



# Facing global environmental change: The role of culturally embedded cognitive biases

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## ABSTRACT

Mankind's ability to mitigate and adapt to climate change may be limited by cognitive biases. To address this challenge, research on cognitive biases has to be expanded beyond the study of individual-based psychological cognition effects to understand their interaction with cultural factors and their impact on group behaviour. Here we describe the relevant cognitive biases and how they are impacted by culture, and we propose that future environmental policymaking has to take into account how such Culturally Embedded Cognitive Biases (CECB) affect willingness to comply.

## 1. Adaptive behaviour and the role of cognitive biases

Human adaptive behaviour in relation to climate change is typically studied with a focus on barriers, constraints, or limits (Eisenack et al., 2014). The Intergovernmental Panel on Climate Change (IPCC), in their fifth assessment report on climate change, summarizes ten such constraints (Klein et al., 2014, pp. 911–918): (1) knowledge, awareness, and technology constraints, (2) physical, (3) biological, (4) economical, (5) financial, (6) human resources, (7) social and cultural, (8) governance and institutional, (9) competing values, (10) cross scale dynamics. An additional factor, which is considered of central importance in specialist studies (e.g. Grothmann and Patt, 2005; Johnson and Levin, 2009; Shu and Bazerman, 2011) is: the perception and cognition of adaptive need and capacity (Cinner et al., 2018).

Despite recent significant progress in the fields of opinion formation and human behaviour, aspects of cognition rarely attract as much attention as physical facts and forecasts in debates about global environmental changes such as climate change. However, triggering an adequate response might be as much relying on our cognition and its related biases as on the well substantiated knowledge and information. Such aspects are therefore relevant and need to be analysed since it is the recognition of the threat posed by environmental changes, based on the cognition of the relevant underlying scientific facts, which should drive adaptive behaviour.

With respect to perceptions of climate change, Moser and Dilling (2007) concluded that society at large does not appear to be concerned enough with global warming to warrant action. They also asserted that the lack of widespread sense of urgency is not the result of a lack of basic knowledge on the subject, rather it has to do with the way climate-change related issues are communicated. Arguably however, even if information is perfected and intensified, perception of such information is not neutral but subject to

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cognitive biases. As such, cognitive biases affecting judgment and decision-making remain a barrier to environmental action (Johnson and Levin, 2009).

Some researchers have even argued that while barriers like knowledge restriction and ideal communication might be surmountable, cognitive biases might make climate change a “perfect evolutionary trap for our species” (Diggs, 2017, p. 4). Our brains - from an evolutionary perspective - are prone to perceive and prioritise: 1) immediate problems or threats, as opposed to dangers that develop gradually over the long-term, 2) events that trigger a sense of urgency due to their fast dynamics, and 3) choices that do not require us to trade short term sacrifices or losses for long term benefits (Gilbert, 2006; Diggs, 2017; Marshall, 2014a). Marshall highlights this point, claiming that climate change contains many marks of disattention and only a few marks of attention (Marshall, 2014a). Furthermore, he argues that because climate change is exceptionally amorphous with no clear deadline and is not seen as an obvious common enemy by all, this “creates the ideal conditions for human denial and cognitive bias to come to the fore” (Marshall, 2014b). As key opinion leader Kahneman puts it, “I really see no path to success on climate change [...as it is] a perfect trigger: a distant problem that requires sacrifices now to avoid uncertain losses far in the future. This combination is exceptionally hard for us to accept” (Marshall, 2014b).

If, however, we were not to accept that our cognitive and behavioural traits represent insurmountable barriers to environmental action, our efforts in climate change mitigation and adaptation should focus on understanding and finding ways to override our cognitive biases to begin with.

Pioneer work in the field of cognition and adaptation behaviour is represented by the work of Grothmann and Patt (2005), who developed a socio-cognitive model of private proactive adaptation to climate change (MPPACC), based on the so called Protection Motivation Theory (Rogers, 1983). The MPPACC model has since been further developed by Dang et al. (2012) to include additional factors that motivate individuals and households to engage in adaptation behaviour, such as: social norms, negative affect, climate change perception, and habits.

Another model describing human responses to global environmental changes was developed by Gifford et al. (2018) proposing their six factor Dragons of Inaction Psychological Barrier (DIPB) instrument to assess “psychological barriers that hinder individuals from helping to mitigate the impacts of climate change and acting more sustainably” (Gifford et al., 2018, p. 178). They provide a more comprehensive model which describes human responses to global environmental changes. From these and other studies, there is a well-established set of psychological variables that influence adaptation behaviour (van Valkengoed and Steg, 2019).

Knowledge of the above would suggest that a concerted effort needs to be made to look beyond the physical aspects of the climate and to pay attention to the characteristics of human brains in interpreting the facts and figures of global environmental changes.

As a start, we can look at universal human behavioural traits that could negatively influence our ability to recognize and to act upon facts. Johnson and Levin (2009), among other authors, propose that cognitive biases, particularly: (1) positive illusion, (2) cognitive dissonance, (3) in-group/outgroup bias, (4) fundamental attribution error, (5) risk perception bias, and (6) present bias, may negatively influence our ability to fully recognize and understand the gravity of the situation surrounding climate change; thereby undermining enactment of effective environmental policies.

