

CLIMATE CHANGE ADAPTATION BY INDIVIDUALS AND HOUSEHOLDS A PSYCHOLOGICAL PERSPECTIVE

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As global temperatures increase, so do the frequency and severity of various natural hazards.¹ Worldwide, climate change can influence incidences of natural hazards such as wildfires, flooding, heatwaves, droughts, vector-borne diseases, and mudslides.² Such events can be deadly, traumatizing, and cause significant economic damages. Climate change adaptation, defined as the process of adjustment to reduce or avoid the negative impacts of climate change³, is therefore of critical importance.

So far, the scientific literature on adaptation to climate change and climate change adaptation policies have overwhelmingly focused on the role of governments. However, the efforts of governments alone will not be sufficient to reduce or avoid the negative impacts of climate change.^{4,5} Climate change adaptation will need to take place at all scales, including the private sector and civil society.^{6,7} Private individuals and households will also need to take measures to reduce the risks of the negative impacts of climate change.⁸ In this background paper, we will focus specifically on the role of individuals and households in the process of climate change adaptation.

While adaptation by individuals and households can be highly effective in reducing the impact of climate-related hazards, many people are not (yet) engaging in adaptive behavior, or they are taking insufficient or inappropriate measures to adapt. For example, in an Australian study, fewer than 30% of the respondents had a household emergency kit, evacuation plan, or had installed rainwater tanks to reduce the impacts of drought.⁹ In a survey among more than 1,000 rural Czech residents, 58% of households had implemented no adaptive measures against flooding, (e.g., moving possessions to higher stories, changing floor material, or using flood barriers); only 5.5% of households had implemented more than three adaptive measures.¹⁰ In a study on wildfire preparedness in the United States, almost all homeowners cleaned surfaces/gutters to avoid the accumulation of needles and leaves, but less than half

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had obtained additional information on wildfire preparedness, and just over 20% had attended community meetings on wildland fire.¹¹ A study conducted in Bangladesh found that over 75% of participants had received warnings from the government to seek shelter before the onset of Cyclone Sidr, but only 33% chose to do so.¹²

Since many people are not yet adapting adequately to the effects of climate change, motivating people to adapt represents a key challenge to successful adaptation. To develop effective strategies to promote adaptive behavior, the following steps are important:

- 1) Identify which changes in behavior are needed to adapt adequately to the risks of climate change
- 2) Examine which factors affect (mal)adaptive behavior
- 3) Design interventions to promote adaptive behaviors by targeting the relevant antecedents of the behavior
- 4) Evaluate the effects of the interventions on antecedents and behavior, and adjusting intervention strategies when appropriate.¹³

We structure this background paper in accordance with these steps identified in the behavioral change literature. First, we discuss why involving citizens and households is critical for successful adaptation to climate change. Second, we give an overview of the behaviors that individuals and households can engage in to adapt to climate-related hazards. Third, we review the psychological factors that motivate or hinder people to engage in these adaptive behaviors. Importantly, we focus on explaining adaptive behavior, that is, the behavior that people engage in to reduce the risks of climate-related hazards. We do not focus on adaptive capacity, which is the *ability* to adapt.^{14,15} Fourth, we show how interventions and policies can promote adaptation by individuals and households by targeting the key antecedents of adaptive behavior.

We note here that, while the focus of this paper is on *psychological* factors, it is important to keep in mind that individual behavior is also conditional upon the context in which it is embedded, which includes institutional, societal, cultural, legal, and physical factors.¹⁶⁻¹⁸ Long-lasting and wide-spread behavioral change at the individual level may thus also require changes at the systemic level.¹⁹ We will come back to this point in the conclusion of this paper.

1. Why Are Individuals and Households Important for Successful Adaptation?

Individuals and households have rarely been considered in the implementation of climate change adaptation policies.²⁰ For example, the United Kingdom's National Adaptation Programme states: 'if adapting to climate change is in the private interests of an individual... then it should occur naturally and without the government's intervention.'^{21,22} An examination of adaptation policies from 402 cities around the world also showed that the majority of the adaptation policies examined do not specify any consideration of, or interaction with, citizens.²³ Within the scientific literature on climate change adaptation, individuals and households are often also overlooked as relevant actors.²⁴⁻²⁶ This is unfortunate, as there are three main reasons why individuals and households are of critical importance in successful adaptation to climate change.

First, due to the increases in climate-related hazards, governments will become overstrained in their capacity to adequately respond to these hazards.^{27,28} Therefore, governments cannot guarantee full reduction of the risks of climate-related hazards, and individuals will still be at risk of many climate-related hazards if they do not undertake adaptive measures themselves (see Box 1). In order to reduce strain on government resources and to effectively reduce the risks from the impacts of climate change, it is necessary that individuals take adaptive measures too.^{29,30}

Second, adaptation actions by households are effective to reduce the negative impacts of climate-related risks and are relatively cost-efficient to implement. For example, clearing vegetation in a 10 to 20 meter (30 to 60 feet) parameter around one's house can increase the survivability of a house during a wildfire to approximately 90%.³¹ Behaviors to reduce the impact of heatwaves, such as wearing light clothing and using cooling devices, significantly reduces mortality for elderly, even when accounting for other risk factors such as illness and lack of mobility.³² Examples from the United Kingdom³³, France³⁴, Germany^{35,36}, and India³⁷ show that flood-proofing (i.e., installing measures to avoid floodwaters from entering the house) can be a cost-effective way to reduce the impacts of flooding. Individual adaptation actions can therefore

contribute significantly to reducing the impacts of climate-related hazards, against relatively low costs.

Third, the adaptive actions of individual citizens can influence the effectiveness of governmental adaptation policies. For example, government plans to renovate a street in Quebec City in Canada motivated residents to plant trees and 'green' the urban environment.³⁸ In response to the success of this citizen-led initiative, the city set up a program for urban greening and reviewing roadwork practices³⁹, resulting in the implementation of more climate adaptive policy. In Dutch cities, approximately 50 to 70% of the total surface area is privately owned.⁴⁰ Policies to reduce pluvial flooding and urban heat island effects through green infrastructure will therefore only be effective if private homeowners are also actively involved in implementing such measures.

Conversely, if individuals fail to adapt, they can hinder or obstruct the effectiveness of adaptation policies by governments.⁴¹ For example, citizens that do not implement adaptive measures may demand immediate assistance from local governments during disasters, which can block emergency lines and complicate effective institutional response to an ongoing hazard.⁴²

2. What Does Adaptation at Individual and Household Level Look Like?

There are many actions that people can take to reduce the risk of climate-related hazards.⁵⁷ Yet, what constitutes successful adaptive action depends on the context in which the behavior takes place. For example, removing trees may reduce the risks of wildfire in one context, but increase the risk of flooding in another. In general, adaptive actions can serve four different purposes: hazard reduction or avoidance, vulnerability reduction (reducing susceptibility to be affected by a hazard), preparedness for response (measures to respond to an ongoing hazard), and preparedness for recovery (measures to bounce back after a hazard).⁵⁸ To make these four categories more concrete in the context of individuals and households, we present a categorization of 6 types of adaptation behaviors performed by individuals and households that have been studied in the psychological literature: information seeking, preparative measures, protective measures, evacuation/migration, purchasing insurance, and political action.⁵⁹ As we will see,

these 6 categories of behaviors can address the four aims of adaptive behavior (see ⁶⁰, for further examples of adaptive behavior by individuals and households).

