

## 1 Introduction

Climate change is already affecting our lives. Global temperature has on average increased by 1°C since the beginning of the Industrial Revolution (IPCC, 2018). Moreover, it has now become unavoidable that the climate will change even further (IPCC, 2014c). Even if we completely halted all greenhouse gas emissions right now, sea levels and global temperature levels would continue to rise for the next decades (Solomon, Plattner, Knutti, & Friedlingstein, 2008). Climate change will increase the frequency and severity of a wide variety of natural hazards, including heatwaves, flooding, drought, tropical cyclones, hurricanes, vector-borne diseases, landslides, hailstorms, and wildfires. Such climate-related hazards threaten human health and well-being and can cause severe economic damage (Sauerborn & Ebi, 2012).

Because climate change is unavoidable, it is no longer sufficient to only focus our efforts on limiting or reducing it. It is also critical that people take actions to protect themselves against the impacts of climate-related hazards. Examples of actions that people can undertake include, amongst others, clearing the fire-prone foliage around their house to reduce the risk of wildfire, purchasing flood insurance, painting their home in a lighter colour to reflect sunlight and lower indoor temperatures during a heatwave, preparing an emergency kit, and actively following weather forecasts so that timely actions can be taken. Additionally, people can support adaptive policies that are aimed at defending them and others against climate-related hazards. Such actions are referred to as “adaptation to climate change” (IPCC, 2014b).

Despite the urgency and effectiveness of adaptation actions in reducing or avoiding the negative impacts of climate-related hazards, many people still fail to take the necessary measures to protect themselves (Basolo et al., 2008). Estimates are that approximately half the households that are at significant risk of flooding in the United Kingdom have undertaken no actions to prepare themselves against flood risks (Bichard & Kazmierczak, 2012), while another study found that 82.1 per cent of participants in the United Kingdom were not prepared for flooding (Soane et al., 2010). Promoting adaptation behaviour amongst individuals and households is one of the critical challenges of the twenty-first century.

In this Element, we provide a social psychological perspective on climate change adaptation behaviour. We discuss literature that applies theory and insights from social psychology to understand which factors explain whether individuals and households are likely to protect themselves against the risks of climate change. By building on fundamental principles and theories of individual and group behaviour, social psychology is uniquely equipped to explain

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and predict how individuals and groups adapt to climate change. Additionally, social psychological research plays a key role in evaluating and explaining which interventions are effective in changing people's behaviour, such as engaging in climate change adaptation. As we will show in this Element, the social psychological perspective on climate change adaptation provides critical insights into understanding and changing how individuals adapt to climate change.

This Element is organised as follows. In Section 2, we start with discussing what is meant by climate change adaptation and which individual and household behaviours may be considered adaptive. In Section 3, we review the literature on which psychological variables are related to adaptation behaviour. We introduce the Model of Private Proactive Adaptation to Climate Change and an extension of this model, and we review empirical evidence on the extent to which the variables included in these models predict adaptive behaviour. In Section 4, we review interventions that demonstrate how adaptation can be promoted by applying psychological theory. In Section 5, we discuss the commonalities and differences between climate change adaptation and climate change mitigation, which focus on adapting to versus preventing climate change, respectively. In Section 6, we propose a research agenda that highlights key gaps in the literature and identifies directions for future research, including possible theoretical advancements and methodological improvements.

### 2 What Is Climate Change Adaptation?

*Climate change adaptation* is defined as 'the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities' (IPCC, 2014b). In this section, we focus on adaptation to natural hazards that are likely to increase in severity and frequency due to climate change, such as heatwaves, flooding, and droughts. As such, we define *adaptation* as 'behaviours that are aimed at avoiding or reducing the negative impacts of climate change'. It has often been argued that climate change mitigation, the process of halting or minimizing climate change, should take precedence over climate change adaptation (Pielke, Prins, Rayner, & Sarewitz, 2007). However, as previous mitigation actions have proven to be insufficient, the impacts of climate change are now unavoidable. Today, adaptation to climate change is recognised as an important component of the response to climate change, complementary to climate change mitigation (IPCC, 2014d).