However, the extent to which these cognitive biases may potentially undermine environmental action is expected to be modulated again by other factors, such as regional geographic influences and culture. Indeed, research shows striking cross-cultural differences in cognition and perception which seems to suggest that they are not as universal as psychology or behavioural economics originally might suggest but that they are modulated by cultural influences (Heine, 2020b; Norenzayan and Heine, 2005; Heine and Ruby, 2010; Markus and Kitayama, 1991). Consequently, the effect of the interaction/interplay of both cognitive biases and its cultural embeddedness on climate change mitigation and adaptation strategies, a term we coin “Culturally Embedded Cognitive Biases” (CECB), is important to investigate with respect to formulating strategies to global environmental changes. We therefore propose that studies analysing the influence of human perception and behaviour on global environmental changes need to evaluate each cognitive bias as it is influenced by its respective culture as further discussed below. In the following, we review the main biases identified by the literature that may negatively influence mitigation and adaptation to climate change, and relate them to the literature which looks at those biases from a cross cultural perspective.

Before describing how cognitive biases are modulated by cultural influences, and how this may undermine mitigation and adaptation efforts, we first have to recapitulate the nature of culture.

## 2. Dimensions of culture

Culture is an umbrella term which has been described from various perspectives. For the purpose of our investigations we will adhere to the definition given by Hofstede as “the collective programming of the mind that distinguishes the members of one group or category of people from other” (Hofstede, 2011, p. 3). In practice, culture groups would usually be represented as a regional population. However, other groups of individuals could also act as a defining entity (e.g. corporate cultures etc.). Hofstede explains cultural differences within the framework of a “6 dimension” model (Hofstede, 2011; Hofstede et al., 2010). The following three dimensions seem particularly interesting to investigate with respect to cognitive biases: Individualism (measured as Individualism Index Scores-IDV), Uncertainty Avoidance (measured as Uncertainty Avoidance Index Scores- UAI), and Long-term Orientation (measured as Long-term Orientation Index Scores - LTO).

Individualism refers to the degree to which people feel they are independent, rather than interdependent, from one another. As such, the ties between members within a society are loose, where everyone tends to primarily look after him- or herself and the immediate family (Hofstede et al., 2010; Hofstede, 2011). People from an individualistic society base their ‘self’ on intrinsic/internal attributes that are to a degree unique from others; as such, they are predominantly concerned with self-actualization and they believe

that speaking one's own mind is a healthy and integral part of the self-actualization process (Markus and Kitayama, 1991; Cooper, 2012).

Contrastingly, collectivism refers to a society in which individuals are part of strong in-groups since birth, giving rise to an accentuated distinction between in-group and outgroup members and the importance to maintain harmonious relationships with ingroup members (Hofstede et al., 2010; Hofstede, 2011). Individuals view their 'self' based on the opinions of others, specifically other in-group members; hence, their behaviour is heavily influenced or regulated by ingroup norms (Wong, 2009; Hui and Triandis, 1986; Triandis et al., 1990). Analysing cross cultural differences along the individualism-collectivism scale is important in our analysis because it has been shown that the "belief in climate change is lower the more people adopt [...] individualistic cultural values" (Hornsey et al., 2016, p.2). Moreover, Xiang et al. (2019), building on Johnson and Levin (2009), have shown that individualism-collectivism does indeed influence the perception of intractability of climate change; particularly, individualistic-oriented people are more subject to perceiving climate change as intractable, and thus exhibit higher levels of climate change inaction, compared to collectivist-oriented people. Individualistic-oriented individuals and collectivist-oriented individuals have often been attributed to western and eastern cultures respectively; however, these are oversimplifications and there exists a lot of heterogeneity between and within western and eastern cultures. It should therefore be understood that where the terms "Westerners" and "Easterners" are mentioned in this context in this article, it is to exemplify rather than to generalize.

Uncertainty Avoidance refers to "a society's tolerance for ambiguity. It indicates to what extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations" (Hofstede, 2011, p. 10). Germany, for example, has a higher UAI and is thus considered more avoidant of uncertainty when compared to Indonesia. Given that climate change entails many uncertainties with respect to its magnitude and impact, this cultural dimension may alter how cognitive biases affect recognition and adaptation towards climate change. For example, UAI has been shown to cause differences in risk-perception (Rieger et al., 2011), is known to be correlated with stronger levels of the present bias (Wang et al., 2016), and may also drive differences in cognitive dissonance.

Long-term Orientation refers to "the fostering of virtues oriented toward future rewards—in particular, perseverance and thrift. Its opposite pole, short-term orientation, stands for the fostering of virtues related to the past and present—in particular, respect for tradition, preservation of "face," and fulfilling social obligations" (Hofstede et al., 2010, p. 239). In other words, this dimension implies that people from different cultures place different values on the future; people in cultures with a high LTO pay greater value on the future, and are hence more patient than people in cultures with a low LTO (Wang et al., 2016). The difference in future weighting may have consequences on the manifestation of cognitive biases, most notably the present bias.

With the above reflection of the nature of culture in mind, let us proceed to cognitive biases and how they are influenced by culture.

### 3. How cognitive biases are influenced by culture

#### 3.1. Cognitive dissonance

Cognitive dissonance can be defined as "a negative affective state that results from an individual experiencing two discrepant cognitions" (Hinojosa et al., 2017, p. 173); whereby cognitions are defined as "elements of knowledge that people have about their behaviour, attitudes, and environment" (Telci et al., 2011, p. 379). Experiencing this uncomfortable psychological state motivates people to reduce discomfort by engaging in dissonance or discrepancy reduction strategies, which include 1) trivialization, 2) a change in attitude or behaviour, 3) denial of personal responsibility, and 4) selective information processing (Harmon-Jones and Mills, 2019; Cooper, 2012; Voisin et al., 2020). The outcome of these reduction strategies has significant relevance in people's recognition and adaptation towards global environmental changes. For example, cognitive dissonance may contribute to continued inaction towards climate change as people may trivialize mitigation/adaptation strategies. Selective information processing may foster distorting conflicting information to match preferred or pre-existing beliefs. In fact, Sunstein et al. (2016) show that asymmetrical updating with regards to evidence on climate change can cause further polarization within a population, which can negatively impact consensus-making and cooperation efforts for successfully adopting climate change mitigation and adaptation strategies.

