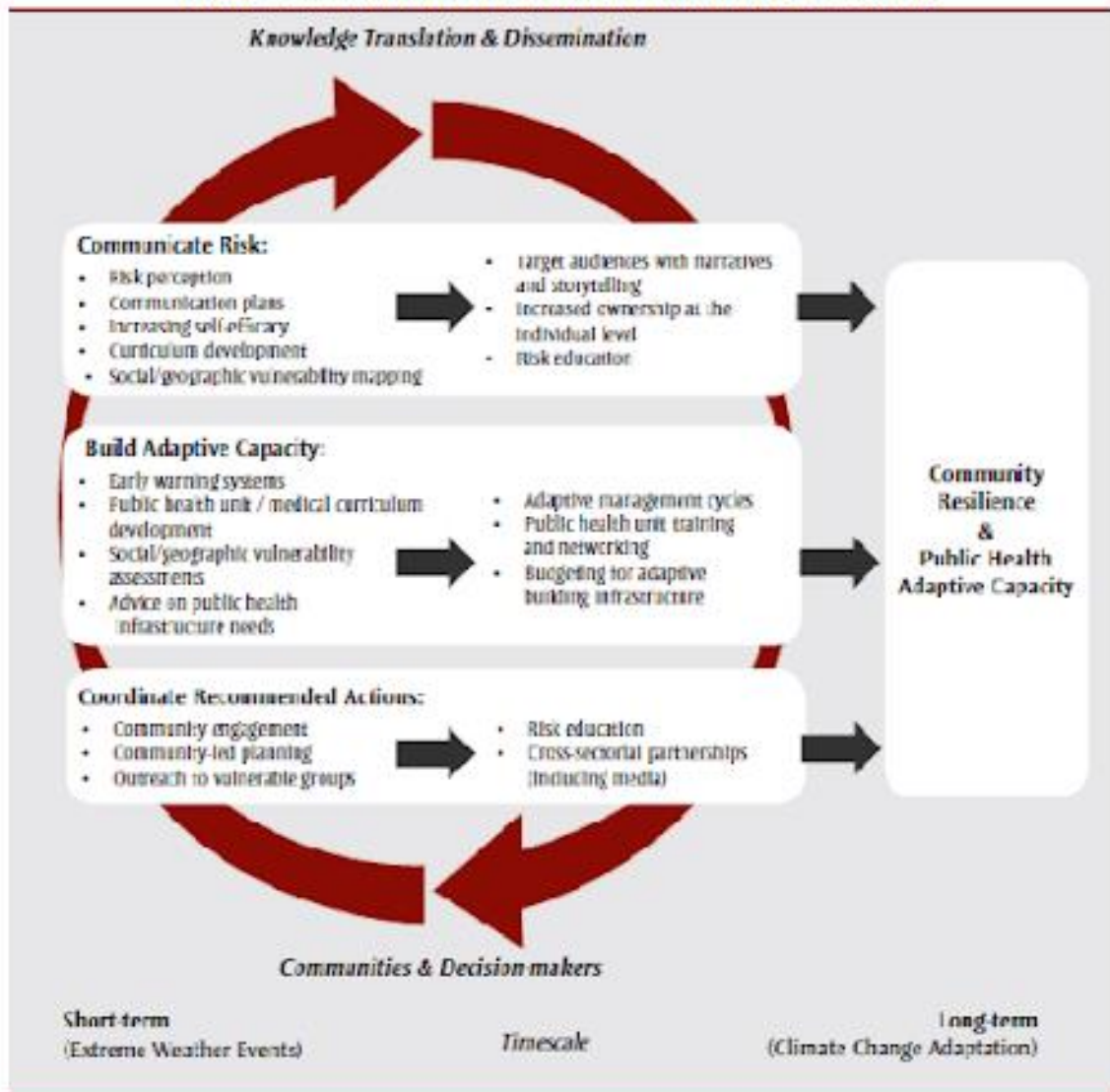
	Preparedness	Evacuation	Insurance	Information seeking	Policy support	Multiple	Total
Trust in measures	4	1	0	0	0	0	14
Trust in government	4	0	1	0	0	0	15
Experience	13	1	7	3	0	0	66
Place attachment	0	0	0	0	0	0	12
Knowledge	6	2	2	2	4	1	15
Risk perception	3	5	5	0	3	0	66
Climate change belief	1	0	1	0	0	0	6
Responsibility	13	3	0	0	4	0	14
Injunctive norms	1	0	1	0	0	0	7
Self-efficacy	4	1	0	0	0	0	11
Outcome efficacy	13	1	1	0	0	0	20
Negative affect	0	1	0	1	0	0	07
Descriptive norms	1	3	0	0	0	0	5