Different types of adaptation can be distinguished. First, a distinction can be made between reactive adaptation and anticipatory adaptation. *Anticipatory*

*adaptation* refers to adaptive actions taken in response to expected climate-related hazards, while *reactive adaptation* occurs in response to climate-related hazards that have already occurred (Smit, Burton, Klein, & Wandel, 2000). Second, *autonomous adaptation* refers to adaptive actions undertaken by private actors without the interference of governments or other public bodies. *Planned adaptation* on the other hand refers to policy decisions made by public bodies (Tol, Klein, & Nicholls, 2008). Third, *incremental adaptation* refers to adaptive actions that aim to maintain the status quo and the current way of life, while *transformational adaptation* subsumes adaptive actions that fundamentally alter existing institutional, governance, and value systems (IPCC, 2014a). Fourth, a distinction can be made between adaptation and *maladaptation*. The latter refers to ‘actions, or inaction that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future’ (IPCC, 2014a, p. 857). Examples of maladaptation include denying or minimizing the problem, wishful thinking, fatalism (Grothmann & Patt, 2005), or actions that may offer protection from climate change in the short term but increase vulnerability in the long term (Barnett & O’Neill, 2010). For example, island inhabitants in the Philippines use coral stone to raise their floors and reduce the impacts from flooding (Jamero et al., 2017). However, coral plays an important role in regulating water levels; removing it increases vulnerability to flooding in the long term (Ferrario et al., 2014). Maladaptation also includes actions that increase greenhouse gas emissions (Barnett & O’Neill, 2010). Examples include desalinisation of water to adapt to drought or using air-conditioning to cope with heatwaves (Barnett & O’Neill, 2010). These examples indicate that adaptation and mitigation are related, and that possible synergies and trade-offs between adaptation and mitigation may occur (R. J. T. Klein et al., 2007). We will return to this topic later in this Element.

## 2.1 Adaptation by Individuals and Households

The process of adaptation to climate change needs to take place at all levels of society and can be initiated by local, national, and international governments, as well as by industry, communities, households, and individuals (Adger, 2001; Adger, Arnell, & Tompkins, 2005). While the literature on adaptation to climate change has mostly focused on planned adaptation, that is, adaptation measures implemented by governments, we focus on adaptation to climate change by households and individuals. Following the previously discussed definitions, we thus focus on adaptation behaviours that are autonomous, mostly incremental, and that may be either reactive or anticipatory. Household actions are more

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likely to be incremental, as transformational adaptation requires large-scale societal changes that may be more difficult to establish by individuals and households alone. Additionally, we focus on adaptive behaviour, as hardly any studies have been conducted on maladaptive behaviour at the level of individuals and households; we return to this topic when we discuss the research agenda.

It is critical to focus on adaptation behaviour of individuals and households, and not to rely only on large-scale, government-issued protective measures, as governments alone cannot guarantee successful adaptation (Takao et al., 2004). Government-issued adaptive measures will typically leave a margin of error referred to as ‘residual risk’ (Aliagha, Jin, Choong, Nadzri Jaafar, & Ali, 2014). For example, the Netherlands is a flood-prone country where many people live below sea level and are protected by dykes. Currently, not all dykes have the same safety level, which is expressed as the probability of a flood occurring in a particular year in that area. The highest safety level is 1/10,000 years, while the lowest safety level is 1/1,250 years (Aerts, 2009). Raising all the dykes to provide the highest safety level for flooding would be extremely costly. Cost-benefit analyses show that the most cost-effective safety level for most dykes in the Netherlands is indeed much lower than the highest possible level (Kind, 2014). As this example shows, government policy to manage climate risks never accounts fully for all risk, as it would be extremely costly to do so. Especially since climate-related hazards will occur more frequently in the future, individual adaptation actions are of critical importance.