Information seeking can increase people's knowledge of climate change and how to adapt, which is often considered an important condition that needs to be satisfied before people can engage in other adaptive behaviors.⁶¹ For example, people can look up information about whether they are exposed to a hazard, what they can do to reduce the impacts of a hazard, or monitor on-going circumstances during the approach or occurrence of a natural hazard. Such information can help people adapt. For example, heat warning systems can reduce heat-related mortality.⁶² Climate and weather information services can also help farmers make adaptive decisions.⁶³ However, providing people with information is, in many cases, not sufficient to promote adaptation, as we will discuss later in this review. The aims addressed by information seeking are hazard reduction or avoidance, vulnerability reduction, preparedness for response, and preparedness for recovery.

Preparative measures consist of actions that people can take before the onset of a climate-related hazard to reduce possible negative impacts. For example, installing flood covers over airbricks in a wall can prevent floodwater from entering the house.⁶⁴ People can install hurricane shutters that can be closed during a hurricane to prevent damage to windows from flying objects.⁶⁵ The effects of drought can be managed by using rainwater harvesting systems.⁶⁶ To reduce the impacts of heatwaves, people can paint their house in lighter colors to reflect some of the heat and lower indoor temperatures.⁶⁷ As these actions need to be taken before a hazard occurs, preparative actions require deliberate planning, and may incur financial costs. The aims addressed by preparative measures are hazard avoidance or reduction, vulnerability reduction, and preparedness for response.

Some preparative actions are more effective if they are implemented at the community level. For example, the risks of local flooding caused by rainwater runoff in urban areas can be reduced by replacing bricks and concrete in private gardens with soil and plants. This measure becomes more effective if more people implement it.⁶⁸ Community actions to reduce malaria (for example by clearing mosquito breeding sites) have also found to be effective.⁶⁹ Community actions can also involve helping others to implement adaptive measures.⁷⁰

Climate change poses a wide array of concrete risks for the health and well-being of individuals and households.⁴³ Individuals and households therefore play a central role in climate change adaptation. Some of the projected impacts of climate change that people may face at different degrees of global warming include:

- Flooding: At 1.5 °C of global warming, the number of people affected by flooding is expected to double compared to current levels.⁴⁴
- Sea-level rise: At 2 °C of global warming, sea-level rise will cause lands to be permanently flooded in 2150 that now are home to 60 million people.⁴⁵
- Drought: 195 to 277 million more people than today (especially urban populations) will be affected by drought when global temperature increases with 2 °C.⁴⁶ The availability of freshwater will decrease by up to 30% under a 2 °C global temperature increase.⁴⁷
- Hurricanes: The expected damage of hurricanes due to climate change will double in 2100 compared to current levels.⁴⁸ Tropical cyclones could form in regions where they have not been recorded before, such as the Persian Gulf.⁴⁹
- Heatwaves: By 2100, 48% (under conditions of strong mitigation) to 74% (if no mitigation takes place) of the world's population could be exposed to conditions of deadly heat (i.e., a combination of critical heat and humidity levels where exposure can lead to fatality) for more than 20 days a year.⁵⁰
- Wildfires: Wildfire potential is expected to increase in the United States, South America, southern Europe, southern Africa, Australia, and Central Asia when global temperatures increase.⁵¹
- Vector-borne disease: The region inhabited by mosquitos transmitting diseases such as malaria, dengue, yellow-fever, amongst others, will expand when global temperature increases, exposing an increasing number of people to these diseases.^{52,53} For example, 6.1 million additional yearly cases of dengue fever are expected in Latin America by 2050 under 2 °C of global temperature increase.⁵⁴
- Loss of coral reefs: 99% of coral reefs will disappear under 2 °C of global temperature increase.⁵⁵ The loss of coral reefs will make coastal communities more vulnerable to sea-level rise and flooding and will have negative economic impacts for fisheries and tourism industries.⁵⁶

Protective measures refer to the actions taken during a climate-related hazard to avoid damages or injuries. For example, people can place sandbags in front of their door or other openings in the house to prevent floodwater from entering⁷¹, avoid flooded areas while driving a vehicle⁷², or reduce water use during a drought.⁷³ Some actions may require deliberate planning, for example using insecticide-treated nets and taking preventive medicine to reduce the chances of being afflicted by malaria.⁷⁴ Other actions may be more intuitive, such as reducing activity or seeking out cool places during a heatwave.⁷⁵ Protective measures can also be prosocial, such as warning others

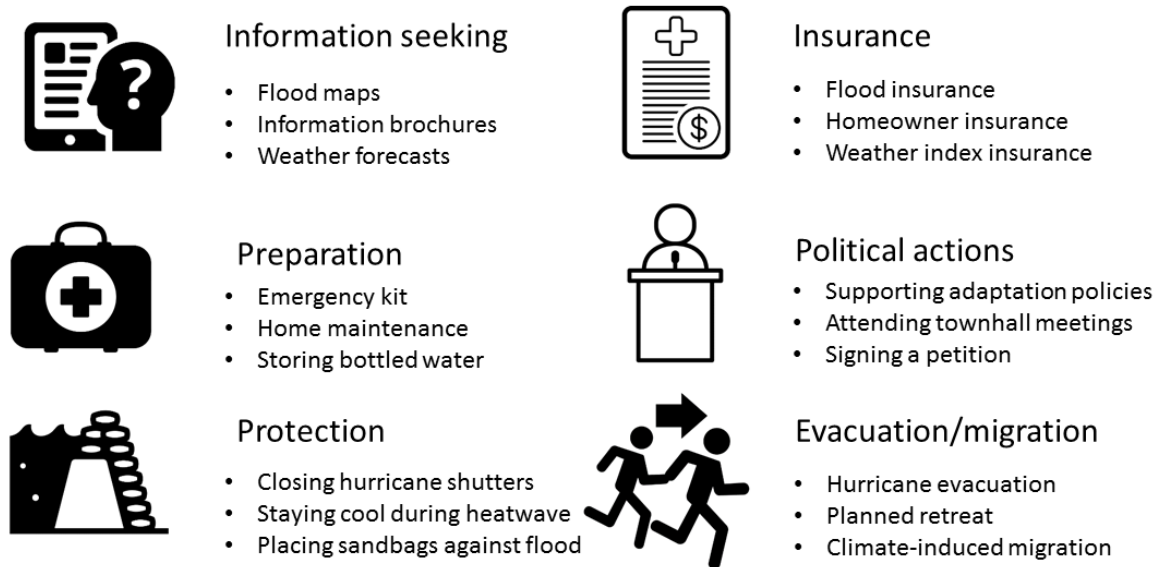
of an impending hazard⁷⁶ or checking up on friends and neighbors during a hazard to ensure their whereabouts and safety.⁷⁷ This can be especially important for vulnerable populations such as the elderly, who are less able to adapt by themselves.⁷⁸ The aims addressed by protective measures are vulnerability reduction, preparedness for response, and preparedness for recovery.

