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Addressing the climate change adaptation puzzle: a psychological science perspective

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ABSTRACT

Unlike climate change mitigation, adaptation to climate change does not as much suffer from the fundamental global public good problem - at least at the countrylevel - since it is in the self-interest of each individual country to adapt. However, the observed level of adaptation is insufficient from an economic perspective. We address this puzzle by adding a psychological perspective to explain actors' behaviour. Based on existing meta-analytic evidence we discuss micro- (i.e. individual-), meso- (i.e. group-) and macro- (i.e. society-) level factors that may contribute to more engagement in adaptation and provide recommendations on how to address them. The results show that the strongest predictors of individual adaptation behaviour are people's beliefs whether adaptive actions will be effective in protecting them from climate-related hazards (outcome expectancy), the degree to which people believe that they are able to engage in adaptive actions (selfefficacy) and their emotional reaction to climate change. Equally strong on a mesolevel are behavioural norms and cultural aspects on a macro-level. We 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 communicative interventions may contribute to motivate adaptive actions by individuals and organisations.

Key policy insights

- Psychological factors play an important but underestimated role in explaining adaptation behaviour.
- If people believe that they can address the risks of climate-related hazards they will show stronger adaptation behaviour. This insight can be used to incentivise more investments in adaptation.
- Social norms and cultural values are linked to adaptation behaviour. Public communication campaigns and other policy interventions can help to change social norms, and they should be tailored to the cultural values of societies.
- The influence of social norms and cultural values can be stronger than individuallevel variables such as beliefs and preferences.
- People underestimate the extent to which others are willing to contribute to society, in particular in societies scoring high on individualism and masculinity. This can prevent people from investing in adaptation.

1. Introduction to the 'adaptation puzzle'

Anthropogenic climate change is considered a result of the biggest market failure the world has ever seen (Stern, 2008). Because climate change is a global externality problem, emission reduction needs to be

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Psychology; adaptation; review; self-efficacy; beliefs; norms; culture coordinated among states at a global level. The economic characteristics of climate change adaptation (hereafter 'adaptation') are fundamentally different since the global public good aspects are drastically reduced. Although there is emerging literature on 'borderless' climate risks such as food security in the context of global food supply chains and cross-border climate-induced population displacement and migration (Benzie & Persson, 2019), most benefits of adaptation measures will materialise in the country or locality where such measures are taken. For example, a dike can protect against sea-level rise at the country- (or regional) level but not at the global level. Governments should play a role in building and financing dikes (Bisaro & Hinkel, 2018) since for any activity providing public goods (even at the national level), purely market-based incentives are insufficient. People are predominantly motivated to implement adaptation measures that benefit them directly.

Positive (and negative) externalities connected to adaptation activities therefore justify policy intervention from an economic perspective (e.g. at the national or municipal level) (see Druce et al., 2016). If barriers such as lack of incentives for public good provision are addressed by public policies, we should observe that people will be motivated to engage in adaptation and invest accordingly. However, we observe an 'adaptation gap' where overall investment in adaptation is below the optimal level (see Carleton & Hsiang, 2016; Global Commission on Adaptation, 2019; UNEP, 2016). What literature identifies as an insufficient level of adaptation investment (relative to the socio-economic optimum) may to some extent result from a lack of available resources, in particular in developing countries. It may, however, also be caused by inefficient investment in adaptation is necessary and despite having policy instruments at their disposal to implement such measures. We call this the 'adaptation puzzle'. It boils down to the question: If it is in the self-interest of people to invest more in adaptation, if countries are aware of the need to do so and if fiscal policy instruments are available to stimulate more investments in adaptation, then why do we still observe sub-optimal investment levels?

This paper analyses how policymakers can stimulate more investments in adaptation. It is not about identifying the extent to which national governments or international support are responsible for adaptation. Literature has identified barriers that prevent investments in adaptation from materialising, including financial-, informational-, institutional-, political/regulatory-, technological- or socio-cultural barriers (see Druce et al., 2016). In this list, psychological variables are missing. Empirical evidence demonstrates that people's judgments and decisions sometimes systematically deviate from the basic principles of logic and probability (Shafir & LeBoeuf, 2002). Instead of just maximising economic utility functions, people seem to rely on intuitive strategies and simple heuristics, which prove reasonably effective in everyday contexts (Gigerenzer & Gaissmaier, 2011) but which may also lead to severe biases in human decision making (Kahneman et al., 1991). Since decisions at all levels are eventually made by individuals acting within their specific roles and environments, a psychological perspective may help to address the adaptation puzzle.

Recent efforts to go beyond a purely rational and traditional economic perspective on adaptation have integrated cognitive, emotional and behavioural variables that drive adaptation (Clayton et al., 2015; 2016; Gifford, 2011; Swim et al., 2011; Van der Linden et al., 2015). This article therefore focuses on understanding essential psychological variables influencing the behaviour of individuals and how they risk generating underestimation and misunderstanding of the numerous ways in which climate change could impact their business or livelihood directly or indirectly (see Pauw, 2015).

This article reviews the literature on adaptation through a psychological lens and summarises findings from previous meta-analyses to derive policy recommendations. Our contribution to solving the 'adaptation puzzle' is twofold. First, we integrate empirical evidence from psychological science into the adaptation literature. This is an important endeavour since the interdisciplinary and fragmented adaptation literature has called for the scientific discussion on adaptation not to identify new variables, but to contribute to a better understanding of known variables (Siders, 2019). Our work goes beyond a purely meta-analytic discussion of statistical relationships 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; as such, it represents a synthesis of meta-analytical studies that further explains the strongest effects of these meta-analyses with illustrative examples. Second, by focusing on constructive approaches rather than on obstructive factors, we take a positive perspective that is of practical relevance given the crucial role of individuals or groups as

decision-makers in the context of adaptation. In doing so, we derive generic policy recommendations to enhance engagement of individuals in adaptation.