Denial of responsibility, a key moderator of dissonance arousal and reduction, can have dire consequences on mitigation and adaptation strategies, as people who believe they should not bear responsibility will have no concern and therefore no sense of urgency for action targeted at combatting climate change (Gifford and Nilsson, 2014; van Valkengoed and Steg, 2019). In fact, cognitive dissonance is considered a 'dragon of inaction' for contributing to people feeling less responsible for their counter-environmental behaviours (Gifford, 2011). To prevent individuals from engaging in counter-attitudinal behaviour that dampens actions to curb climate change, it is important to find ways to increase a personal sense of responsibility amongst as many individuals as possible. Evidence shows that "informing people of an injunctive pro-environmental norm seems to be a possible avenue for increasing awareness of their responsibility in terms of environmental impact" (Voisin et al., 2020, p. 9). Furthermore, cognitive dissonance may imply that people are unable to reconcile the safety they perceive around them with a reality they are only confronted with through images they see in the media about disasters following flooding events or in scientific forecasts for the future (Johnson and Levin, 2009). As such, cognitive dissonance is seen as a barrier, as it has negative consequences on the recognition of, and, as a result, the adaptation to global environmental changes.

Although cognitive dissonance is typically viewed as a barrier to environmental action, suggestions have been made to utilize the uncomfortable psychological state of dissonance that people may experience when becoming aware of the discrepancy between their preaching and their actual behaviour, to induce motivation towards environmental action. The respective technique of induced hypocrisy (Langer, 2015; Odou et al., 2018) has proven effective in transforming people's behaviour towards one that promotes a desired

societal outcome in various contexts, including: increasing condom use for AIDS prevention, increasing obedience to speed limits, encouraging healthy nutrition consumption, and also in improving pro-environmental behaviour<sup>1</sup> (Aronson et al., 1991; Dickerson et al., 1992; Fointiat, 2004; Schwartz, 2009; Stone and Fernandez, 2008; Priolo et al., 2019). Consequently, hypocrisy induction is a tool that should be considered by policymakers when devising strategies to encourage pro-environmental actions and to foster collective action against global environmental changes such as climate change.

Although cognitive dissonance is a phenomena exhibited universally by all humans, it nonetheless depends heavily on cultural influences (Harmon-Jones and Mills, 2019, p. 12). Culture influences what cognitions a person has and hence dictates whether two cognitions are considered dissonant with one another or not. The following example from Festinger (1957) demonstrates this:

“Dissonance could arise because of cultural mores. If a person at a formal dinner uses his hands to pick up a recalcitrant chicken bone, the knowledge of what he is doing is dissonant with the knowledge of formal dinner etiquette. The dissonance exists simply because the culture defines what is consonant and what is not. In some other culture those two cognitions might not be dissonant at all.” (Festinger, 1957, p. 14, p. 14)

Furthermore, given that 1) “different cultures have strikingly different construals of the self, of others, and of the interdependence of the two” (Markus and Kitayama, 1991, p. 224), and 2) the concept of the ‘self’ is integral to the dissonance process (Aronson, 1968, 1999; Cooper, 2012, 2019; Elliot and Devine, 1994), it follows that culture influences cognitive dissonance. In particular, Westerners tend to feel dissonance from inconsistencies that might suggest incompetence or that something is wrong with them in some way, whereas Easterners tend to be more concerned about choices and behaviours that could lead to social rejection – for example, bad choices made on behalf of other people (Kitayama et al., 2004; Wong, 2009; Hoshino-Browne et al., 2005). The reason behind this lies in cross-cultural differences in how individuals view themselves, how important the opinion of others are in dictating one’s own behaviour, and the difference in aspiration for self-consistency (i.e. Westerners typically aspire towards self-consistency, while Easterners are more concerned with being consistent with others).

The idea that people filter information through a particular lens is inherent not only in cognitive dissonance theory, but in the social identity approach and cultural cognition theory (Fielding and Hornsey, 2016, p. 5). In other words, filter is a cultural lens that can be based on someone’s social identity and associated norms (described in the social identity approach), or their world-views (described in the cultural cognition theory). As such, cultural influences impact cognitive dissonance and the culturally embedded cognitive dissonance affects how much of a barrier or solution cognitive dissonance will be to dealing with global environmental changes.

Furthermore, given that separate thinking styles (i.e. analytic thinking for Westerners and holistic thinking for Easterners, particularly people from East Asia) is considered one of the most distinct cultural difference with respect to cognition and perception, coupled with the fact that there is a cross-cultural difference in principle and acceptance of contradiction (see details of Aristotelian law of non-contradiction vs ancient Chinese principle of contradiction referred to as naïve dialecticism in Heine, 2020a), it seems that East Asians are less unsettled than Westerners by contradictions in the world and in themselves (Heine and Ruby, 2010; Heine, 2020a). These cultural factors may affect how effective cognitive dissonance can be used to promote rather than to hinder pro-environmental behaviour and efforts to tackle global environmental changes such as climate change.