Fig. 3 | Types of adaptive behaviours examined. Number of studies observed for each combination of adaptive behaviour type and motivational factor. Green cells indicate four or more observed studies. Yellow cells indicate one to three observed studies. Red cells indicate no observed studies.

Incremental	Transformative for the individual/household or incremental with the potential to be transformative for society		Transformative for society
Moving valuables to a safer place in the home in a flood-prone area <sup>127</sup> Buying flood insurance <sup>128</sup> Storing food and other items for emergencies <sup>129</sup> Making a household evacuation plan <sup>127</sup>	Undertaking voluntary migration <sup>130</sup>  Installing a rain garden to reduce stormwater runoff <sup>131</sup> Moving agriculture operations to a more appropriate climate <sup>131</sup> Changing one's identity by adopting a new livelihood or growing a new crop <sup>131,132</sup>		Contributing to political engagement to reduce vulnerability of municipal water infrastructure <sup>133</sup> Initiating eco-villages with green infrastructure that attract residents with prosocial values <sup>134</sup>
Behaviours below may impose externalities and be maladaptive at scale Behaviours above do not impose such potential negative externalities	Reducing water use through xeriscaping or using drought-tolerant plants <sup>135</sup> Reducing water consumption in one's own home <sup>136</sup>		Engaging in planning process to shift from irrigation agriculture to tourism-based economy in response to groundwater depletion <sup>137</sup> Working with an NGO to engage policy makers in ways that challenge and disrupt dominant social relations to produce a more sustainable future <sup>138</sup>
Installing air conditioning in response to increased temperatures <sup>139</sup> Purchasing flood barriers for private property <sup>125,157</sup> Drilling a new well in response to water scarcity <sup>140</sup>	Mostly personal benefits	Removing flood barriers in own community to reduce risk of flooding downstream <sup>141</sup> Checking on elderly neighbours or volunteering in emergency areas during a heat wave <sup>142,157</sup> Assisting in efforts to increase use of prescribed fire to reduce fuel connectivity at large scales <sup>143</sup> Personal and collective benefits	

**Fig. 3 | Typology of adaptation behaviours.** Classification of behavioural adaptations based on their potential contributions to transformation conceptualized as a gradient, with examples. The first column shows incremental adaptations—that is, short-term coping behaviours that benefit the individuals or households undertaking those actions<sup>127–129,144,145,146,147</sup>. Some incremental behaviours could have negative downstream impacts and thus reduce societal resilience to climate change. The middle column indicates behaviours that could be transformative for an individual or household in that they represent important changes to one's lifestyle, livelihood or worldview<sup>125,130,131,132,133,134,135,136,137,138</sup>. Such actions also have the potential to be transformative for society if adopted by a critical mass of individuals, or if they are sufficiently long-lasting, or highly innovative, or contribute to changes in values, beliefs or worldviews that further support that behaviour. These behaviours may produce largely personal benefits, a mix of personal and collective benefits, or largely collective benefits. The third column shows behaviours or processes that involve deliberate efforts to bring about transformation at the system level<sup>133,134,138,140,141,142,143,144</sup>. The actions may involve considerable personal costs, may be highly innovative, and can ultimately result in changes in beliefs, values or worldviews. NGO, non-governmental organization.