This article is structured as follows: The next section explains the method of the literature review. Section 3 provides an overview of essential psychological variables identified by previous research on adaptation and organises these by providing a multilevel psychological perspective. Sections 4, 5 and 6 elaborate on the identified groups of variables, provide empirical evidence for each variable and offer general recommendations for policymakers. The final section of the paper discusses these recommendations and describes new directions for further research.

2. Method

We systematically searched for meta-analyses on adaptation, i.e. literature reviews that apply a formal statistical analysis of empirical results. We categorised the meta-analytical variables as *micro-, meso-* or *macro-level* variables, an approach frequently applied in the social sciences (see e.g. Bergström & Dekker, 2014; Jaspal et al., 2016; Maibach et al., 2008). Micro-level variables constitute the smallest unit of analysis, typically the individual, and they comprise people's temporally stable dispositions as well as state-related cognitions and emotions. The meso-level focuses on how social relationships and group memberships (e.g. in organisations) impact behaviour. The macro-level represents the highest level of analysis; it analyses how cultural contexts and policies influence behaviour (Jaspal et al., 2016).

We ran a computerised literature search in November 2019 using EBSCO, Scopus and ProQuest with combinations of the following keywords; 'adaptation', 'climate change', 'meta-analysis'. To ensure methodological quality, we did not consider grey literature such as practitioner reports and donor-funded project evaluations. We focused on quantitative results that included effect sizes. We excluded meta-analyses on physical aspects of adaptation and focused on empirical work that is related to human perception, emotions and behaviour.

We report Pearson's *r* correlation coefficients to denote effect sizes; *r* is among the most frequently used effect size measures in the analysis of human behaviour; it describes the linear relationship between two continuous variables and ranges from -1 (perfect negative linear relationship) to +1 (perfect positive linear relationship) (see Field et al., 2012). Recent research recommends *r* = .10 for small, *r* = .20 for typical and *r* = .30 for relatively large effects (Gignac & Szodorai, 2016). Although these figures may seem small, Rosenthal and Rubin (1982) suggest that they can have relevant implications. For example, if the correlation between an adaptation strategy and survival is *r* = .20, 60% of those who use the adaptation strategy will survive compared to only 40% in the control group not using it. Thus, the magnitude of the correlation is the difference in survival rates between the two groups. The correlations in the identified meta-analyses for the present work ranged from *r* = .02 to .33; to account for the key variables, we followed Gignac and Szodorai (2016) and focused on variables with effect sizes of *r* > .20.

To illustrate these variables beyond the size of their statistical effect and derive recommendations for decision-makers, especially those not primarily working in the field of psychology, we conducted an additional literature search. We first reviewed the psychological literature for each variable and briefly described the theoretical concept and mechanisms behind it. Second, we searched for empirical studies that investigated this variable in the context of adaptation activities of individuals, groups or societies. These studies were identified using the following combinations of keywords on Google Scholar: *name of the key variable* (e.g. self-efficacy) and combinations of 'adaptation', 'climate change', and 'individuals', 'groups' 'organisations/ organizations' or 'society'. We included studies that were published between 2010 and 2020 and that used a quantitative research design, hence no theoretical articles were included. We only considered studies that focused on the variables previously identified in the meta-analyses (see Results section) and that were related to climate change and/or adaptation in a broader sense.

3. Results

Three studies (Alló & Loureiro, 2014; Bamberg et al., 2017, 2020; Van Valkengoed & Steg, 2019) met the inclusion criteria of our literature search on meta-analyses. From these meta-analyses we derived six variables (see Figure



Figure 1. Multilevel psychological science perspective on factors affecting adaptation, based on meta-analytical evidence of Alló and Loureiro (2014), Bamberg et al. (2017, 2020) and Van Valkengoed and Steg (2019).

1) with effect sizes ranging between $.23 \le r \le .33$. Since Alló and Loureiro (2014) performed a meta-regression, we inferred *r* by standardizing the regression coefficients and converting them into Pearson's *r* correlation coefficients following the methodology proposed by Peterson and Brown (2005)¹ – an approach frequently used in meta-analyses (e.g. Van Valkengoed & Steg, 2019).

Micro-level variables. Van Valkengoed and Steg (2019) reviewed 106 studies from 23 different countries and identified a total of 13 variables related to adaptation. In descending order, the strongest effects were for *outcome expectancy* (belief that adaptation will effectively protect against climate risks and hazards; r = .29), *nega-tive affect* (dysphoric state of mind associated with climate change which people attempt to reduce; r = .29), *self-efficacy* (belief that one is able to engage in relevant adaptation actions; r = .26) and *climate change belief* (belief in the reality of climate change; r = .23). Bamberg et al. (2017, 2020) analysed adaptation behaviours in the context of flood prevention. Reviewing 36 studies, they identified five variables of which two had a correlation coefficient of r > .20: *coping appraisal* (generic term for self-efficacy and outcome expectancy; r = .25) and *threat appraisal* (estimated likelihood of threat exposure and its perceived consequences; r = .23).

Meso-level variables. Besides individual-level variables, behavioural norms motivate people to invest in climate change adaptation. Van Valkengoed and Steg (2019) differentiate between *descriptive norms* (perception of whether others are engaging in adaptation; r = .29) and *injunctive norms* (perception of whether adaptive actions will be approved/disapproved by others; r = .25). Moreover, if people *perceive themselves responsible* in comparison to others, they are more likely to engage in adaptation behaviour (r = .25).²

Macro-level variables. Alló and Loureiro (2014) conducted a meta-analysis with 58 studies and used Hofstede's culture index (Hofstede, 2001) to assess the influence of cultural dimensions on preferences towards adaptation and mitigation policies. Hofstede (1980a, p. 25) defined culture as 'the collective programming of the mind which distinguishes the members of one human group from another.' Three dimensions of his cultural framework were significantly related to people's willingness to contribute to both climate mitigation and adaptation programmes: It seems that people in societies with a *long-term*, future-oriented *perspective* have a greater willingness to contribute to mitigation and adaptation compared to people in societies with a short-term orientation (r = .33). In contrast, societies with a preference for values associated stereotypically as *male* (e.g.