### 3.2. Positive illusion

Positive illusion refers to a three-fold bias with the general theme of having an unrealistically positive perception towards: 1) one’s own abilities (i.e. inflated self-capabilities), 2) one’s ability to control events (i.e. illusion of control), and 3) the future (Taylor and Brown, 1988). Integral to positive illusion are the three conceptualizations of optimism: dispositional optimism, comparative optimism, and unrealistic optimism. Dispositional optimism, which is the broadest term of the three, refers to the generalized positive expectancy that one will experience good outcomes (Radcliffe and Klein, 2002; Beattie and McGuire, 2019). Comparative optimism describes the belief that one’s risk is below average without regard to whether this belief is correct. Unrealistic optimism can be defined as “an inflated ratio of positive to negative expected events” (Radcliffe and Klein, 2002, p. 838). Though dispositional optimism is similar in concept to unrealistic optimism, the main difference between the two conceptualisations is that dispositional optimism is simply an orientation which cannot be classified as either accurate or inaccurate, whereas unrealistic optimism is considered a bias; thus the latter contains a negative connotation and is associated with irrationality and wrongness. Such negative connotation is associated with comparative optimism as well; hence the two are deemed optimism bias. All three conceptualizations of optimism associated with positive illusion can lead to an underestimation of the risks associated with climate change, which may consequently limit mitigation and adaptation efforts. Given that Schmidt and Gifford (1989) found people’s tendency to underestimate their objective risk to twenty-two environmental hazards, which surely will only become more frequent and intense if climate change is not combatted, it is evident that positive illusion, particularly unrealistic optimism, poses a serious threat to our ability to combat global environmental changes such as climate change (Beattie and McGuire, 2019).

<sup>1</sup> Promotion of pro-environmental behaviour by hypocrisy induction is exemplified in the following experiment: Dickerson et al. (1992) asked college swimmers to either reflect on the environmental compatibility of their shower-water use, or to sign off to a college water conservation campaign, or both. Those students who were asked to complete both tasks exhibited significantly reduced water consumption in the process, in contrast to those who were only asked to reflect on their water use or those who were only asked to participate in the conservation campaign. In conclusion, inducing the combination of commitment to environmental actions and critical reflection on behavioural patterns was able to produce pro-environment behavioural changes that could not have been realised by action commitments or behavioural reminders alone.

Although positive illusion, particularly unrealistic optimism, is considered by neuropsychologists as a “pervasive human trait” (Sharot et al., 2011, p. 1475), questions regarding cross cultural differences of this self-enhancing tendency have been investigated in recent studies. Cross cultural-differences in unrealistic optimism have been shown depending on what methodology is used – the direct or indirect method (Rose et al., 2008; Joshi and Carter, 2013; Heine and Hamamura, 2007). Using the direct method (for description of each method see Helweg-Larsen and Shepperd, 2001), Rose et al. (2008) show that both western and eastern cultures exhibit unrealistic optimism due to the underlying egocentrism cognitive bias. Using the indirect method, however, they show that Westerners seem to have a greater engagement in self-enhancement (which is positively associated with unrealistic optimism) than Easterners; hence a cross-cultural difference exists. These results support the claim that individuals with an interdependent ‘self’, typically exemplified in the East, do not succumb to self-enhancement as easily as individuals with an independent ‘self’ (Markus and Kitayama, 1991). However, the methodology used by Joshi and Carter (2013), which they claim would result in less or no unrealistic optimism being found in East Asian collectivist cultures, provided evidence that collectivists, which in their study were Indian participants, were found to have higher levels of unrealistic optimism, particularly for bad events, compared to the individualistic-oriented English participants.

To date, there is a consensus irrespective of methodology that there is a robust tendency for Westerners to exhibit unrealistic optimism; this consensus does not extend however to non-western samples (Joshi and Carter, 2013). Moreover, research suggests that unrealistic optimism is not shaped solely by culture, but rather by an interplay of culture and socioeconomic circumstances such as income inequality (Joshi and Carter, 2013; Loughnan et al., 2011).

### 3.3. Fundamental attribution error

People can attribute and thus explain behaviour based on either dispositional, internal factors or situational, external factors. Fundamental attribution error (FAE) is a term originally coined by Lee Ross to refer to the tendency for attributers or observers to overestimate the role of dispositional factors and underestimate the impact of situational factors when analysing and explaining the behaviour of others (Ross, 1977). Parallel to this error is the concept of the Actor-Observer (A-O) asymmetry, which describes the tendency for people to attribute the behaviour of others to their personality or intentions, called dispositional causes, while one’s own behaviour is attributed to limited choices, necessities, or competing concerns, called situational causes (Jones and Nisbett, 1972; Choi and Nisbett, 1998). Since Ross’s original interpretation of FAE “to describe the penchant for dispositional explanations” (Ross, 2018, p. 3), he proposed a new interpretation, which he considers to be a more basic, serious, and thus more fundamental failing of human beings. Calling it the ‘truly fundamental attribution error’ (TFAE), he describes it as the tendency to assume that the way we see the world is the way the world really is, and that therefore reasonable people should see it the same way, and if they however don’t see it the same way, it’s because some bias is affecting them (Ross, 2018).