Evacuation or migration from an area can be an effective way of reducing the impacts of hazards such as flooding, hurricanes, and wildfires. While governments often recommend or even order evacuation, people may fail to heed

FIGURE 1

Categories of adaptive behavior at the level of individuals and households.

Examples of how people can adapt to climate change



Source: Authors.

these instructions.⁷⁹ People may not want to evacuate for a variety of reasons, such as the fear of looters or not wanting to leave behind pets that are not allowed in evacuation centers.⁸⁰ Financial resources can also prevent people from evacuating; some people may not be able to take time off work or lack the resources to travel.⁸¹ In collectivist cultures, previous negative impacts at the community level (rather than the individual level) may also be an important predictor of evacuation.⁸² Furthermore, previous experiences with unnecessary evacuation can reduce people's intention to evacuate in the future.^{83,84}

The impacts of climate change can also render areas permanently uninhabitable. For example, increases in temperature and humidity could cause conditions that exceed the human body's capacity to cool down in regions in the Middle East, India, and Bangladesh.^{85,86} Some atoll islands that are part of Small Island Developing States (such as the Marshall Islands, Maldives, and Seychelles) could become uninhabitable due to rising sea levels and wave-driven

flooding.⁸⁷ In such cases of slow-onset but chronic climate hazards, migration (i.e., permanent relocation) may be required. While migration has been recognized as an important adaptive strategy by some⁸⁸⁻⁹¹, others are more critical as to whether migration constitutes successful adaptation, describing migration as a failure to adapt.^{92,93} For example, migration may have negative impacts, such as the losses in cultural heritage and severing important people-place relationships⁹⁴, which may have differential impacts on men and women within the same household.^{95,96} Migration may therefore not be preferred by all communities or individuals, but may be necessary if certain areas become uninhabitable. The aim addressed by evacuation and migration is hazard reduction or avoidance.

The purchase of insurance can form an effective strategy to reduce economic losses from climate-related hazards by distributing the risk among policyholders.^{97,98} Insurance is used as a measure of preparedness for recovery, but can also have other benefits. For example, the *Kilimo Salama*

microinsurance program implemented in Kenya and Rwanda resulted in 16% more earnings for insured farmers compared to their non-insured counterparts.⁹⁹ Insured farmers were more willing to invest their savings into farm productivity, as they no longer needed to save money for recovering from climatic shocks. This also resulted in the uptake of more adaptive farming practices.¹⁰⁰

However, insurance also has its limits as an adaptive strategy, since it does not reduce the risks of the physical or emotional impacts of hazards.¹⁰¹ Insurance is also not available to many people in developing countries, as the know-how to calculate probabilities and set up insurance policy prices may not be available to their governments.^{102,103} An increase in natural hazards due to climate change may increase premiums significantly and therefore make insurance unaffordable or even make particular properties entirely uninsurable.^{104,105} Insurance may also decrease people's motivation to engage in the other types of adaptive actions discussed here¹⁰⁶, or could lead to maladaptation. For example, government-subsidized flood insurance may lead to the continued occupancy of floodplains, which exposes many people to the risks of flooding.¹⁰⁷ Insurance may therefore not always be an effective adaptation strategy. The aim addressed by insurance is preparedness for recovery.

Political action refers to active citizen involvement in political processes regarding climate change adaptation. Predominantly, climate change adaptation has been managed by governments at the local, regional or national level. In democratic countries, citizens can take political action to promote adaptation, for example by voting in favor of climate change adaptation policies or supporting parties that put climate change adaptation on the agenda and are likely to implement adaptation policy. People can also try to influence policy by, for example, contacting national or local politicians, attending meetings with local government officials, or engaging in different forms of collective action, such as signing a petition.¹⁰⁸ We will also discuss public participation in decision-making later in this review. The aims addressed by political actions are reducing or avoiding hazards, vulnerability reduction, preparedness for response, and preparedness for recovery.

Knowledge gaps

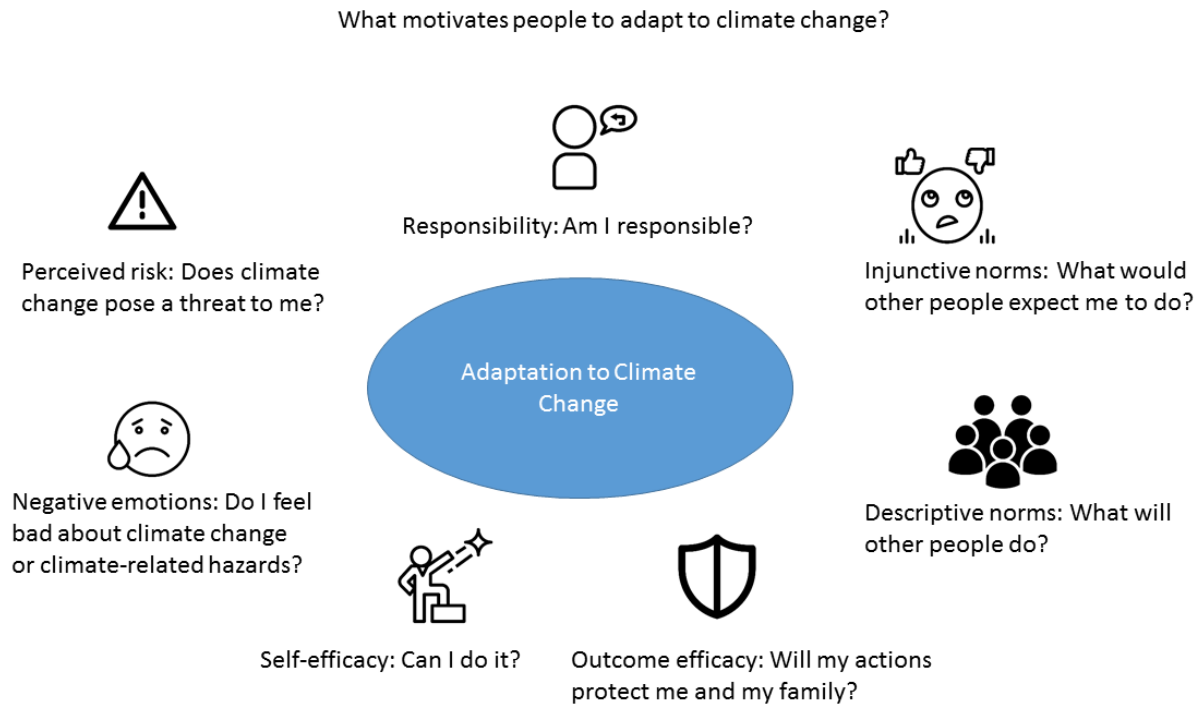
The overview presented here summarizes adaptive behaviors that have been studied in the literature and may therefore not fully cover all types of actions that are important for successful adaptation.¹⁰⁹ For example, psychological adaptation to climate change, that is, effectively coping with the stress and anxiety associated with climate-related hazards, can be an important adaptive response.^{110,111} Moreover, some adaptive responses are unique to a particular group, such as farmers' use of livelihood diversification and adaptive farming strategies.¹¹² *Maladaptive* behaviors, such as denial of the problem, wishful thinking, and fatalism, that are likely to inhibit or obstruct successful adaptation, are under-researched and commonly overlooked.¹¹³ This represents an important knowledge gap, as research suggests that the drivers of maladaptation may be different from the drivers of adaptive behavior.¹¹⁴

3. What Motivates People to Adapt?

A meta-analysis that summarized the results of more than 100 studies identified various motivational factors that can encourage or inhibit individuals' and households' adaptation to climate change¹¹⁵; we will summarize the most relevant insights below.