190 👄 M. N. BECHTOLDT ET AL.

achievement, heroism, assertiveness and material rewards for success) are less willing to contribute to adaptation compared to societies with a preference for values associated stereotypically as feminine (e.g. cooperation, modesty and caring) (r = -.32). Also, *individualistic* cultures where people are expected to take care of themselves have a lower willingness to pay for adaptation compared to collectivistic cultures (r = -.30).

The next section will elaborate on these findings in order to derive recommendations for how to stimulate more investments in adaptation by individuals.

4. Micro-level factors to stimulate adaptation investments

How individuals perceive and feel about climate change significantly impacts their adaptation behaviour. Notably, their adaptation behaviour is also affected by how they perceive themselves.

4.1. Efficacy beliefs & appraisals

Efficacy beliefs constitute core components of several prominent behavioural theories in psychology (Theory of Planned Behaviour, Ajzen, 1985; Social Cognitive Theory, Bandura, 1997; Protection Motivation Theory, Rogers, 1975, 1983). *Outcome expectancy* (sometimes also called outcome efficacy) relates to one's own judgements regarding the likely consequences that specific actions will produce. *Self-efficacy* refers to the 'beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments.' (Bandura, 1997, p. 3). Applying these concepts to adaptation, outcome expectancy refers to the degree that individuals perceive their adaptive actions as effective in protecting them from specific climate-related threats, whereas self-efficacy relates to the degree people perceive that they are capable in engaging in relevant adaptive actions (Van Valkengoed & Steg, 2019).

Whether people perceive themselves as self-efficacious depends on both individual resources (human capital such as knowledge, education, health, labour, income), structural resources like the availability of material, infrastructure and technology (e.g. communication networks, early warning systems, transport and water infrastructure) as well as the availability of financial instruments such as loans (Burnham & Ma, 2017).

Notably, there is evidence that people's sense of *collective efficacy* is even more important in promoting environmental behaviour than individual self-efficacy (Chen, 2015). Perceived collective efficacy is an emerging group characteristic that goes beyond the sum of the efficacy beliefs of individual members (Bandura, 2000). Even brief manipulations of people's collective efficacy may increase individuals' confidence to deal effectively with climate change and thus strengthen their pro-environmental intentions (Jugert et al., 2016). For example, participants who read that their generation was capable of preventing the impending catastrophes of climate change were more motivated to support pro-environmental actions. Jugert et al conclude that '(i)t is through the group that individuals come to feel in control of their outcomes' (2016,, p. 21).

While it has long been assumed that people's efficacy beliefs causally influence their outcome expectancy, there is evidence that the causal relationship is reversed and one may need to 'acknowledge the causal influence of outcome expectancies on ... efficacy' (Williams, 2010, p. 422). Thus, people may feel confident that they can engage in adaptation behaviours (efficacy beliefs) but they will still not do so if they are not convinced that their actions will prove useful in protecting them from adverse climate change outcomes (outcome expectancy).

Policymakers can draw two lessons from the above-mentioned insights of psychology when aiming to promote engagement and investment in adaptation at different levels. First, to raise people's outcome expectancy, decision-makers need to emphasise that people's engagement is not only important but also effective for adaptation. Second, appealing to people's group identity strengthens their collective efficacy that will in turn motivate them to adapt. For example, farmers might be more interested to invest in water-efficient irrigation if it can be shown that this will enable them to collectively avoid water shortages (or, as a result, increased water prices). Observing how others successfully engage in adaptation will not only increase people's collective efficacy but also their self-efficacy since vicarious learning, alongside personal experience, is an effective strategy for increasing self-efficacy (Bandura, 1994).

Efficacy beliefs and outcome expectancy, which are summarised as coping appraisals (Rogers, 1975, 1983; Bamberg et al., 2017, 2020), are related to *threat appraisal*. Threat appraisal concerns the process of evaluating the components of fear that are relevant to an individual's perception of how threatened he or she feels' (Milne et al., 2000, p. 108). Feng et al. (2017) investigated the impact of threat- and coping appraisal on behavioural intentions to adapt with 658 apple farmers in China. Both threat- and coping appraisal (self-efficacy and outcome efficacy) influenced their behavioural intentions to adapt. Moreover, higher threat appraisal reduced the occurrence of farmers' maladaptation (i.e. denial, wishful thinking, fatalism). However, for perceived threat to stimulate adaption, it must combine with positive coping appraisal: People need to feel confident to deal with the threat. If not, they are more likely to remain inactive.

Policymakers at the national as well as at the local level may use these insights in different ways to stimulate investments in adaptation. Adaptation strategies formulated at the sub-national and also sectoral level would produce and deliver information that can help shape people's threat- and coping appraisal. Importantly, threat-related information needs to be combined with action-related information that strengthens people's coping appraisal. Thus, decision-makers should increase people's (collective) efficacy beliefs and outcome expectancy by creating more transparency and less uncertainty about the cause-effect chain between adaptation activity and reduced vulnerability to the impact of climate change. This may be particularly suitable for rural communities where information may diffuse easily (Feng et al., 2017).

4.2. Affective states

Information campaigns that target people's threat appraisal implicitly influence their affective states. According to Russell and Barrett (1999, p. 806) *core affect* refers 'to the most elementary consciously accessible affective feelings ... [and] can be seen as the elemental feelings included within prototypical emotional episodes.' Knowing people's emotions (e.g. fear of the effects of climate change) does not mean that one could predict their behaviour; they might be equally likely to engage in adaptation or remain inactive and deny their responsibility. Still, meta-analytical evidence (Van Valkengoed & Steg, 2019) seems to indicate that it is primarily negative affect that will instigate adaptation. Here, we focus on three fundamental negative affective states that relate to adaptation: guilt, anger, and fear.