As indicated earlier, governments base their risk management strategies on cost-benefit analyses (Baan & Klijn, 2004). Such analyses also show that individual actions to adapt to climate change can be highly effective in reducing the impacts of climate-related hazards while incurring relatively low costs (Bates, Quick, & Kloss, 2009; Botzen, Aerts, & van den Bergh, 2009). For example, one study found that flood-adapted building use (i.e. not placing expensive furniture and equipment in the lower stories and cellar of a building) and flood-adapted interior fitting (i.e. using waterproof building materials and easily movable furniture) reduced flood damage ratios by 46 per cent and 53 per cent, respectively (Kreibich et al., 2005). Another study estimated that monetary damage from floods could be reduced by up to 80 per cent through individual adaptation actions, such as moving furniture or temporarily sealing openings in the house with sandbags (Egli, 2002, cited in Grothmann & Reusswig, 2006). Governments therefore increasingly acknowledge that behaviour by individuals and households forms an essential component of climate adaptation strategies (Baan & Klijn, 2004; Elrick-Barr, Smith, Preston, Thomsen, & Baum, 2016). 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’ (DEFRA, 2013, p. 7, quoted in Porter, Dessai, & Tompkins, 2014).

Having identified the importance of adaptation at the individual and household levels, the next critical question is what adaptation actions can be taken by individuals and households. It is almost impossible to present an exhaustive list of adaptive behaviours that households and individuals could perform. Indeed, one study presented more than 100 adaptive actions that households in Sweden could conduct (Wamsler & Brink, 2014). Importantly, different geographical areas are faced with different climate-related risks and therefore require unique adaptive responses. Rather than presenting an exhaustive list, we therefore use a categorisation to identify the most commonly studied adaptive actions at the level of individuals and households. Our categorisation is composed of six categories of adaptive behaviours that may be conducted by individuals and households to protect themselves against climate-related hazards: information seeking, preparative actions, protective actions, evacuating, purchasing insurance, and political actions. Please note that this categorisation was informed by the literature review we conducted for this Element and was therefore not developed a priori on theoretical grounds. As such, this categorisation may not be complete; we come back to this when we discuss the research agenda. An overview of the categorisation used for this Element is provided in Table 1.

**Table 1** Classification of different types of adaptive behaviours that individuals and households can undertake

| Type of adaptive behaviour | Description   | Examples   |
|----------------------------|---|--|
| Information seeking        | Expending time and effort to gain more information about specific climate-related hazards, to identify whether you are at risk of a hazard, and gaining information on which actions to perform to successfully adapt to climate change | Studying weather forecasts, using flood maps, looking up information on how to flood-proof the house, reading government brochures on preparedness, listening to the radio during a climate-related hazard |

**Table 1** (cont.)

| <b>Type of adaptive behaviour</b> | <b>Description</b>  | <b>Examples</b>   |
|-----------------------------------|---|---|
| Preparative actions               | Structural actions taken before the onset of a climate-related hazard aimed at reducing the probability of being affected by a hazard or minimising its negative impact | Boarding up windows before a hurricane, installing valves with back-flow prevention, cleaning gutters, storing non-perishable foods                   |
| Protective actions                | Actions taken during an ongoing climate-related hazard to avoid or reduce its impact  | Defending the home against wildfire, not driving through floodwater with a vehicle, staying inside during a hurricane, staying cool during a heatwave |
| Evacuation                        | Temporarily moving away from an area to avoid the negative impacts of climate-related hazard; may also include leaving an area permanently if required                  | Complying with government-issued evacuation, planned retreat, migration   |
| Purchasing insurance              | Purchasing an insurance policy that covers losses from one or multiple climate-related hazards  | Flood insurance, wildfire insurance, homeowner insurance  |
| Political actions                 | Influencing local or national governments to implement adaptation policies  | Voting in favour of adaptive policies, protesting, participating in town hall meetings, forming an action group, signing a petition                   |

*Information seeking.* An important part of reducing the impacts of climate-related hazards is to be aware of whether you are at risk. Information seeking can be defined as ‘a deliberate effort to acquire information in response to a need or gap in one’s knowledge’ (Kievik & Gutteling, 2011, p. 1477). Information seeking is often conceptualised as an initial phase or first step in the process of hazard adjustment (P. D. Howe, 2011). People may start seeking information before or after a climate-related hazard has occurred (Griffin et al., 2008). People can also look up information on immediate weather forecasts or government-issued weather warnings. This information can help people determine whether a natural hazard is imminent, and whether and which urgent responses are required. Governments frequently provide information about the risk of hazards such as flooding and wildfires that a residential area faces. The Federal Emergency Management Agency (FEMA) in the United States issues flood maps that showcase long-term flood probabilities for residential areas (Xian, Lin, & Hatzikyriakou, 2015). Many governments also provide checklists, information sheets, or websites that indicate what actions are appropriate to adapt to specific climate-related hazards. Such information may help people prepare effectively.