All of these concepts (the FAE, A-O asymmetry, and the TFAE) describe errors in people’s judgement and decision-making process, which can have negative consequences on the recognition and adaptation towards climate change. Combatting climate change requires the fostering of consensus making, cooperation and collective action, which may be negatively impacted or reduced by these biases as 1) people may demonize others, and 2) use this demonization as type of rationalization for both blaming others and not effectively combating climate change. These biases emerge when attention is focused on the behaviour of others, when communication is poor, and when distrust is high.

Culture plays a pivotal role in people’s tendency to commit FAE and A-O asymmetry. Individualistic-oriented individuals (i.e. Westerners) have a tendency to 1) think and reason analytically rather than holistically, which influences their attention style (i.e. they have a tendency to view things as separate and internally consistent, a phenomenon known as field independence, rather than in connection to a wider context, which is typically exhibited by Easterners; see Masuda and Nisbett, 2001; Heine and Ruby, 2010; Heine, 2020b), 2) define themselves on their own intrinsic attributes (Markus and Kitayama, 1991), as well as 3) explain behaviour in terms of stable personality characteristics (Gawronski, 2007). As such, Westerners have an overall robust tendency to explain behaviour of others based on dispositional rather than situational factors; this holds true even when situational factors are made salient (Heine, 2012; Heine and Ruby, 2010; Gawronski, 2007; Choi and Nisbett, 1998; Gilbert and Malone, 1995). Contrastingly, collectivist-oriented individuals (i.e. Easterners) typically exhibit the opposite tendency – they do not explain behaviour in terms of stable personality characteristics, but rather in terms of situational factors. As such, Easterners are less likely to commit FAE compared to Westerners (Choi et al., 1999; Markus and Kitayama, 1991; Morris and Peng, 1994). A similar pattern, that Westerners are more susceptible than Easterners, holds true for the A-O asymmetry (Choi and Nisbett, 1998). This does not mean, however, that FAE is non-existent in collectivist cultures (Krull et al., 1999). Nevertheless, given the increasing evidence of cross-cultural differences outlined above, the universality of committing these biases has been doubted (Norenzayan and Heine, 2005; Heine, 2020b).

### 3.4. Ingroup/outgroup bias

In-group/Out-group bias is primarily based on the minimal group paradigm proposing that the minimal condition for this bias, such as favoritism towards one’s own group and prejudice towards other groups, is simply being a member of a group (Hewstone et al., 2002; Tajfel, 1974; Everett et al., 2015; Wilder, 1986; Wilder and Allen, 1978). The in-group/out-group bias can be particularly relevant for dealing with global environmental changes, because actions aiming at preventing or adapting to the environmental disasters expected to occur in the future depend on consensus-making, cooperation and coordination of different groups (Pearson and Schuldt, 2018). Such biases are more likely to emerge in the presence of strong categorisations into groups and in the presence of actual or perceived inter-group threats and low information flow between groups.



Research indicates that a message can be rejected or accepted solely on the basis of the group allegiance of the messenger (Cohen, 2003; Fielding and Hornsey, 2016; Esposo et al., 2013; Hornsey and Imani, 2004). Regarding the discourse on climate change, Jang (2013), drawing on attribution theory, found that “individuals exhibited in-group favouritism when interpreting the cause of climate change. When exposed to information stating that an in-group is responsible for the cause of climate change, individuals tended to escape from that burden by denying the link between human activities and climate change” (Jang, 2013, p. 34). These results suggest that social identity has a powerful influence on attitudes, beliefs, and actions relating to climate change. It is therefore important to understand how exactly social identity - via the in-group/out-group bias - can exert such powerful influence, because “(1) if we conceive of ourselves in terms of a particular social identity, we are more likely to make pro-environmental decisions and engage in pro-environmental behavior if the norms of the group are pro-environmental; (2) intergroup comparisons can change our conception of the ingroup’s environmental credentials which can in turn influence ingroup members’ pro-environmental attitudes and behavior; and (3) negative intergroup relations [...] leads to distrust of outgroup members and less likelihood of developing consensual solutions [to environmental issues]” (Fielding and Hornsey, 2016, pp. 9–10).

Given that the discourse on climate change involves both present and future generations, Meleady and Crisp (2017) argue that climate change action is inherently an intergroup issue, with the present generation categorised as one group, and future generations as another group. They claim “a reason for inaction on climate change is the perception of future generations as an outgroup” (Meleady and Crisp, 2017, p. 206), meaning that they may be subject “to all the ingroup-favoring biases that plague conventional intergroup relations” (Meleady and Crisp, 2017, p. 206). Consequently, they redefine climate change inaction as a temporal intergroup bias, and “argue that reducing ingroup-favoring biases and increasing concern for future generations is an important avenue for the enhancement of pro-environmental, intergenerational action” (Meleady and Crisp, 2017, p. 207).

As illustrated with the previously mentioned cognitive biases, the in-group/out-group bias is also modulated by cultural influences. Individuals from collectivist societies are more likely to be exclusionist as they classify others as either ingroup or outgroup, while individuals from individualistic societies tend to classify others simply as individuals (Hofstede et al., 2010; Hofstede, 2011). As such, the ingroup-outgroup distinction is vital for those who identify with an interdependent self, while it is not as vital for those who identify with an independent self. This is due to the fact that the construction of reality and regulating of behaviour is significantly influenced by the importance of the other (Markus and Kitayama, 1991). In other words, although independent selves associate themselves with others selectively as interdependent selves, it is to a much less degree as their behaviour is not a direct contingent on the actions of others as is true for interdependent selves. This cross-cultural difference in classifying others may give rise to a difference in the existence and manifestation of the in/out group bias between individualistic-oriented individuals (i.e. those with an independent self typically exemplified in individualistic societies) or collectivist-oriented individuals (i.e. those with an interdependent self typically exemplified in collectivist societies). This is significant as anything that creates divisions can dampen efforts to foster consensus-making and cooperation, which are prerequisites for dealing with global environmental changes.