Guilt is 'an aversive self-conscious, affective state that people experience when they feel they have done something wrong or have violated expectations' (Grant & Patil, 2012, p. 552); accordingly, guilt triggers behavioural efforts to make up for the wrongdoing (Rees et al., 2015; Thomas et al., 2009). Anger can broadly be categorized into two emotional states: self-focused anger and moral outrage, which is directed at others' wrongdoing (Thomas et al., 2009). Whereas experiencing anger often triggers dysfunctional behavioural actions (e.g. complaining, exclusion, aggression, punishment) (Tangney et al., 2007), anger can also have positive consequences, particularly in the interpersonal context (Van Doorn et al., 2014). Justice and equity concerns are an important component of interpersonal anger. Therefore, there are two strategies to make amends and regulate anger, (a) to deprive the offender of the benefits (i.e. punishment) or (b) to compensate the victim.

Guilt and anger share the same bodily reactions and seem to motivate actions but in two opposite ways. While guilt seems to promote social relationships, anger might destroy or at least challenge them (Pivetti et al., 2016). In the context of climate change, guilt and anger predict distinct environmental action intentions. While guilt motivates intentions to repair potential environmental damages, anger leads to intentions to punish fellow group members for causing environmental damage (Harth et al., 2013).

In contrast to anger, which motivates approach behaviour, fear more strongly triggers avoidance (Stern, 2012). Thus, whereas fear may cause adaptive behaviour, it may also backfire and lead people to reduce their fear (for example by denying it) rather than the threat (e.g. Witte & Allen, 2000). This is particularly relevant for communication campaigns about climate change to stimulate adaptation. While their verbal message may appear factual, the psychological message targets people's fears (Stern, 2012). The experience of danger is likely to trigger inaction or psychological denial if people's coping appraisals are negative (see section on 'Efficacy beliefs & appraisals' above). For fear to stimulate adaptive behaviour, it needs to combine with positive emotions like hope (Bain et al., 2012). Accordingly, recent scholarly work suggests that positive moral emotions such as

pride, hope and gratitude not only fuel prosocial behaviour in general but also seem to positively influence climate change action (Markowitz & Shariff, 2012).

Encouraging people to engage in adaptation is therefore less a question of filling knowledge gaps, and more of increasing both their affective threat appraisal and their positive affective states related to improved outcome expectancies. These outcome expectancies may refer to outcomes other than climate-related consequences, e.g. increased technological development or social justice through pro-environmental actions (Bain et al., 2012). Wirth et al. (2014) identified 13 good practice examples that seem to be fruitful for adaptation communication. One of the core elements is to be aware of the emotional impact of factual information on climate change and to accompany information that triggers negative affective states with hints to gains that would result from adaptive actions in order to also instill people with positive affective states.

While these findings do not provide specific guidance for the formulation of the abovementioned adaptation strategies at the sub-national and sectoral levels, they do point to the importance of the emotional impact of factual information and highlight the danger of potential pitfalls such as fear, which tends to trigger inaction. Pointing to specific adaptation options will help to avoid inaction (through denial) and successful adaptation scenarios can trigger hope or pride and stimulate adaptation action.

4.3. Climate change beliefs

'Beliefs ... describe enduring, unquestioned ontological representations of the world and comprise primary convictions about events, causes, agency, and objects that subjects use and accept as veridical.' (Connors & Halligan, 2015, p. 2). Beliefs provide people with a consistent and coherent depiction of the world; they offer a framework that allows them to pursue goals and avoid threats, and guides their behaviour. Beliefs seem to vary in their consequence on behaviour and are dependent on the intensity of conviction (Connors & Halligan, 2015). Not surprisingly, belief in the reality of climate change is positively related to adaptation behaviour (Van Valkengoed & Steg, 2019). Still, the empirical evidence is less stable than for efficacy beliefs and affective states, as two out of five studies that were part of the meta-analytical analyses report non-significant relationships. Perhaps more surprisingly, disbelief in climate change is not so much a signal of lack of knowledge as of psychological defence (Stern, 2012), which might explain the significant proportion of people who deny the reality of climate change despite much available information to the contrary (Stern, 2012). Therefore, providing more information is not an effective strategy for convincing disbelievers. Instead, it can be effective to focus on non-climate related gains of adaptation like technological advancement, social justice or protection against already existing climaterelated hazards. Even those who deny climate change may come to support adaptation, albeit for nonclimate change related reasons.

In addition to the obvious disbelief in climate change, an overly positive belief in technological progress can reduce adaptation intentions. Gardezi and Arbuckle (2020) showed, for example, that strong beliefs in technological progress ('human ingenuity will enable us to adapt') and technical skills ('knowledge and technical skills will allow us to deal with all weather-related threats to farm viability') reduced farmers' support for adaptation. Similar to climate change denial, these are psychological defence strategies to deal with negative affective states and negative coping assessments, not knowledge deficits. Again, demonstrating the positive co-benefits of adaptation in estimated non-technological areas of society can be an effective strategy to gain people's support. This may, for example, be part of formulating the adaptation strategy as discussed above.

5. Meso-level factors to stimulate adaptation investments

The following section takes a closer look at social environmental conditions for stimulating adaptation activities.

5.1. Norms

The notion that peoples' behaviour is dependent on the behaviour of reference groups has long been established in the psychological literature (Asch, 1955; Sherif, 1936). Historically, social psychologists differentiated between *descriptive norms* (prevalence of a specific observed behaviour) and *injunctive norms* (prevalence of approval or disapproval of behaviour) (Cialdini et al., 1990; Miller & Prentice, 2016). This article focuses on the term *social norms*, which denotes that people – and groups – orient their behaviour towards that of others.