Knowledge

Policy makers often assume that people do not adapt to climate change because they lack information; they hold the assertion that if people were aware of the risks of a hazard and how to adapt, they would undertake the necessary measures to adapt.¹¹⁶ Yet, a meta-analysis found only a weak positive relationship between knowledge and adaptation.¹¹⁷ Similarly, studies show that providing information is often not sufficient to motivate people to undertake adaptive measures.¹¹⁸ Hence, while having knowledge about climate-related hazards and adaptive actions may be a necessary factor for adaptation, it is often not sufficient to motivate people to engage in adaptive actions.

FIGURE 2**Key psychological variables that play a role in climate change adaptation.**

Source: Authors.

Risk perceptions and negative emotions

Risk perception refers to a judgment that people make of the probability and severity of a particular hazard.¹¹⁹ Such judgments are subjective and can vary from person to person; while one person may find a particular hazard quite risky, another may not find it risky at all. A meta-analytic summary showed that, overall, the more people perceive risks of climate change and climate-related hazards, the more likely they are to implement adaptive measures, but the pattern of results was highly variable across studies.¹²⁰ Specifically, while some studies found that people who perceive more risks are more likely to implement adaptive measures, other studies found no significant relationship between risk perception and adaptation.¹²¹ Importantly, risk perception was more strongly related to intended behaviors than to behaviors that had already occurred in the past.¹²² This is likely because people felt less at risk after they implemented adaptive measures.¹²³

People may also respond emotionally to a climate-related risk.¹²⁴ Such emotional and affective reactions appear to play a role in adaptation to climate change. For example, in a survey conducted in Switzerland and Great Britain, respondents who had a stronger negative emotional response to climate change were more likely to support adaptation policies.¹²⁵ Especially concern about climate change or climate-related hazards has been found to be consistently related to adaptation.¹²⁶ For example, people that were more concerned about climate change were more likely to support adaptation policies.^{127,128} Interestingly, negative emotions (e.g., concern, fear) are generally more strongly related to adaptive behavior than risk perception.¹²⁹

Perceived efficacy: Can I do it and will it help?

As indicated above, perceiving a risk may not be sufficient to motivate people to undertake adaptive measures. People also need to believe they are capable of engaging in adaptive measures, and that such measures will be effective in reducing or avoiding the risk.^{130,131} Two types of efficacy are relevant in this respect. Self-efficacy refers to whether people think they are capable of implementing a particular adaptive behavior or course of action.¹³² Importantly, it refers to people's *perceived* capability, and therefore differs from (but is related to) adaptive capacity, which reflects people's objective capabilities to adapt to climate change.¹³³ Self-efficacy can play an important role in whether or not people undertake adaptive actions. For example, coastal residents in Cambodia who had more confidence in their personal abilities to adapt were more likely to engage in adaptive actions.¹³⁴ People who had more confidence that they were able to do what is needed to evacuate were more likely to report the intention to evacuate in the event of a hurricane.¹³⁵ Self-efficacy was also positively associated with taking preventive measures against malaria, such as using insect repellent and wearing long-sleeved clothing at night.¹³⁶

Outcome efficacy reflects whether people perceive an action to be effective at reducing the risks from climate-related hazards.¹³⁷ This is important, as perceiving a measure as ineffective can demotivate people to undertake such a measure in the first place. For example, an interviewee in Canada who had just lost their home in a wildfire said the following about using fire-resistant building materials:

So ... it makes no difference whether the outside [of the house] is clad in cedar or everybody you see has got plastic, which melts, and as soon as it melts it's just back to cedar ... You know, not allowing the homeowner to do what they want and then the end result it wouldn't make a darn good of difference, because we had a cement block house and it blew apart.¹³⁸

This respondent was not planning to rebuild their house using fire-resistant materials because they perceived this measure to be ineffective. On the other hand, perceiving high outcome efficacy of a measure may increase the likelihood of implementing it. Indeed, a higher perceived outcome efficacy was found to be associated with

more preparedness for flooding^{139,140}, wildfires^{141,142}, and drought^{143,144}. In fact, outcome efficacy has been found to be overall one of the key motives for adaptive behavior.¹⁴⁵

The influence of other people

Perceptions of what other people are doing, referred to as 'descriptive norms'¹⁴⁶, play a role in the process of adaptation to climate change. For example, people were more likely to purchase flood insurance if they thought that others would buy it too.¹⁴⁷ Sri Lankan farmers who perceived that other farmers were engaging in adaptive farming practices were more likely to report the intention to engage in these practices.¹⁴⁸ Similarly, seeing neighbors evacuating and businesses closing during a hurricane motivates people to evacuate.¹⁴⁹

People are also sensitive to what they believe others expect them to do, reflecting 'injunctive norms'.¹⁵⁰ Injunctive norms can inhibit or promote adaptation, depending on whether people believe that others approve or disapprove of adaptation. For example, a study in Australia found that people who thought others expected them to get a rainwater tank had stronger intentions to install one.¹⁵¹ Similarly, in China, people who perceived that their friends, family, and community expected them to prepare for flooding were more likely to do so.¹⁵² On the other hand, a British interviewee said the following about why she did not want to implement flood-protection measures in her house, even though she had been affected by flooding in the past:

I think we don't really want to [...] change it—I like my house to look nice—I don't want to have a door that is like a bit daft because I raise the [doorway]. And each time when we have friends or people coming through, you say well, you know, 'can you please step higher' That just, um—I don't know.¹⁵³

The idea of raising the doorway was unappealing to this respondent because she worried that it would make her house look 'a bit daft' and that it could inconvenience guests. A fisherman in India said the following about why he did not want to use hand-held cast nets or crab traps, which could be an effective adaptive strategy to supplement and diversify the income gained from using a more traditional, large-scale fishing method called 'Padu':

It is our birth right to have a productive lagoon and Padu system, rights which should not be compromised by adopting fishing styles of lower status fishermen.¹⁵⁴