**FIGURE 2**  
**Preliminary conceptual framework for extreme weather and climate change risk communication and public health adaptive capacity**



## PROMINENT THEORIES

### Key theories, disciplines and research approaches

Reviews generally draw on different bodies of theory to address their research questions. A range are mentioned: Model of private proactive adaptation to climate change (MPPACC), Protection Motivation Theory (PMT), The social cognitive model of disaster preparedness, The “hazard to action chain”, protective action decision model (PADM) , Decision theory, innovation theory, person-relative-to-event

theory, and the Social Amplification of Risk Framework, focus theory of normative conduct, Social identity theory, theory of planned behaviour.

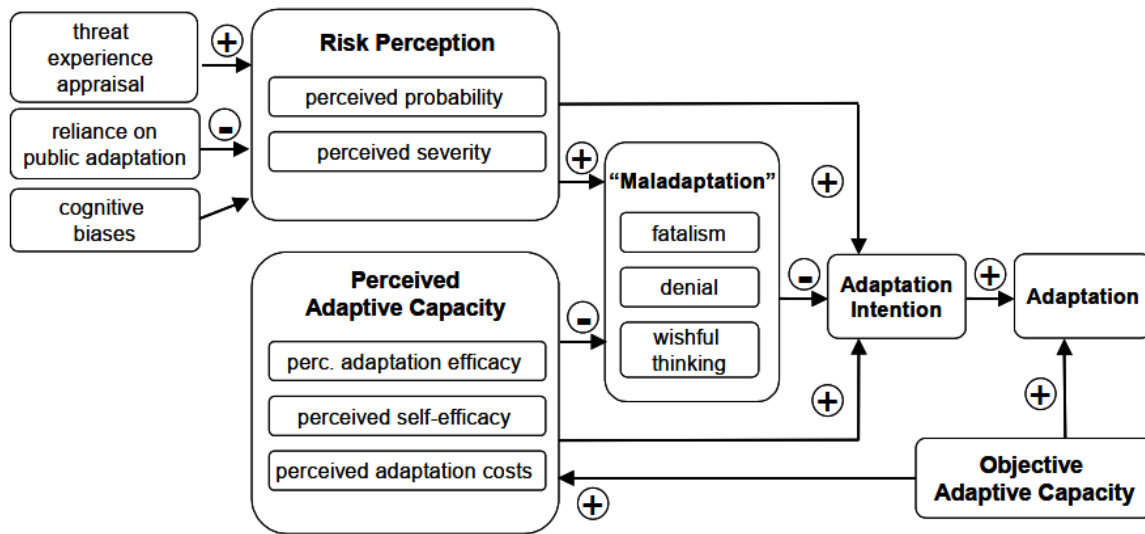
Different reviews use different perspectives, however, some theories were mentioned in more than one review; for example. PMT and Social Amplification of Risk are widely used in broader risk research.

Table summarises some of these which appeared highly relevant for understanding adaptation behaviour. The following section provides a visualisation of each theory.