Changes in human behaviour can be abrupt when the expectations of other people about what constitutes adequate behaviour in a specific situation changes. People usually prefer to conform to their peers (Nyborg et al., 2016) since part of people's identity and self-esteem depends on the social groups to which they feel they belong (Tajfel & Turner, 2004). These groups need not exist as physical groups whose members know each other but can encompass large collectives including cultures (e.g. defining oneself as an Israeli, woman and a liberal). People are motivated to adhere to the social norms that define their social groups to maintain their positive self-identity. Therefore, they adapt their behaviour to the standards that they expect to be approved by members of their social groups. This third order-inference (Correll et al., 2017; Ridgeway & Correll, 2006) has proven to be a powerful mechanism for overriding individual preferences: Even if individuals would prefer to behave differently, they will behave following what they believe would be appreciated by significant others.

Lo (2013) conducted a study in which factors influencing flood insurance purchases were investigated with 501 randomly selected residents from the eastern cities of Australia. Social norms were assessed with the following two items: (1) 'their family or friends want them to purchase flood insurance' and (2) 'other people like them would purchase flood insurance'. While the perception of flood risk was not related to voluntary adaptation by flood insurance purchases, social norms were. Similarly, in a study with residents of the metropolitan area in Houston, US, after Hurricane Rita in September 2005, Stein et al. (2010) showed that people's decisions to evacuate were dependent on the behaviour of their neighbours. Moreover, learning that, for instance, a relevant social group (e.g. neighbours) uses significantly less energy not only reports standards of behaviour; thus, it may increase individuals' self-efficacy (Miller & Prentice, 2016). Indeed, norms seem to directly influence not only public-sphere climate actions but also efficacy beliefs (Doherty & Webler, 2016). Hence, communication campaigns that complement factual information with references to the behaviour of peers will be more effective; 'peers' may in this case simply include others that are geographically close, such as neighbours.

Notably, it is not necessary to increase people's effectiveness beliefs in order to change behaviour, because at a certain point it becomes easier to follow a new social norm than not. For example, domestic gardens constitute an important element in surface water runoff. Paved gardens jeopardize water runoff, in particular as future rainfalls are projected to increase in the coming years and decades (Kelly, 2018). The more people will replace impermeable surfaces in their gardens with gravel or green surfaces, the more attractive it may become for other neighbours – whether people believe that permeable surfaces are an important element to prevent urban floods or not. Hence the approval and disapproval of others concerning appropriate gardening practices may guide adaptation behaviour.

Nyborg et al. (2016) argue that social feedback (e.g. positive feedback of neighbours about the beauty of the garden) is at the core of social norm changes and contributes to 'tipping points', where new social norms reinforce themselves and set virtuous circles in motion.

It is not always necessary to change the norms of the whole (peer) group to fuel a reflection process of behaviour, since small minority groups may already be able to question established societal perceptions (Gardikiotis, 2011) and change the perception of appropriate behaviour. Considering local perspectives and values, for example by conducting workshops in which different voices and concerns are listened to, may prove valuable for designing effective locally integrated adaptation programmes. Communication campaigns that promote and highlight observable behaviours that are easy to implement have a higher probability of success and have a higher potential for virtuous tipping points (Nyberg et al, 2016). Policymakers can use three main intervention strategies to influence social norms on adaptation: social norms marketing (SNM), personalized normative feedback and focus group discussion (see Miller & Prentice, 2016). SNM uses factual information that documents incidences of some desirable behaviour in a reference group. In the context of adaptation, a message to encourage private sector actors to invest in adaptation could be: 'A study on voluntary company disclosure on climate risk demonstrates that 76% of the companies take at least soft measures (e.g. planning and knowledge generation) to adapt to the physical impacts of climate change, and 47% used hard adaptation measures (e.g capital investments into technology)' (cf. Goldstein et al., 2019). Personalized normative feedback targets individuals by providing them with both individual information about themselves and their peers. For example, a hotel guest is more motivated to reuse his/her towel based on the knowledge that the majority of hotel guests does so, even if towel use of the other guests remains unobservable. Since people are not only motivated to adapt to the behaviour of others but also to be better than others, it is effective to give them information about their relative performance compared to the norm (Schultz et al., 2008).

Another concrete example would be for instance: 'Your organisation consumes 59% more water compared to similar companies in your industry'. In order to avoid the undesirable development that those with below-average consumption could increase their consumption, insights from the psychology of learning (Skinner, 1938) can be used to reinforce desired behaviour. Trivial rewards such as emoticons on consumption bills have proven to be effective (Miller & Prentice, 2016).

Focus group discussions constitute an intervention for modifying norms by facilitator-led live group discussions regarding the groups' perceptions of specific practices as well as the causes and consequences of these perceptions.

The use of personalized normative feedback seems to be more effective than SNM alone in making information self-relevant. In general, personalized normative feedback is attractive to decision-makers, given the low cost and simple mechanics of this intervention (Miller & Prentice, 2016).

Policymakers should use the information that norms strongly affect adaptation behaviour to motivate individuals to invest more in adaptation. This finding is particularly relevant at the procedural level. In the process of formulating an adaptation strategy, the involvement of relevant social groups (rather than, e.g. technical experts only) will contribute to the development of (norm-conforming) adaptation options.