Previous research in social psychology has shown differences in behaviour between individualistic and collectivist societies particularly with respect to group interactions. Evidence of greater levels of communal sharing is found in collectivist societies (Singelis et al., 1995), and the level of cooperation among in-group members is especially noticeable in collectivist cultures due to the expectation group members have of the notion of reciprocity (Yamagishi et al., 1998). The validity of claiming that individuals from collectivist cultures exhibit higher levels of cooperation is debateable however, as there are mixed results in the literature (Wagner, 1995; Koch and Koch, 2007; Martinsson et al., 2013). With respect to out-group derogation, stronger anti-social punishment towards members of the outgroup were seen in collectivist societies (Herrmann et al., 2008). Alt et al. (2018), using a dictator game to conduct research on in-group bias, indicated that pro-social behaviour in out-groups was higher than in in-groups in the Indonesian study sample. The key findings of this work were related to the contrasting behaviours observed between the subjects in Indonesia and the dominant Western, Educated, Industrialized, Rich, and Democratic (WEIRD) subject pool typically used in experimental economics.

Differences in self-construal between Westerners and Easterners, which affect how they view others as either part of an ingroup or simply as a neutral individual, may affect Meleady and Crisp (2017)’s temporal intergroup bias. One might think that Easterners, given that they are exclusionists, may consider future generations as outgroups, and are thus more susceptible to committing this temporal intergroup bias. However, the reverse may be true, given that Easterners with their interdependent self-construal and accentuated social norm to include family members as part of their ingroup, may internalize future generations more so than individualistic-oriented Westerners. Additionally, Westerners see others as individuals and may not internalize the future generations as part of their ingroup. In any case, if climate change inaction can be redefined as temporal intergroup bias, it is important to see how cultural factors (i.e. differences in cultures) may impact this.

### 3.5. Risk perception bias

Risk perception bias is based on prospect theory and it describes the way people choose between alternatives that involve risk. In essence, people make decisions based on the potential value of losses and gains rather than on the final outcomes (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). Specifically, people are risk-averse when choosing among potential gains (the domain of gains), but they are risk-prone when choosing among potential losses (the domain of losses). Prospect theory has implications for establishing climate mitigation and adaptation strategies (Osberghaus, 2017). It has been acknowledged that risk perception bias contributes to the discounting of one’s personal risk to the consequences of climate change, ultimately acting as a barrier towards climate change action (Langer, 2015; Frondel et al., 2017; Grothmann and Patt, 2005; Johnson and Levin, 2009). In line with this rationale, we are currently in the domain of losses because we would need to implement costly changes now to avoid the prospect of major environmental disasters in the future. This may explain the current tendency to do less than advised in the hope that the situation

will turn out better than predictions suggest.

Risk perception bias approaches risk perception from the standpoint that humans are universally subjective to heuristics and cognitive biases when processing information regarding risk and uncertainty. The impact of these heuristics and cognitive biases on processing information regarding risk and uncertainty seem to be different across cultures. “Cultural differences do not prevent risk preferences to be qualitatively different, i.e. most people worldwide follow in their behavior the typical features that prospect theory captures: risk aversion in gains, risk seeking behavior in losses, overweighting of small probabilities and loss aversion. The quantitative differences, however, are large: not only on an individual level, but also on a between-countries level. These differences can be explained to some extent by economic, but also cultural differences” (Rieger et al., 2011, p. 30). In short, although risk perception bias is a universal phenomenon, the universality of prospect theory exhibited in humans is modulated by cultural influences, as evidence shows “cultural factors indeed cause substantial differences in risk preferences” (Rieger et al., 2011, p. 30).

Many cross-cultural differences have been found with respect to the biases and behavioural phenomena described in prospect theory such as risk aversion in gains, risk seeking in losses, probability weighting, and loss aversion. For example, individuals from collectivist societies are generally less risk averse, due to their reliance on social networks as a cushion (Hsee and Weber, 1999; Weber and Hsee, 1998; Rieger et al., 2011; Wang and Fischbeck, 2008), and are generally more overconfident in probability judgements (Yates et al., 1989, 1997, 1998; Wang and Fischbeck, 2008) than individualistic/western individuals. Rieger et al. (2011) found evidence of Hofstede’s cultural variables uncertainty avoidance and individualism as causal factors for all biases in prospect theory except for probability weighting (for which only a weak correlation was found). For loss lotteries, uncertainty avoidance increases while individualism decreases risk seeking behaviour (Rieger et al., 2011, p. 26); this result of individualism influencing risk seeking in losses supports Hsee and Weber (1999)’s cushion hypothesis, which claims that collectivists are generally less risk averse to potential losses, due to their reliance on social networks acting as a safety-net or cushion by mitigating those potential losses. For gain lotteries, uncertainty avoidance increases risk aversion; individualism does not seem to have a causal relationship with risk aversion. Loss aversion is significantly impacted by both uncertainty avoidance and individualism, though this result is not as robust as the others.