*Table 4: Possibly relevant theories*

Theory	Summary	Exemplars
<p>Model of private proactive adaptation to climate change (MPPACC) {Grothmann, 2005 #150}</p>	<p>The model of private proactive adaptation to climate change (MPPACC) argues that adaptation is positively influenced by two proximal factors: i) objective adaptation capacity, and ii) adaptation intention. Objective adaptation capacity influences perceived adaptive capacity. Perceived adaptive capacity consists of perceived adaptation efficacy, perceived self-efficacy and perceived adaptation costs.</p> <p>Adaptation intention is positively influenced by risk perception, and perceived adaptive capacity and negatively influenced by maladaptation. Maladaptation consists of fatalism, denial and wishful thinking. It is positively influenced by risk perception and negatively influenced by perceived adaptive capacity. Risk perception consists of perceived probability and perceived severity. It is influenced by threat experience appraisal, reliance on public adaptation and cognitive biases.</p>	<p>{Hamilton, 2018 #23}{Wilson, 2020 #29}</p>
<p>Protection Motivation Theory (PMT){Rogers, 1975 #151}</p>	<p>Protection Motivation Theory (PMT) argues that intent to adopt the recommended response is driven by protection motivation. Protection motivation is positively influenced by appraisal of severity, expectancy of exposure and belief in efficacy of coping response. Belief in efficacy of coping response covaries with appraised severity. Belief in efficacy of coping response is influenced by efficacy of recommended response. Expectancy of exposure is influenced by probability of occurrence. Appraised severity is influenced by magnitude of noxiousness.</p>	<p>{Andráško, 2021 #49}{Bechtoldt, 2021 #82}</p>
<p>Protective action decision model (PADM) {Lindell, 2011 #152}</p>	<p>The Protective action decision model (PADM) argues that behavioural responses to threats have three components, information searching, protective responses, and emotion focused coping. Behavioural responses are negatively influenced by situational impediments and positively influenced by situational facilitator and protective action decision making. Protective action decision making is influenced by protective action perceptions. These are influenced by pre decision processes: Exposure, attention, comprehension. These are influenced by environmental cues, social cues, information sources, channel access and preference, warning messages and receiver characteristics.</p>	<p>{Wilson, 2020 #29}{Andráško, 2021 #49}</p>

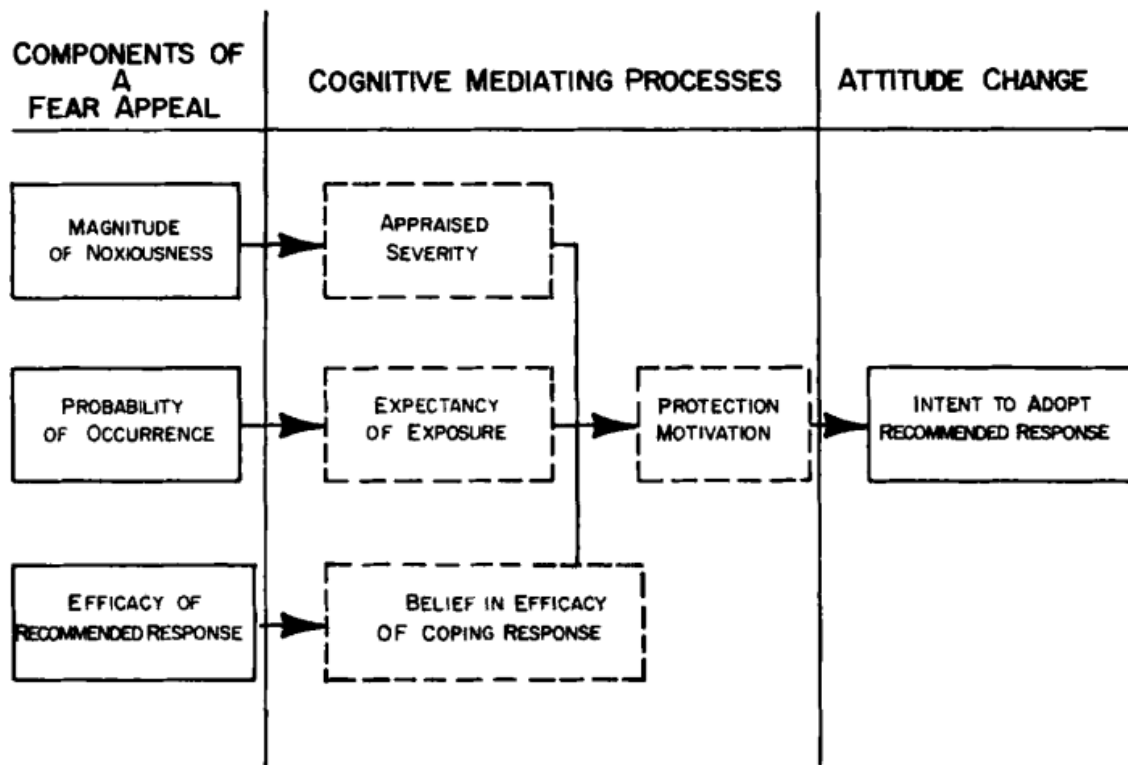
## Model of private proactive adaptation to climate change (MPPACC)



The [model of private proactive adaptation to climate change](#) (MPPACC) {Grothmann, 2005 #150} argues that adaptation is positively influenced by two proximal factors: i) objective adaptation capacity, and ii) adaptation intention. Objective adaptation capacity influences perceived adaptive capacity. Perceived adaptive capacity consists of perceived adaptation efficacy, perceived self-efficacy and perceived adaptation costs.