5.2. Perceived responsibility

In the initial absence of norms, a key issue is whether people perceive adaptation as their own responsibility. The perception of responsibility is socially constructed and contextual: Differentiating between 'others' and 'us' (e.g. groups in a particular region or in a particular sector) creates the idea of an ingroup facing an outgroup (Caillaud et al., 2016). The process of symbolic *othering* generates a sense of collective responsibility but not necessarily adaptive behaviour. For example, Caillaud et al. (2016) investigated how social groups deal with responsibility for ecological problems. Groups that faced information emphasising collective responsibility for ecological problems experienced negative collective emotions, mostly in the form of discomfort. To cope with these emotions, they mainly denied responsibility for the ecological problems or they minimised the consequences of pollution by, for instance, using social comparisons (e.g. with poor countries). Wright and Nyberg (2017) argue in a similar direction, namely that organisations seem to develop mechanisms that allow them to translate the grand challenges of climate change to business as usual. By doing so, 'corporations are inherently unsuited to deal with issues that play out over the medium to long term' (p. 1656).

Adaptation strategies of the world's largest corporations are indeed still characterised by some 'blind spots' (Goldstein et al., 2019). For example, companies underestimate or misunderstand many of the ways in which climate change could affect their business; they rely on 'business as usual' risk management; they are prone to short-term thinking and tend to strongly ignore the impacts of climate change that are likely to occur in the future (ibid). Accordingly, companies are unlikely to meet their adaptation responsibilities. Since organisations have to comply with industry standards to meet the expectations of important stakeholders (e.g. customers), the previously discussed interventions to influence social norms can be a promising way to also strengthen the perception of private sector actors' responsibility for adaptation.

6. Macro-level factors to stimulate adaptation investments

Societal responses to adaptation are moderated by cultural aspects like values, symbols, and rituals that shape collective understanding and behaviour (Adger et al., 2013). Accordingly, culture impacts how people identify and respond to risks, including those related to climate change. The following section elaborates on three broad cultural dimensions that significantly correlate with people's adaptation behaviour (Alló

& Loureiro, 2014): long-term versus short-term orientation, masculinity versus femininity, and individualism versus collectivism.

6.1. Culture

Since culture not only describes groups but also large collectives such as societies, whose members do not know each other, we categorise culture as a macro-level variable. Hofstede (1980a) originally identified four cultural dimensions: individualism-collectivism (defining oneself as an autonomous individual or as a member of groups), power distance (acceptance of power differences within society), uncertainty avoidance (acceptance of uncertainty and ambivalence as core elements of life) and masculinity-femininity (preference for gender-stereotypically male vs. female values); later he added long- versus short-term orientation (also referred to as Confucian dynamism; Hofstede & Bond, 1988) as well as indulgence versus restraint (tendency to allow relatively free gratification of basic and natural human desires versus strict regulation; Hofstede, 2001).

High regard for future-orientation, perseverance and thrift, which associate with more flexibility to adapt traditions to changing circumstances, are characteristics of cultures with long-term orientation. Long-term oriented cultures tend to be more pragmatic than cultures with short-term orientation, which are more concerned with respect for tradition and the fulfilment of social obligations (Taras et al., 2010). Additionally, people in long-term oriented cultures are more inclined to invest in order to achieve results (Taras et al., 2010). These characteristics may explain why cultures scoring high on long-term orientation are more willing to invest in adaptation (Alló & Loureiro, 2014).

Similar to cultures scoring high on long-term orientation, cultures scoring high on femininity rather than masculinity are more willing to invest in the conservation of environmental resources and measures to adapt (ibid). Cultures scoring high on femininity have a preference for 'friendly atmosphere, position security, physical conditions, [and] cooperation' (Hofstede, 2001, p. 281); they more strongly value 'quality of life, maintaining warm personal relationships, care for the weak and solidarity' (Hofstede, 1994, p. 6). In contrast, masculinity is defined as valuing 'assertiveness and the acquisition of money and things' (Hofstede, 1980b, p. 46).

The apparently weaker sense of solidarity in masculine cultures is also typical for individualistic cultures, where people 'prefer to act as individuals rather than as member of a group' (Hofstede, 1994, p. 6) and where people are expected 'to take care of themselves and of their immediate families only' (Hofstede, 1980b, p. 45). These values and self-conceptualizations associate with a lower willingness of people in both masculine and individualistic cultures to invest in adaptation (Alló & Loureiro, 2014). Since investments in adaptation measures often have some characteristics of public goods — people who did not pay for them may still be the beneficiaries of these investments — they may seem incongruent with some core values and beliefs in masculine and individualistic cultures. People who define themselves as autonomous individuals are more likely to engage in conditional cooperation: They wait for others to take initiative before they are willing to contribute.³ In contrast, in collectivist cultures, people define themselves by their group memberships, to which they feel a strong sense of loyalty and obligation. People from a collectivist cultural background are therefore more willing than people from individualistic cultures to pay for climate change adaption measures that not only benefit themselves but also their ingroup members (ibid).

While individuals within societies are the representatives of cultural values, culture is conceptualised as an emergent phenomenon that characterises societies and that emanates from the shared values of individuals (Taras et al., 2010). Still, policymakers should take into account that assigning cultural values from secondary data like those originally reported by Hofstede (1980a) to individuals within cultures equals stereotyping, as the variance among individuals within cultures may be larger than between cultures (Taras et al., 2010). For example, people in individualistic cultures are more likely to engage in prosocial behaviour and make concerted efforts to preserve environmental resources than cultural norms predict; but they remain inactive because they expect others to adhere to pursue selfish interests (Capstick, 2013). More precisely, in individualistic cultures the pursuit of self-interest is the dominant norm; therefore arguing with self-interest to justify one's own behaviour is not only recognised but even expected (Miller, 1999). This once again demonstrates how perceived social norms may more strongly affect behaviour than individual values and attitudes. At the same time, it shows that individual values may significantly deviate from cultural norms, although they do not become evident in overt behaviour. To address this, communication campaigns may emphasise the individual's self-interest in

investing in adaptation, including through financial incentives. Even small financial incentives can be sufficient because their function is primarily to enable people to justify their commitment – even to themselves (Miller, 1999).