This fisherman perceived the smaller scale fishing methods as behavior that is associated with a lower status group, and that there is a strong social norm that people from a high social status group do not adopt this behavior. Another study also found that people who thought family members would not like the idea of wildfire preparation were less likely to take preparatory measures such as clearing foliage around the house.¹⁵⁵ Overall, both injunctive and descriptive norms appear to be an important influence on adaptation behavior.¹⁵⁶

Responsibility

Perceived responsibility refers to the extent that people believe they themselves are responsible for taking adaptive measures. The lack of feeling a personal responsibility to reduce the risks of climate-related hazards has been recognized as an important barrier to successful adaptation.¹⁵⁷ Research suggests that many people seem to accept, at least, some responsibility to adapt to climate change. For example, a Dutch study found that most people perceived an equal distribution of responsibility to adapt to flooding between themselves and the government.¹⁵⁸ Similarly, most respondents of a study conducted in Colorado, United States, perceived moderate or great responsibility to prevent wildfires.¹⁵⁹ In contrast, a study conducted in the UK found that most interviewees perceived the government as responsible for preventing flooding; they rejected their own responsibility as they did not perceive themselves as capable of avoiding the impacts of flooding.¹⁶⁰ Perceived responsibility may therefore be related to perceived self-efficacy; if people perceive low self-efficacy to adapt, they may also reject their personal responsibility to adapt.

Overall, people who perceive more responsibility for adapting are more likely to engage in adaptive behavior.¹⁶¹⁻¹⁶⁴ If people deny personal responsibility and perceive governments as primarily responsible, they are less likely to implement adaptive measures.¹⁶⁵

Knowledge gaps

We have reviewed whether knowledge and different psychological motives play a role in adaptive behavior. Yet, the literature on this topic is still very much in development, and many questions remain to be addressed. Notably, some motivational variables have been studied much more extensively than others. For example, while risk perception and experience with climate-related hazards have been

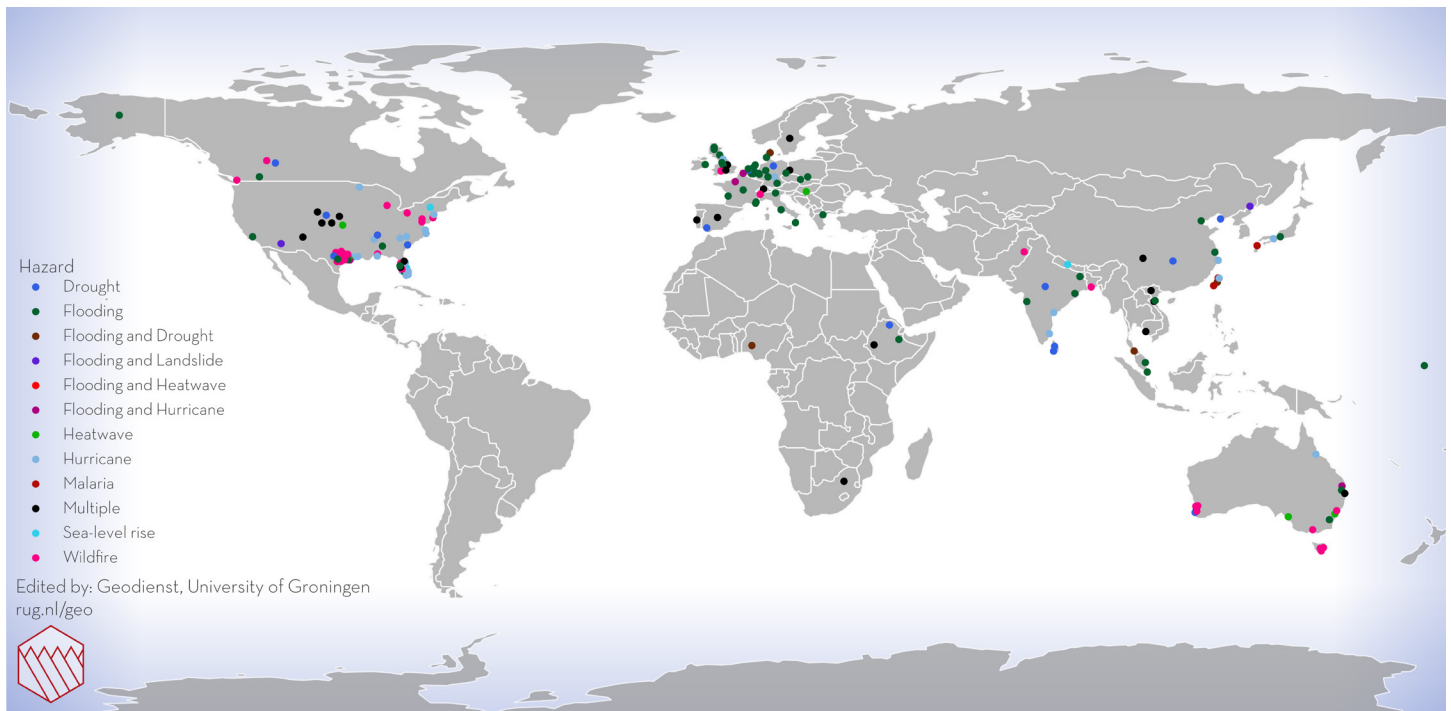
studied frequently in the literature, there is little research on the effect of descriptive and injunctive norms in adaptation.¹⁶⁶ The question therefore remains how robust the effects of social norms on behavior are, since our review was based on relatively few studies.¹⁶⁷ In a similar vein, some types of adaptive actions, such as preparative measures, have been studied more extensively than others, such as migration.¹⁶⁸ More research is therefore needed on how different psychological motives relate to different types of adaptive actions.

Moreover, the effects of different motivational factors on adaptive behavior are not consistent across studies.¹⁶⁹ Future research is needed to understand under which conditions different psychological motives may be more or less predictive of adaptive actions. For example, it may be that the predictive power of different motives varies across different types of adaptive behaviors or different types of climate-related hazards.¹⁷⁰ Most of the studies have also been conducted in the United States, Europe, and Australia (see Figure 3), so the question remains whether similar motives drive adaptive behavior in different countries and cultures. Addressing this question is particularly important as the most vulnerable populations live in the Global South, and adaptation is therefore urgent in these regions.

Furthermore, studies have scarcely looked at how different motivational factors are interrelated. Therefore it is not clear how different factors jointly determine how people adapt to climate change. Hence, future studies are needed to gain a more comprehensive understanding of how these motives are related, and under which circumstances particular motives may be more or less relevant. As an example of how psychological variables may jointly explain adaptive behavior, a study conducted in France and Germany found that descriptive social norms may be relevant in adaptation because people who perceived that others had already implemented adaptive measures also perceived higher self- and outcome efficacy of adaptive measures.¹⁷¹

Finally, the studies that we reviewed focused on a specific type of climate-hazard, namely acute hazards that are expected to intensify due to climate change. However, climate change can also cause slow-onset chronic hazards, such as rising sea levels and drought. People's responses to such slow-onset hazards may rely on different motives than responses to acute hazards. Climate change may also cause 'novel' acute hazards in areas that have not

FIGURE 3



Source: "Meta-Analyses of Factors Motivating Climate Change Adaptation." and van Valkengoed, A.M., and Steg, L. 2019. "The Psychology of Climate Change Adaptation."

historically been exposed to such risks. For example, climate change may cause malaria to migrate into new territories.¹⁷² Studying whether the psychological motives discussed here are also applicable to adaptation to such 'novel' hazards is of critical importance.¹⁷³

4. How Can Individuals and Households Be Encouraged to Engage in Adaptation?

In addition to understanding what motivates or hinders people to engage in adaptive behaviors, it may also be relevant to know how adaptation behavior can be promoted. Behavioral change interventions are more effective if they target the key antecedents of the behavior they are trying to promote.^{174,175} We will discuss how two strategies used by governments (communication and public participation in decision-making¹⁷⁶) can promote adaptive behavior by targeting the key antecedents of adaptive behavior discussed in Section 3.

