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Cognitive bias between individuals and groups: how to improve sustainable decision making?

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Résumé

Le développement durable de notre société, ou comment répondre aux exigences du présent sans compromettre la capacité des générations futures à répondre à leurs propres besoins, est l'une des questions les plus difficiles auxquelles l'humanité est actuellement confrontée. Ce problème nécessite une approche multidisciplinaire dans laquelle des chercheurs de différents domaines collaborent pour le résoudre. Dans la présente étude, nous tentons d'expliquer comment les "biais cognitifs", qui sont des tendances systémiques ou des distorsions dans la perception et la prise de décision humaines, contribuent à ce dilemme. De nombreuses études universitaires ont démontré l'influence des biais cognitifs sur la manière dont les décisions sont prises. Nous proposons un examen conceptuel de l'ensemble des recherches sur l'influence des biais cognitifs chez les individus et les groupes sur la durabilité et la conduite éthique. Bien que les deux catégories puissent influencer un comportement non durable, nous constatons que les biais cognitifs de groupes peuvent influencer le comportement plus que les biais individuels. Nous concluons qu'un grand nombre de biais cognitifs documentés dans la littérature peuvent être interprétés comme des manifestations de biais cognitifs humains spécifiques au contexte social et nous proposons une série de solutions pour surmonter ces contraintes.

Mots clés: Biais cognitifs, influence comportementale, prise de décision environnementale, durabilité, comportement durable

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Abstract

The sustainable development of our society, or how to meet the demands of the present without compromising the capacity of future generations to meet their own needs, is one of the most challenging issues that humanity currently faces. This problem requires a multidisciplinary approach where academics from various fields collaborate to solve it. In the present study, we attempt to explain how "cognitive biases," which are systemic tendencies or distortions in human perception and decision-making, contribute to this predicament. Numerous academic studies have demonstrated how cognitive biases influence how decisions are made. We offer a conceptual review of the body of research on the influence of cognitive biases among individuals and groups on sustainability and ethical conduct. While both categories may influence unsustainable conduct, we find that group cognitive biases may influence behavior more than individual biases. We conclude that a large number of cognitive biases documented in the literature can be interpreted as social context-specific manifestations of human cognitive biases and offer a set of solutions to overcome such constraints.

Keywords: Cognitive bias, behavioral influence, environmental decision making, sustainability, sustainable behavior

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1. Introduction

The world has changed drastically in a matter of decades, giving human beings enormous practical advantages in a wide range of fields. Food shortages, illnesses, and conflicts—then intractable problems that brought agony and suffering—have since been successfully resolved (Pinker, 2018). Unprecedented economic expansion has been experienced by a significant portion of the world, and through the currents of globalization, it is thought that less developed nations can, in theory, also benefit from this progress (Harari, 2016). The same economic expansion, which has granted us access to a surplus of food, energy, medications, and improved living conditions, is at the same time disrupting the delicate ecological equilibrium. Critical difficulties are already emerging from this two-edged transition, including the depletion of natural resources and the detrimental effects of environmental degradation, such as droughts, biodiversity loss, and a lack of fresh water. (Greco & de Jong, 2017). As of now, scientists have accumulated significant and convincing evidence that the stability and survival of contemporary societies are seriously threatened by the use of fossil fuels which is accelerating global warming (McGlade & Ekins, 2015), a phenomena that could have devastating consequences for future generations' health, prosperity, and existence. Rising sea levels, extended droughts, deadly floods, water scarcity, and refugee displacement are all examples of this (Biermann et al., 2012; IPCC, 2022; Kates & Parris, 2003; Meadows, 1997; Steffen et al., 2015). Today, not just scientists but also most politicians and the public regard these truths as universal. Yet, despite the widespread knowledge of the problems facing humanity, practical remedies are still absent. Our behavior and decision-making regarding the preservation of our natural resources and the prevention of upcoming (natural) disasters have not significantly changed because of this understanding. This phenomena is caused by certain aspects of human decision-making, which might be erroneous at times. For example, it is common to underestimate the long-term risks connected with concerns such as global warming and species extinction. Due to this underestimate, major future dangers may appear insufficient to compel serious action (Berger, 2009). In general, we see these common and frequently faulty decision-making processes in numerous aspects of our society (Eigenauer, 2018). Another example can be illustrated in the excessive consumption of fossil fuels, exceeding what is reasonable, a decision that can be justified using the concept of rational choice in economics. This perspective emphasizes that the consumption of fossil fuels incurs pollution costs, which are not adequately reflected in the market price. This disparity between market prices and social costs is an example of market

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failure (Hanley et al., 1997). As advocated by Pigou (1920), the rational answer to such a market failure is to impose a tax on the product that represents its authentic societal costs. Despite some countries having enacted such carbon taxes, many, including the world's largest CO2 produced, the United States, have not (World Bank, 2023). Such examples lead us to the question: If we are aware of the issue and have viable solutions, why does it take an eternity to implement real change?