Kahan et al. (2011)’s influential “cultural cognition of risk” theory, which claims that people’s assessment of risk, empirical evidence, and scientific consensus is shaped by their cultural values on how the world is established (i.e. whether they believe in individualistic-collectivist values), additionally suggests cross-cultural differences in risk perception. The theory “refers to the tendency of individuals to form risk perceptions that are congenial to their values [and that] cultural cognition shapes individuals’ beliefs about the existence of scientific consensus, and the process by which they form such beliefs” (Kahan et al., 2011, p. 147). In their approach, Kahan et al. (2011) fuse two theories: 1) the cultural theory on risk perception, an anthropological and sociological approach developed by Douglas and Wildavsky (1982), which includes the taxonomy of individualistic-communitarian and hierarchical-egalitarian, and 2) the psychometric paradigm, a psychological approach based on Tversky and Kahneman’s works on heuristics and biases which posits that individuals are subject to cognitive and affect mechanisms that cause systematic deviations in risk perceptions from rational decision theory (Slovic, 2000). The Kahan et al. (2011) theory corresponds with data by Hornsey et al. (2016), who conducted a meta-analysis investigating the determinants of the belief in or scepticism about climate change. Their data indicate a robust medium sized negative relationship between people who adopt individualistic (and hierarchical) cultural values and the belief in climate change (Hornsey et al., 2016). Although Douglas and Wildavsky (1982) have been criticised (see Renn and Rohrmann, 2000), risk-perception is undeniably, as argued by Renn and Rohrmann (2000), a multidimensional concept governed by anthropological, psychological, social and cultural variables. This leads to the necessary detachment of approaching risk perception as simply governed by universal heuristics.

### 3.6. Present bias

Present bias, the notion that what happens in the present carries more weight than what happens in the future, is crucial for (economic) decision-making situations (O’Donoghue and Rabin, 1999; O’Donoghue and Rabin, 2015; Rubinstein, 2003). It is also very relevant in sustainability contexts (Ioannou and Sadeh, 2016; Zaval and Cornwell, 2016; Fehr and Leibbrandt, 2011; Gowdy, 2008; Shu and Bazerman, 2011; Stern, 2007; Nordhaus, 2007; Weitzman, 2007), because it often leads to myopic decisions due to the tendency of people to disregard costs and benefits occurring in the future. This myopic decision making is linked with the concept of procrastination; people know what they have to do but they do not wish to incur the costs necessary at present and thus postpone action into the future, believing that the consequence of doing so is not as bad as what it actually will be. In fact, Laibson (2018) claims the present bias partially explains why our (impatient) actions deviate from our good intentions. His reasoning is as follows: people typically tell themselves that they will at a certain point in the future do what has to be done (i.e. the right and rational thing), but when that future point in time finally occurs, they are tempted to break away and seek immediate gratification (i.e. to not deal with the costs of engaging in what should be done, but rather procrastinate as it is deemed easier and pays-off instantly; for more details see Laibson, 2018). Undeniably, present bias is fundamental to climate change because this global environmental change is long-term and involves hypothetical dangers while people are much more sensitive to immediate and direct personal experience. Moreover, delaying action, which is inherent in present bias, does not foster the necessary climate action needed today. As such, the present bias is suspected to have a negative impact on mitigation and adaptation efforts towards climate change (Langer, 2015; Shu and Bazerman, 2011).

Time inconsistent preferences (e.g. hyperbolic discounting, i.e. discounting the immediate future more than far future) are considered to be a universal phenomenon, yet with the rise of cultural comparative studies and the idea that perception of time is a part of culture, a few studies have investigated the role of culture on time preferences. One recent study was conducted by Wang et al. (2016) who examined time preferences in 52 countries and investigated the role of culture on these preferences by using the Individualism, Uncertainty Avoidance, and Long Term Orientation dimensions in Hofstede’s model of national culture. Their results show

that although hyperbolic discounting is truly a universal phenomenon, significant variations in time preferences exist due to cultural influences; this holds true even when economic factors (e.g. GDP, inflation rate, etc.) are controlled. Specifically, the level of present bias is positively correlated with Uncertainty Avoidance and negatively correlated with Individualism and Long-Term Orientation. Culture, thus, has an impact on the strength of people's present bias.

### 3.7. Possible synergies among biases

While each of the above biases has the potential to lead people to underestimate the consequences of climate change, in addition, there could be synergistic interactions among these biases that could magnify their collective negative effects. For example, [Johnson and Levin \(2009\)](#) suggested that positive illusions can reinforce the bad choices typical of the prospect theory's domain of losses. Similarly, both FAE and A-O asymmetry can aggravate the in-group bias by attributing the actions of others to their selfishness while one's own actions are attributed to necessity. Given the possibilities of magnified negative effects due to synergistic interactions, one can hypothesise that these biases transform perceptions of vulnerability and information (e.g. from opinion leaders and social media) into highly significant and non-rational influences on the attitude of people towards the environment. Based on the above analysis of the influence of culture on cognitive biases, one has to assume that cultural influences can either mitigate or aggravate such synergistically interactive amplification effects of cognitive biases, thus increasing the variability of irrationality in climate change perception even further.