In general, cultural effects have been shown to be stronger for men than for women, because women seem to prioritise the preservation of relationships over self-directed, value-driven behaviour (Taras et al., 2010); cultural effects are also stronger for managers and employees than for students, for older people and for those with higher educational levels. This is because managers and employees work in organisations, and organisations are central representatives of cultural values; moreover, as people grow older and spend time in educational institutions — which are powerful mediators of cultural values (Taras et al., 2010) — they internalise cultural values.

Regardless of individual-level variables like gender, age or educational level, the impact of culture on people's behaviour will be stronger in tight cultures (Gelfand et al., 2006). Tightness versus looseness is a national-level variable that does not describe content-related values like the dimensions identified by Hofstede. Instead it defines the efforts of nations to enforce cultural values and their willingness to allow individuals the freedom to deviate from these values. Tight cultures monitor the behaviour of individuals more closely and they sanction culturally deviant behaviour. To the extent that adaptation requires changing norms, this will be easier for policymakers to achieve in tight than in loose cultures.

Policymakers should also consider that broad cultural dimensions as defined by Hofstede are multi-faceted phenomena whose impact on behaviour is not monolithic, also because of interactions with micro- and meso-level factors. For example, people in cultures scoring high on individualism report higher self-efficacy (Taras et al., 2010), which is a strong predictor of engagement in adaptation. At the country level, individualism further-more correlates strongly with innovation (Taras et al., 2010); a societal climate that values innovation is likely to stimulate flexibility in the adaptation of current business models to changing contexts. Therefore, policymakers should take a differentiated approach when considering the effects of culture to increase commitment to adaptation: Where certain beliefs and values shared within cultures can prevent people from taking action, further correlates of culture at the individual level, such as personality, can compensate for cultural tendency to inaction. For example, to stimulate adaptation efforts in individualistic and masculine cultures, policymakers should emphasise the individual gains from adaptation and reinforce people's self-efficacy, while in more collectivist and feminine cultures they should emphasise more strongly the collective benefits from adaptation and people's shared responsibility for action against climate change.

An example of the complexity of considering cultural aspects in adaptation includes a case study from Burkina Faso, where the ethnic groups 'Fulbe' and 'Rimaiibe' responded differently to recurrent droughts. While the Rimaiibe reduced their vulnerability by adopting specific strategies such as labour migration, the cultural values of the Fulbe prevented them from adapting. One major hindrance in undertaking labour migration (e.g. moving to other locations for work as an adaptation strategy) was the Fulbe's preference for living in the bush in small isolated households that corresponded to their notion of freedom and personal integrity. Moreover, they lacked engagement in development projects because they refused to 'behave like slaves' by working for development projects (mostly provided by international aid organisations including, for instance, planting trees) and doing manual and repetitive work like gardening (Nielsen & Reenberg, 2010). Similarly, Coulthard (2008) reported a case study of adaptation strategies by south Indian fishers where responses of two different fisher communities were bounded by cultural aspects.

Adaptation initiatives are likely to fail when cultural aspects are ignored. In order to integrate cultural dimensions it is essential to recognise diverse values and perspectives and to promote decision making at multiple levels (Adger et al., 2013; Nicholson-Cole & O'Riordan, 2009), including the local level, because this is where people experience climate change most directly. This strongly calls for an inclusive development of adaptation strategies.

7. Discussion and conclusion

This article identifies the 'adaptation puzzle', which is based on the widely acknowledged observation that the current level of adaptation is insufficient and below the level suggested by a societal cost-benefit analysis. Although the lack of adaptation activities seems irrational, it does not mean it is inexplicable; it might follow

a different logic instead – a *psychological* one. Based on meta-analyses of adaptation behaviour and broader literature, this paper identifies and discusses several variables that are located within the individual and social influences that come from peers, groups or societies. We find the following:

First, if people believe that they can adapt to climate-related hazards to which they are exposed, they will show greater adaptation behaviour. In other words, if people learn that they can adapt, they are more likely to make efforts and actually succeed in doing so. Effective strategies to reinforce these beliefs include the experience of mastering a certain behaviour or observing others who display this behaviour (cf. Bandura, 1994).

Second, people need to be convinced that their adaptation will lead to desirable results. Therefore, it is not enough to stress that commitment to adaptation is important; people should also perceive that specific behaviours (e.g. water-efficient irrigation) are effective for adaptation. Increasing collective (i.e. group-based) beliefs about the effectiveness of adaptation behaviour may further strengthen adaptation: Knowing that others are involved in adaptation will increase people's adaptive behaviour, even if they personally do not consider such behaviour useful.

Third, emotions — although typically seen in Western philosophy since Plato as a source of irrational behaviour (e.g. Santas, 2010) — can help to promote rational behaviour such as adaptation. Negative affect such as guilt, anger and fear seem to be the main drivers of adaptation. However, they influence behaviour in different ways and must therefore be treated with caution if they are to be used to stimulate more investment in adaptation. While these findings do not provide technical guidance for the formulation of adaptation plans and strategies as such, they do point to the importance of the emotional impact of factual information and highlight the danger of possible pitfalls. They can also help to shape the process of adaptation planning.

Fourth, people's beliefs play a central but less understood role in their adaptation behaviour. It is particularly important to note that disbelief in climate change is less a signal of lack of knowledge than of psychological defence. Providing more information to those who deny climate change is therefore not effective. Instead, a focus on co-benefits of adaptation, such as technological progress, social justice or protection from existing climate-related threats may be more effective to motivate climate change deniers to support adaptation.

Fifth, people's behaviour depends on the behaviour of reference groups such as neighbours, competing companies, other cities or even other countries. Changes in human behaviour can be abrupt if people's expectations about what constitutes appropriate behaviour change. Communication campaigns that supplement factual information on climate change with clues about the behaviour of peers will be more effective, in particular for unobserved behaviour. The involvement of relevant social groups (instead of, e.g., only technical experts) in communication campaigns will contribute to the development of (standard-compliant) adaptation options. As organisations need to comply with specific standards, references regarding the behaviour of other market participants could be an important mechanism for the perception the responsibility for adaptation.