*Preparative actions.* Preparative actions are structural actions taken before the onset of a climate-related hazard and are aimed at reducing the probability of being affected by a hazard or minimizing its negative impacts. Examples of preparative actions include installing hurricane shutters, trimming fire-prone foliage around the house, preparing an emergency kit, applying heat-reflecting paint to the home, and purchasing sandbags to avoid floodwater entering the home. These measures are usually more cost and time intensive than the other behaviours described here and require deliberate preparation.

*Protective actions.* Protective actions include all behaviours that are conducted during a climate-related hazard to avoid or reduce its negative impacts. This may include avoiding physical labour during a heatwave, moving to a cellar during a hurricane, reducing water consumption during a drought, or moving upstairs during a flood. These actions are taken in response to ongoing hazards and are therefore usually more intuitive and less planned for than preparative actions, even though some protective actions can also be planned beforehand.

*Evacuation.* For some climate-related hazards, negative consequences may be best avoided by temporarily evacuating. For example, governments recommend evacuation in response to strong hurricanes or wildfires. Migration, that is, permanent relocation, may also be an adaptive action if conditions become too extreme due to climate change (McLeman & Smit, 2006). Some island communities may be forced to relocate to the mainland in the future because of

rising sea levels and inundation (Burkett, 2011). Migration has been suggested as an effective way to improve resilience in such circumstances (Black, Bennett, Thomas, & Beddington, 2011). Yet, migration is often associated with significant losses of community, sense of place, and cultural heritage. For example, many Native American communities, particularly in coastal areas such as in Alaska and Louisiana, may have to migrate from areas that hold important cultural and historical significance (Maldonado, Shearer, Bronen, Peterson, & Lazrus, 2013). Migration may not solve all issues caused by climate change. A study in Cambodia found that migration for climate reasons did not always achieve the goal of reducing food insecurity, which could lead to a vicious cycle of food insecurity and migration that reinforces poverty over the long term (Jacobson, Crevello, Chea, & Jarihani, 2019). It is therefore disputed to what extent migration represents successful adaptation to climate change (de Sherbinin et al., 2011).

*Purchasing insurance.* Purchasing insurance may be an effective way to reduce the financial costs associated with coping with the negative impacts of climate-related hazards. This adaptive action however has its limits, as it only protects against financial costs and does not offer protection against personal physical damage, injury, or the emotional damage associated with experiencing a natural hazard (Siegrist & Gutscher, 2008). Yet, insurance may be critical for low-income households that are faced with repeating natural hazards that may contribute to the perpetuation of the cycle of poverty (Mechler, Linnerooth-Bayer, & Peppiatt, 2006).

*Political actions.* As mentioned previously, adaptive actions can also be initiated by local, national, and international governments. In democratic countries, individuals and households can be actively engaged in the development and implementation of adaptation policy. For example, people may vote in favour of or against government-level adaptive policies or parties that support them (Hagen, Middel, & Pijawka, 2016). People may also attempt to convince their government representatives to implement more adaptive measures (Elrick-Barr et al., 2016). Furthermore, people can influence government policies through forms of protest or collective action, although, to the best of our knowledge, these actions have not been studied in the context of climate change adaptation.

In the next section, we discuss studies that examine how different psychological variables relate to whether people engage in these types of actions. To preserve the readability of the Element, we do not discuss the results for each type of adaptive behaviour separately. Rather, we talk about adaptation or adaptive behaviour in general, which we use as an umbrella term to refer to the previously mentioned behaviours. However, it is important to keep in mind



that some psychological predictors may be more or less important than others for some adaptive behaviours. We return to this topic in the research agenda.