## 4. Implications of Culturally Embedded Cognitive Biases for environmental action

At present there seems to be a range of recognized barriers to efficient adaptation to climate change. The IPCC Assessment Report 5 (AR5) currently considers 10 categorical factors/constraints ([Klein et al., 2014](#), pp. 911–918). In addition, [Johnson and Levin \(2009\)](#) detail 5 cognitive biases with the potential to influence human behaviour with respect to climate change mitigation and adaptation: (1)

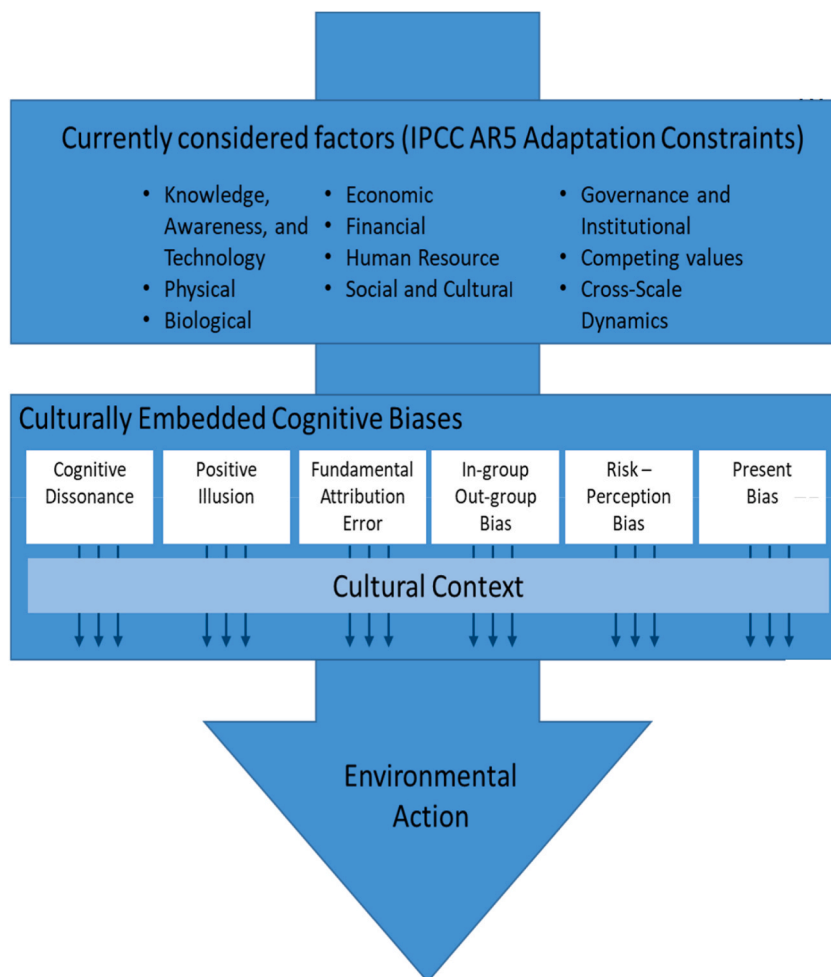


Fig. 1. Barriers to Environmental Action: the role of *Culturally Embedded Cognitive Biases*.



positive illusion, (2) cognitive dissonance, (3) in-group/outgroup bias, (4) fundamental attribution error, (5) risk perception bias. Another bias that we deem necessary to consider in this context is present bias (Zaval and Cornwell, 2016).

In the above, we demonstrate that each of these cognitive biases is highly sensitive to cultural influences. These influences complicate the analysis of human adaptive behaviour to global environmental changes. However, a comprehensive understanding of human adaptive behaviour, including additional, modifying influences, such as culture, is a prerequisite for effective, sustainable environmental policy making (see Fig. 1). We therefore consider it necessary that studies analysing the influence of human perception and behaviour on global environmental changes need to evaluate each cognitive bias as it is modulated by cultural influences. The investigation of CECB must be empirically researched to investigate 1) to what degree cognitive biases negatively impact mitigation



**Fig. 2.** Policy Cycle (revised from Howlett and Giest, 2015). A CECB-testing feedback-loop is an essential step in policymaking to ensure environmental action compliance.

and adaptation towards global environmental changes (e.g. climate change) and 2) to what degree the magnitude and impact of cognitive biases do in fact vary across culture.

Policy makers usually strive to adhere to quality management requirements when devising and implementing their strategies; therefore, the procedures chosen are basically adaptations of the Plan-Do-Check-Act quality management process (International Organization for Standardization, 2015), as exemplified in the popular 5-step “policy cycle model of the policy process” described in the International Encyclopedia of the Social and Behavioural Sciences (Howlett and Giest, 2015): In a first step, termed *Agenda Setting*, an issue is being recognized as requiring action, and in a second and third step, solutions are being worked out (*Policy Formulation*) and a final decision on implementation is being made (*Decision Making*). The fourth step, *Policy Implementation*, is then followed by *Policy Evaluation*, a procedure of assessing the success of the policy, and re-enter the process at the *Agenda Setting* step, should revisions be necessary.

As much as this policy process is undoubtedly geared towards upholding high quality standards, it is prone to be undermined by undetected CECB: *Policy Formulation* focuses on identifying the environmental actions necessary to protect the environment, but does not inherently consider possible CECB driven implementation modulations; and furthermore, *Policy Evaluation* analyses measurable outcomes, but does not produce feedback as to how much of possible shortcomings, or unrealised upsides is owed to CECB.

We therefore propose to adapt the policy process to specifically account for CECB-related quality shortcomings (see Fig. 2). Specifically, we recommend the introduction of a policy feasibility testing with regards to negative CECB interference consisting of (1) selecting a set of CECB which, based on their properties described above, present the highest risk of negatively affecting implementation compliance of the proposed policy, and (2) conducting a willingness to comply study with a representative subset of the policy target group. Any information gathered on CECB-caused policy implementation pain points can be fed into a new iteration of the policy formulation cycle.

## Author declaration

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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