Finally, adaptation initiatives are likely to fail if cultural aspects are ignored. Both in so-called masculine and individualistic cultures, the willingness to invest in adaptation is generally lower. Since investments in adaptation often have characteristics of public goods — people who have not paid for them may still be the beneficiaries of these investments — they may appear incompatible with some of the core values and beliefs in masculine and individualistic cultures. To stimulate adaptation in individualistic and masculine cultures, in particular among individuals or groups of people where cultural impact is strong, policymakers can emphasise the individual gains from adaptation and strengthen people's self-efficacy. In more collectivist and feminist cultures, collective benefits of adaptation and people's shared responsibility should be emphasised. Even when people are inclined to take action for prosocial or altruistic reasons, they do not do so if they expect others to be driven by selfish motives. Ironically, this expectation reinforces the norm of self-interest.

Looking at each of these variables in isolation, their effects are comparably strong: Intra-individual variables such as efficacy beliefs and affectivity are as strongly linked to adjustment behaviour as are external and more distant variables such as social norms and cultural values. However, under certain circumstances, external variables such as norms and cultural values guide individual behaviour more than personal beliefs and preferences: Clear and consistent situational cues that convey desirable standards of behaviour have been shown to limit and constrain the impact of variables at the individual level (Mischel, 1977). For example, if a person perceives purchasing flood insurance in a specific region to be a social norm (i.e. peers or similar others purchase flood

insurance) this factor plays a more important role in determining her adaptation behaviour than individual-level variables such as personal efficacy beliefs.

7.1. Limitations and future directions

In this overview, a selection of variables that were most prominent in meta-analyses on adaptation were identified; still, the list of variables presented here is not conclusive. For example, Van Valkengoed and Steg (2019) additionally identified risk perception, which, resembles threat appraisal (Bamberg et al., 2017, 2020) that is part of our review. Van Valkengoed and Steg (2019) also included variables such as knowledge about climate change, place attachment, and trust in government. However, the size of their effects was weaker (r = .11-.14) than those discussed here (.23 $\leq r \leq .33$).

Furthermore, although decisions on adaptation are sometimes made in groups rather than by individuals, it was beyond the scope of this review to address this issue, and it was not part of the meta-analyses we reviewed. Future research on adaptation should take into consideration that group decision making differs from individual decision making. Some scholars, for instance, argue that groups are more rational in economic decision making (Fahr & Irlenbusch, 2011; Kugler et al., 2012) and seem to be less affected by social considerations (Charness & Sutter, 2012) than individuals. Others point out that decision making in groups have potential downsides and dangers (e.g. groups seem to process information in a confirmatory rather than a diagnostic manner and underestimate their vulnerability; De Dreu et al., 2008). Hence, specific factors affecting group-level decision making may require adjustments and extensions regarding general recommendations for decision-makers.

Some empirical studies presented in this paper, including those that were part of the reviewed meta-analyses, relied on cross-sectional surveys that cannot identify causal effects (e.g. Lo, 2013). While cross-sectional surveys may point to a relationship between two or more variables (e.g. positive relationship between selfefficacy and technology adaptation), the causal chain of effects remains unclear. Experiments are an alternative to surveys, as they disentangle causal effects. Alpizar et al. (2011), for instance, used a field experiment where they randomly assigned coffee farmers in Costa Rica to different risk conditions (e.g. 1% or 5% unknown risk of natural disasters) and looked at how these conditions affect adaptation decisions (e.g. invest or not). The decisions of farmers were monetarily incentivised to reveal their true preferences.

Literature on adaptation is highly diverse regarding climate-related hazards (e.g. flooding, hurricanes, wildfires, heatwaves, droughts), adaptive behaviours (e.g. insurance, policy support, information seeking, evacuation, preparedness; see Van Valkengoed & Steg, 2019), and actors (e.g. smallholder farmers, medium and large-sized corporations, financial, governmental and non-governmental institutions). Our review used an aggregated view with more general recommendations for decision-makers. Future research may take a closer look at specific climate-related hazards, behaviours and/or actors to derive more specific recommendations to fuel engagement and investments in adaptation tailored to specific groups (e.g. private sector actors).

Furthermore, insights into gender-related aspects of adaptation are limited. Psychological research posits that women seem to be more likely to engage in altruistic informal investments, for example in funding new ventures without getting a positive financial payback (Klyver et al., 2017). However, they less easily get access to appropriate levels of finance (Marlow & Patton, 2005). It seems warranted to further investigate the role of gender (and gender stereotypes) in the context of economic efficiency and adaptation decisions.

We are confident that transdisciplinary research endeavours can contribute to identifying factors that may motivateengagement in adaptation. We believe that integrating considerations and thus avoiding the perspective of a simple and homogeneous group of actors may constitute an important element that will determine whether or not individuals engage in adaptation. With our more general integrative review from a psychological perspective, we hope to enhance the scientific debate on this topic and to advance the understanding for policymakers.

Notes

1. The dependent variable in Alló and Loureiro (2014) was logarithmised.

- 2. We categorised perceived responsibility as a meso-level variable since responsibility constitutes a relational concept which means that responsibility "rests both on causation of effects and on the social expectations of others for one's action. These expectations are determined heavily, albeit not entirely, by social roles" (Hamilton, 1978, p. 326).
- 3. Similarly, one may expect people from cultures with high power distance to be less willing to pay for climate change adaptation, since in countries with high power distance people accept that power is distributed unequally, and some are in charge whereas others are not. Accordingly, people, including organisations, will be less likely to feel responsible for taking initiatives if they expect policymakers to be in charge. Since power distance correlated highly with individualism-collectivism, meta-analytical analyses excluded this dimension due to multicollinearity (Alló & Loureiro, 2014).

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