Communication

Communication strategies are the most frequently used strategy by governments in motivating private adaptation to climate change.¹⁷⁷ This mostly entails providing citizens with information on climate change risks or how to adapt.¹⁷⁸ Examples of communication strategies include flyers providing information on how to adapt to climate change, climate information services that provide localized climate information for farmers, and warning systems. Yet, as indicated above, knowledge about climate change and adaptation was only weakly positively related to adaptive behavior, which suggests that information campaigns may not be very effective in promoting adaptive behavior. Already in 1983 a literature review concluded that there was little evidence for the effectiveness of information campaigns to promote adaptive behavior against natural hazards.¹⁷⁹ A recent study in the United States found that providing coastal residents with maps that showed how their ZIP-code area would be affected by rising sea-levels did not increase participants willingness to pay for the implementation of adaptation policies, compared to

a control group that saw no sea-level rise information.¹⁸⁰ Similarly, same-day exposure to television, radio, and print information on heatwaves did not reduce heatwave-related mortality in India^a.¹⁸¹ Hence, policy makers should be aware that information campaigns are typically not sufficient to encourage behavioral change.

The findings discussed in Section 3 suggest that communications strategies may be more effective if they target people's perceptions of risks of and negative emotions associated with climate change or climate-related hazards, perceived self-efficacy, perceived outcome efficacy of adaptive actions, injunctive and descriptive norms towards adaptation, and perceived responsibility to adapt. Empirical studies support this assumption. For example, a Dutch study compared the effects of messages stating that people were either in the 10% of the population most at risk of flooding, or the 10% of the population least at risk of flooding. People who saw the high-risk message reported stronger intentions to look for information on flood reduction and to implement flood reduction measures, and were more likely to click on links with information on flood preparedness.¹⁸² This study also tested the effects of information targeting self-efficacy and outcome efficacy. People read an article about flood-preparedness, which either stressed the ease and effectiveness of different flood-preparedness measures (targeting self- and outcome efficacy, respectively), or that only mentioned flood-preparedness. People who read the article which stressed the ease and effectiveness of flood-preparedness reported stronger intentions to look for information on ways to reduce the risks of flooding, to implement flood reduction measures, and were more likely to click on the links about flood preparedness, compared to people who read the article that only mentioned flood-preparedness.

A study in Australia found that providing people with a message stating that many people in the participants' area had already taken adaptation measures (targeting descriptive norms) was more effective in promoting wildfire evacuation planning than giving people information on how to prepare (targeting knowledge).¹⁸³ Importantly, providing

information on how to prepare did not increase adaptive actions compared to a control group that received no information, again showing that simply providing information is often not sufficient to promote adaptation.

A study in the United Kingdom found that reminding people of the negative emotions they experienced during a previous heatwave could increase their intention to take adaptive measures during the next heatwave.¹⁸⁴ In an Australian study, more than 1,000 respondents rated the likelihood that they would follow the advice of different real-life adaptation campaigns. The results showed that, overall, campaigns were most effective if they gave concrete suggestions of appropriate adaptive behaviors (targeting knowledge and self-efficacy), and conveyed relatively strong negative emotional content (targeting negative emotions).¹⁸⁵ Combining the provision of knowledge with appeals to other motives such as negative emotions and self-efficacy can thus be effective in promoting adaptive behavior. Interestingly, this study also found that people were less likely to follow the advice in the campaigns if the messages explicitly mentioned climate change, but only if people were skeptical about climate change.¹⁸⁶ For people that were concerned about or indifferent towards climate change, the reference to climate change in the adaptation campaign did not influence the likelihood that they would follow the advice, suggesting that the role of climate change in causing different hazards does not seem to matter much. More generally, tailoring the content of adaptation appeals or information to specific audiences may increase the effectiveness of information provision strategies.¹⁸⁷

Overall, targeting key antecedents of adaptation behavior appears to be an effective way to promote adaptation behavior. One example of how an intervention was developed to target various relevant antecedents of adaptive behavior is the 'VisAdapt™' tool.¹⁸⁸ We highlight this example in Box 2.

Public participation in decision-making

In addition to communicating to citizens, governments may consider including citizens more intensively in their decision-making processes. Citizen participation has been described as a 'ladder' that consists of different levels of public participation in governmental decision-making, rang-

^a Interestingly, this study showed that cumulative exposure to the information over a 7-year period did predict a reduction in heatwave-related mortality. The effectiveness of information campaigns may therefore depend on whether the information becomes collective knowledge after a longer period of time. This finding may also hint towards the gradual development of social norms surrounding heat-protection behavior that followed as a result of yearly information campaigns.

VisAdapt™ is a web-page tool designed to help Nordic homeowners adapt to climate change.¹⁸⁹ The tool aims to address important barriers to climate change adaptation amongst Nordic homeowners. To identify these barriers, a series of focus group interviews were held with homeowners in Sweden, Norway, and Denmark. Based on these focus groups, five key barriers to adaptation were identified: low levels of perceived risk, high levels of psychological distance (the idea that climate change will happen only in the future or in faraway locations), lack of clarity regarding what constitutes adaptation, high perceived financial costs, and low levels of perceived responsibility.¹⁹⁰ The VisAdapt™ tool was subsequently developed to reduce these barriers.

The tool consists of a web-page with three panels (see Figure 4). First, homeowners enter their address to visualize their home on Google Maps, and select the relevant features of their house (e.g., having a basement, a flat roof, etc.). Second, homeowners are able to see projected local impacts of climate change in their local area. These two panels are designed to make people aware of the local impacts of climate change and to reduce the psychological distance of climate change. In the third panel, users are shown different adaptation measures that can be implemented around their house, highlighting the measures that are most relevant to the homeowner based on the projected local impacts shown in the second panel and the features of the home selected in the first panel.¹⁹¹ The aim of the information shown in the third panel is to provide an overview of adaptive actions that people can take, to demonstrate that some adaptive measures are low cost, and to highlight that these actions are the responsibility of homeowners.

Preliminary tests have shown that the VisAdapt™ tool helped homeowners to make climate change and adaptation more personally relevant and to make adaptive actions more closely associated with day-to-day home maintenance^{192,193}, but its effectiveness in changing real-life adaptive behavior still needs to be assessed.