Adaptation intention is positively influenced by risk perception, and perceived adaptive capacity and negatively influenced by maladaptation. Maladaptation consists of fatalism, denial and wishful thinking. It is positively influenced by risk perception and negatively influenced by perceived adaptive capacity. Risk perception consists of perceived probability and perceived severity. It is influenced by threat experience appraisal, reliance on public adaptation and cognitive biases.

## Protection Motivation Theory (PMT)

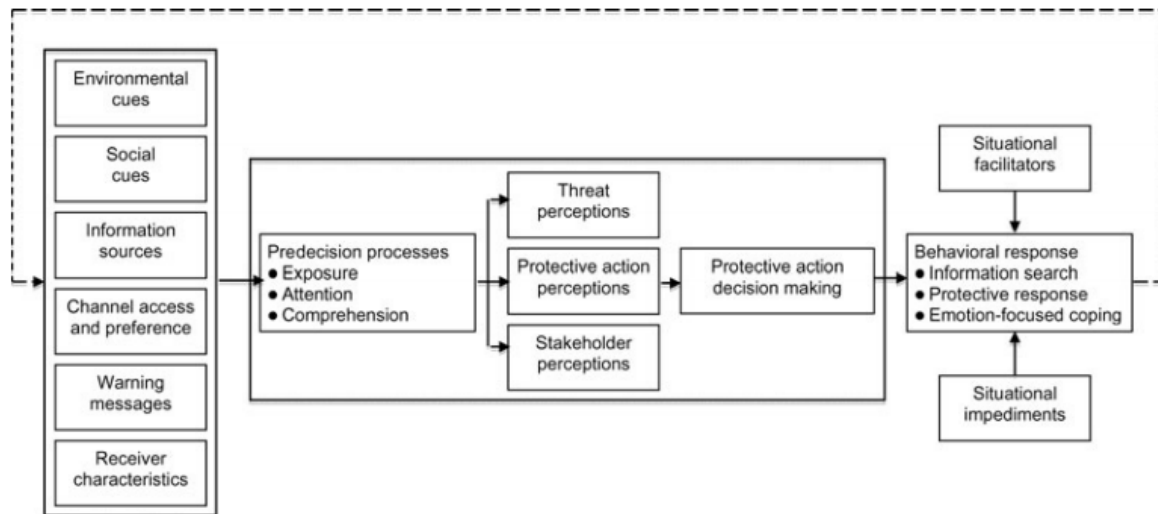


**FIGURE 1**  
**SCHEMA OF THE PROTECTION MOTIVATION THEORY**

[Protection Motivation Theory \(PMT\)](#) argues that intent to adopt the recommended response is driven by protection motivation. Protection motivation is positively influenced by appraisal of severity, expectancy of exposure and belief in efficacy of coping response. Belief in efficacy of coping response covaries with appraised severity. Belief in efficacy of coping response is influenced by efficacy of recommended response. Expectancy of exposure is influenced by probability of occurrence. Appraised severity is influenced by magnitude of noxiousness.



## Protective action decision model (PADM)



[The Protective action decision model \(PADM\)](#) {Lindell, 2011 #152} argues that behavioural response to threats have three components, information searching, protective responses, and emotion focused coping. Behavioural responses are negatively influenced by situational impediments and positively influenced by situational facilitator and protective action decision making. Protective action decision making is influenced by protective action perceptions. These are influenced by pre decision processes: Exposure, attention, comprehension. These are influenced by environmental cues, social cues, information sources, channel access and preference, warning messages and receiver characteristics