### 3 Factors That Promote Adaptation Behaviour

In this section, we review the psychological literature on adaptation. We introduce fifteen psychological variables that could be related to climate change adaptation. We discuss the theoretical rationale explaining why variables may be related to adaptation behaviour and review the associated empirical evidence.<sup>1</sup> We first introduce the Model of Private Proactive Adaptation to Climate Change (MPPACC; Grothmann & Patt, 2005, see Figure 1). Based on protection motivation theory, the MPPACC proposes that four key components predict adaptation behaviour: risk perception, self-efficacy, outcome efficacy, and perceived costs of adapting. The MPPACC also includes three additional variables, namely experience with climate-related hazards, trust in government measures, and perceived incentives to adapt. Next, we introduce an extension of the MPPACC model proposed by Dang, Li, and Bruwer (2012) (see Figure 1) that contains four additional variables: social norms, negative affect, climate change perceptions, and habits. Last, we introduce four variables that were not included in these theoretical models but that have been examined in the adaptation literature frequently. These variables are place attachment, knowledge, personal responsibility for adaptation, and trust in the government. Table 2 provides an overview of the variables that we discuss, the main conclusions from the literature review, and key references.

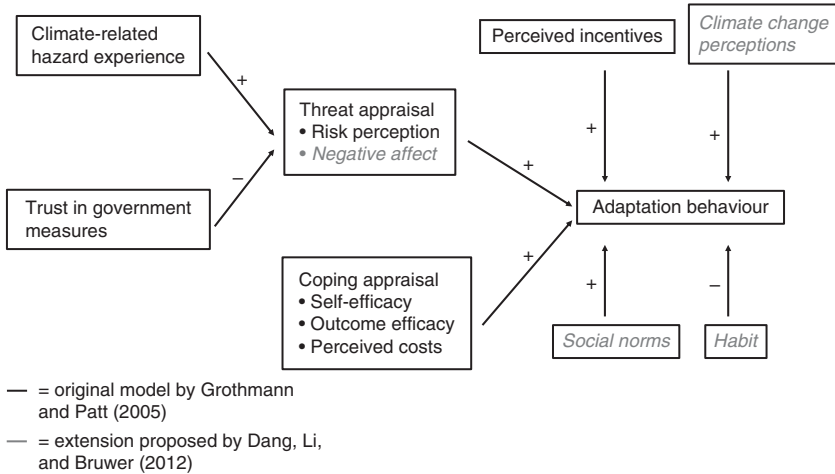
In this review, we discuss in depth the different studies for each psychological variable. For a meta-analytic overview of the relative importance of the discussed variables in climate change adaptation, please see Van Valkengoed & Steg (2019).

#### 3.1 The Model of Private Proactive Adaptation to Climate Change

The MPPACC has been developed to explain which factors motivate individuals and households to engage in adaptation behaviour (Grothmann & Patt, 2005). The model is an extension of protection motivation theory (Rogers, 1975, 1983), which has been used extensively in the domain of health psychology to explain how people cope with health-related threats, such as smoking (Yan et al., 2014), engaging in physical exercise

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<sup>1</sup> We would like to highlight that many of the studies we discuss were conducted in a Western context, and results may therefore not be generalizable to all contexts. We discuss this in more detail in the discussion section.



**Figure 1** The model of private proactive adaptation to climate change (adapted from Grothmann & Patt, 2005) and the extension proposed by Dang, Li, and Bruwer (2012) in *italic*.

**Source:** Figure made by authors.

(Bui, Mullan, & McCaffery, 2013), and choosing to undergo cancer screenings (Bai et al., 2018). As climate change adaptation also involves coping with threats, the protection motivation framework seems relevant to explain which factors motivate adaptive behaviour. The MPPACC was developed to adapt the protection motivation framework employed in health psychology to explain climate change adaptation. Similar to protection motivation theory, the MPPACC proposes that four factors predict people's adaptation behaviour: risk perception (referred to as the 'threat appraisal') and self-efficacy, outcome efficacy, and perceived adaptation costs (jointly referred to as the 'coping appraisal'). We discuss each component in turn before looking at the interrelationship between these variables as assumed in these models.

### 3.1.1 Risk Perception

*Risk perception* is defined as people's subjective judgements of the likelihood and consequences of a hazard harming them or someone/something they value, such as family members, close others, possessions, or nature (Paek & Hove, 2017). Perceiving high risks results in an uncomfortable state of mind that people want to reduce. Risk perception is therefore likely to motivate people to undertake adaptive actions. This is also referred to as the 'motivational hypothesis' (Weinstein, Rothman, & Nicolich, 1998). The greater the