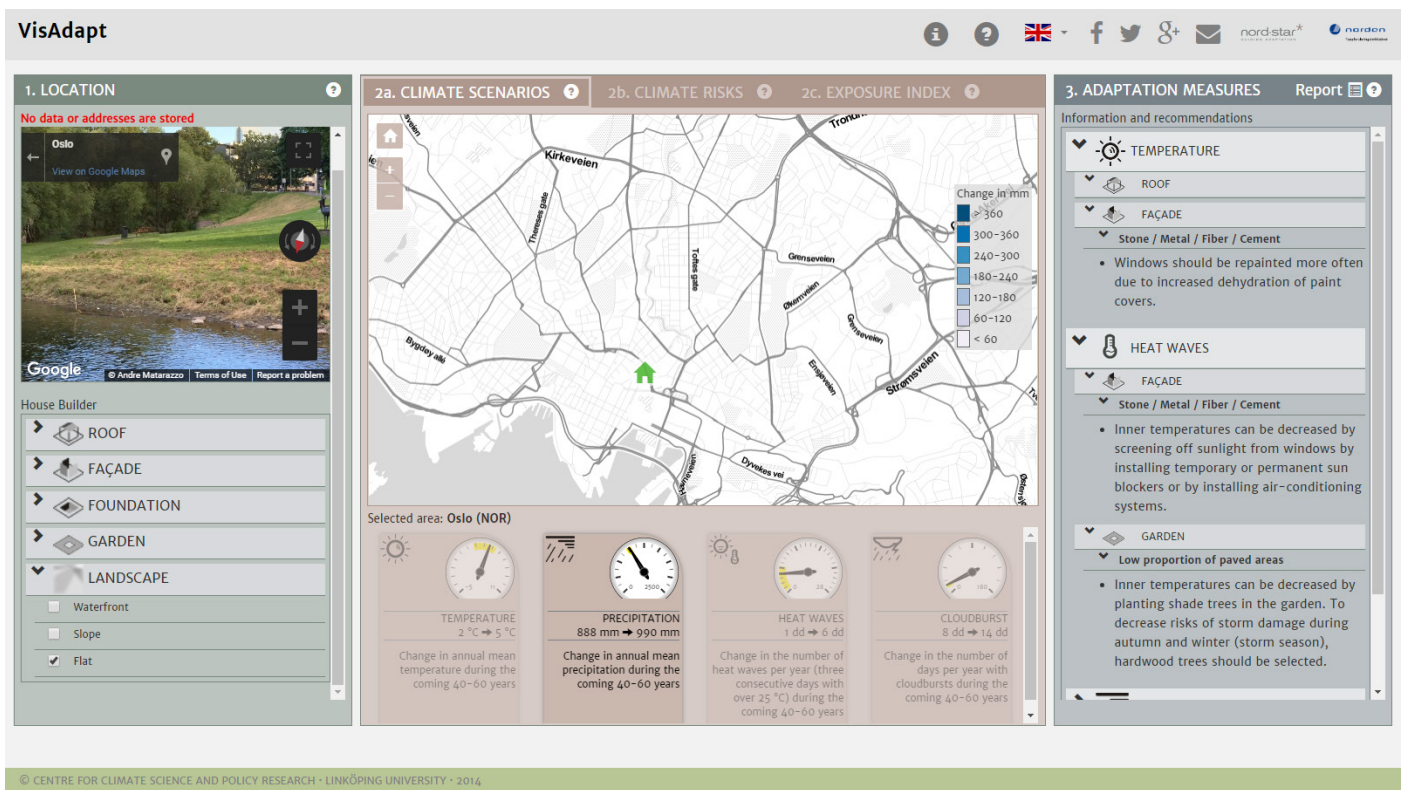
ing from non-participation (not listening to, nor informing citizens), to tokenism (informing and listening to citizens, but government takes decisions), to citizen power (yielding power to citizens to influence government decision-making).¹⁹⁴ The ladder of citizen participation considers the communication strategies described previously as 'tokenism', because they do not grant citizens power to actually influence governmental decision-making. True public participation in decision-making occurs when governments actively engage citizens in the decision-making process by ensuring two-way communication and offering citizens the possibility to influence the policy or project that is to be implemented.^{195,196}

Policy makers may be reluctant to include citizens in adaptation planning, for example because they believe it is 'too technical for citizens to be interested in'.¹⁹⁷ Also, municipalities may not have the capacity to accommodate citizens in adaptation planning.¹⁹⁸ Yet, adaptation policy can benefit greatly from including citizens in its planning, for three main reasons.¹⁹⁹ First, citizens have a right to influence

decisions that affect them directly. Second, citizens can contribute important localized knowledge that can increase the effectiveness and acceptability of the policy. For example, if governments wish to implement measures to reduce local pluvial flooding in a neighborhood, residents of that neighborhood will be the most knowledgeable about which areas in the neighborhood flooded in the past during cloud-bursts, and can therefore advise which areas are most vulnerable.²⁰⁰ Third, by including citizens in decision-making, people may perceive the decision-making process as fairer, and therefore find the overall policy more acceptable.²⁰¹

Public participation in adaptation policy can also be an important pathway to stimulating private adaptation by individuals and households, as it can play into the key motives of adaptive behavior introduced earlier. Inviting citizens to participate in adaptation planning can initiate a conversation between governments and citizens to determine each actor's responsibilities associated with adaptation. This may make citizens more aware of their personal responsibility to adapt to climate change. Second, adapta-

FIGURE 4 The VisAdaptTM interface.



Source: Taken with permission from www.visadapt.info.

tion measures that are implemented through collaboration between government and citizens are likely more extensive and effective than measures implemented by single households alone, which can raise people's perceived outcome efficacy of adaptation measures. Public participation in decision-making can also increase perceived autonomy and empower citizens²⁰², which can increase their self-efficacy to further undertake individual adaptive measures. Additionally, as mentioned previously, public participation can increase the perceived fairness of adaptation planning, which may increase people's trust in the government.²⁰³ Higher trust in government has been found to be positively, albeit weakly, associated with more engagement in private adaptation behavior.²⁰⁴ Furthermore, public participation may change perceived descriptive and injunctive norms related to adaptation. Specifically, convening a group of citizens can establish a descriptive norm that others are willing to engage in adaptation behavior. This may even spread to people who are not actively participating themselves, but hear that different community members are involved in adaptation planning. Similarly, if citizens are

actively involved in adaptation planning, adaptation to climate change may be perceived as part of a 'citizens' duty' or a 'community value', which may strengthen people's injunctive norm that adaptation is desirable and approved by members of the community.

Public participation may also increase the effectiveness of communication strategies. For example, PICSA (Participatory Integrated Climate Services for Agriculture) is a climate information system that combines climate data with localized knowledge using participatory approaches, such as active discussion and joint interpretation of climate data with trained facilitators.²⁰⁵ Most farmers perceived the PICSA approach as very useful, and that it could assist them in making adaptive decisions.^{206,207}

Yet, public participation may have two important pitfalls. First, participatory approaches can fail if governments assume that a local community is a homogenous group where all individuals have similar needs and desires²⁰⁸, thereby not acknowledging diversity in demographics (e.g.,

economic status, ethnicity, gender, age²⁰⁹) and in political orientation and personal values.²¹⁰ Local communities typically consist of diverse stakeholders that will have different preferences for adaptation policies, as they are likely to benefit or suffer to different extents from climate change adaptation policies.²¹¹

Second, well-educated and wealthy citizens are more inclined to participate.^{212,213} Participatory approaches could therefore lead to an 'illusion of inclusion', where they serve an already privileged group rather than the entire community.²¹⁴ This can lead to 'elite capture', where the needs and position of influential actors are further reinforced and entrenched.²¹⁵

To overcome these pitfalls, it is recommended that governments engage as many stakeholders as possible, share information openly with all parties, engage stakeholders in meaningful interaction, and attempt to satisfy multiple viewpoints.^{216,217} Adaptive measures and policies that appeal to different kinds of values that people may endorse, such as traditionalism, the importance of community, and protecting the environment, may be required for wide-spread public participation in decision-making.^{218,219}

Knowledge gaps

We have reviewed how communication and public participation in decision-making can promote adaptation. We identify three key knowledge gaps in motivating adaptive behavior. First, very few studies so far have tested which strategies are effective to promote adaptive behavior. The studies we discussed represent relatively small-scale studies that relied on self-report measures. While these results are promising, more systematic research is needed to better understand the effects of different interventions to promote adaptation in different contexts. Notably, to strengthen the evidence base of adaptation policy, it is important that such interventions are evaluated properly. It is key to not only assess whether an intervention was able to promote adaptation behavior, but also to examine whether the antecedents of the behavior that were supposed to be targeted by the intervention changed in the expected direction²²⁰, and whether the impacts of climate risks were actually reduced. Measuring changes in behavioral antecedents is important in order to understand *why* an intervention did (not) work, and yields important insights into how interventions can be improved.²²¹ Additionally,

measuring changes in the targeted antecedents can inform theory, as it represents an experimental test of the causal pathways within a theoretical framework.²²²

Second, it is not yet clear whether people's participation in public adaptation projects also leads to them implementing private adaptation measures. One study conducted in Sweden found that people who had interacted with the municipality regarding adaptation matters (for example, trying to influence long-term urban planning or lobbying against erosion) were more likely to implement private adaptation measures.²²³ This suggests that public participation may indeed be related to people's private adaptation behavior. However, this correlational study does not allow drawing firm conclusions about the causality of this relationship. That is, people who already have implemented more private adaptive measures may be more likely to participate in public adaptation projects too. There may also be a third variable in play that motivates people to engage in both private adaptation and participation in decision-making, such as perceived social norms or perceived risks. Future research is required to untangle whether, why, and under which conditions public participation can lead to more acceptable adaptive policies as well as motivate private adaptation to climate change.

Third, we discussed communication and public participation in decision-making as strategies to promote behavioral change. Yet, other modes of city-citizen interaction may also promote adaptation, such as financial incentives (e.g., the provision of subsidies or lowering taxes to motivate adaptation²²⁴), social influence strategies (e.g., commitment strategies, implementation intentions, using role-models²²⁵) and other structural strategies (e.g., implementing laws or removing bureaucracy in order to make it easier for people to implement adaptive measures themselves).²²⁶ Future research could examine the effectiveness of such strategies in promoting adaptation behavior by individuals and households.

5. Conclusion

In this background paper, we discussed the role of individuals and households in climate change adaptation from a psychological perspective. The role of individuals and households is often overlooked in climate change science and adaptation policymaking. Yet, individuals and households have an important role to play in successful adap-

tation to the impacts of climate change. Six categories of adaptive behavior have been studied in the literature: information seeking, preparative measures, protective measures, purchasing insurance, evacuation/migration, and political action. People are more likely to engage in these adaptation behaviors if they: perceive higher risks and experience stronger negative emotions from climate change and climate-related hazards; feel that they are able to implement adaptive measures and perceive such measures as effective to reduce climate risks; think that other people are also adapting and that other people approve of adaptation; and think that they are personally responsible for undertaking adaptive measures. Adaptive behavior can be promoted by designing interventions to target these motives, for example via communication campaigns or public participation in adaptation decision-making.

Based on our review, we offer the following three recommendations for policy makers. First, adaptation planning will be more successful if the behavior of individuals and households are systematically considered. Individuals and households can play a critical role in protecting themselves and close others against the risks of climate change. Additionally, individuals can contribute to the effectiveness and fairness of adaptation policies through public participation in decision-making. Individuals and households therefore represent an important force in the fight against climate change risks that has so far been mostly overlooked.

Second, there are multiple factors underlying people's decisions to (not) adapt and different strategies can be implemented that target key factors to promote adaptive behavior. Importantly, adaptation behavior is not just a

function of a person's knowledge or perceived risks of climate change. Rather, people are motivated or hindered by a variety of psychological factors, such as perceived responsibility and the perceived expectations and behavior of others. These different psychological factors likely interact and determine adaptation behavior in ways that are still poorly understood, and which will require future studies to disentangle. To increase the effectiveness of interventions aimed at promoting adaptation behavior, systematic monitoring and evaluation of both the target behavior as well as the targeted antecedents of adaptation behavior are necessary.

Third, individual adaptation is a necessary, but not a sufficient, condition for successfully reducing the risks of climate change. The effects of individual adaptation will be marginal if governments and industry fail to implement large-scale, infrastructural adaptation measures. For example, the effects of individual measures to reduce the impacts of heatwaves will be futile if urban heat-island effects are not addressed via climate-proof urban planning. More generally, the behavior of individuals is determined by the institutional, societal, cultural, legal, and physical context in which it takes place. Attempts to change behavior through informational or motivational campaigns may therefore be futile if there are key structural or systematic barriers to adaptive behavior. It is therefore imperative that governments create enabling environments that support individuals' decision-making for effective climate change adaptation. Overall, we hope that this background paper will inspire more consideration for the role of individuals and households in the overall discourse on climate change adaptation.

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ABOUT AUTHORS' RESEARCH INSTITUTION

The University of Groningen is an ambitious international research university with strong roots in the north of the Netherlands. The University creates and shares knowledge through its outstanding research, scholarship and education. With an academic tradition dating back to 1614 and a rich heritage, the University is a unique academic community with a strong sense of belonging and a culture of innovative education and research.

The Geodienst is the only organization-wide university spatial expertise center in the Netherlands. The Geodienst is the central point of contact for technological innovation in the field of applications of spatial information technology (data, software, visualization). Multidisciplinary specialists in the field of spatial computing and Geographic Information Systems (GIS) support scientific research with customized software, analytics and visualisations.

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The Global Commission on Adaptation seeks to accelerate adaptation action and support by elevating the political visibility of adaptation and focusing on concrete solutions. It is convened by 20 countries and guided by more than 30 Commissioners, and co-managed by the Global Center on Adaptation and World Resources Institute.