In this article, our main goal is to investigate how decision-making processes are influenced by the human brain and its inherent psychological characteristics. Our argument is based on the notion that human cognitive biases can play a significant role in explaining countless instances of unsustainable decision-making and behavioral patterns. Furthermore, we consider how our comprehension and recognition of these cognitive biases might be used to find remedies to one of environmental psychology's biggest challenges: the advancement of sustainable behavior (Sörqvist, 2016). Cognitive biases can be broadly defined as systematic and universally occurring tendencies, inclinations, or predispositions in human decision-making processes that can render them susceptible to producing inaccurate, suboptimal, or erroneous outcomes (e.g., Kahneman, 2011; J. E. Korteling & Toet, 2022; Tversky & Kahneman, 1974). Examples of bias that are widely recognized include confirmation Bias which posits that we have a tendency to look for and value information that confirms our existing beliefs and expectations (Kahneman, 2011), and Sunk-Cost Fallacy which is the tendency to continue investing in courses of action, even when they are yielding negative outcomes (Thomas, 2018). Moreover, we are often unaware of our own biases since biased decision-making appears normal and self-evident (Pronin et al., 2002). As a result, we may not completely understand how biases affect our decision-making processes since we usually fail to detect their presence. Cognitive biases are well-documented psychological phenomena that have been thoroughly indicated, defined, and explored in the scientific literature. People continuously display typical tendencies in how they receive and process information for decision-making and judgment, regardless of the settings or contexts. These biases are systematic and pervasive, and as a result, they have a big impact on societal challenges and policymaking (e.g., Baron, 2023; Flyvbjerg, 2021; Mercer, 2005; Shiller, 2015). Multiple examples have demonstrated that policymakers are risk-averse when anticipating benefits but more prepared to take risks when presented with prospective losses (e.g., McDermott, 2004; Vis, 2011). It is also crucial to remember that political decisions are frequently made by groups rather than individuals, and thus the quality of decisions may be

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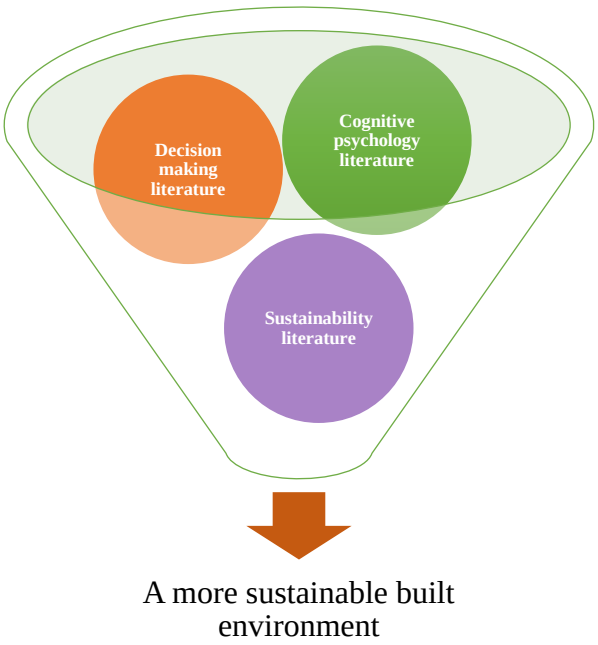
greatly hindered by a variety of cognitive biases introduced by the collective decision making (Engler et al., 2019). Current studies often concentrate on certain biases and consider whether policymaking could be improved with regard to those biases. (e.g., Arbuthnott & Dolter, 2013; Thaler & Sunstein, 2009), current research in this field frequently disregards the significance of group settings and instead focuses on a specific bias and its relationship with a particular element of sustainability, such as global warming (Bazerman, 2006; Stoknes, 2015) or conservation (Clayton et al., 2013). The understudied nature of sustainability-related biases in collective decision-making has lately come to light (Attari et al., 2014). Thus, the purpose of our convergent research[1] is to investigate how cognitive biases— whether at the individual or group level— affect unsustainable decisions. In the next sections, after presenting the methodology of our study, we discuss the selected cognitive biases relevant for sustainable behavior. Finally, we synthesize the most crucial lessons to direct us toward more sustainable decisions and behaviors.

Figure 1: Convergent research is applied and interdisciplinary



Source: Authors

[1] Convergent research is fueled by a societal problem, involving intense and ongoing integration across fields. The methods and difficulties covered in this review are probably applicable to convergent research for other sustainability-related problems.

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2. Methodology

Since the early work of Tversky and Kahneman (1974), the number of biases identified by behavioral scientists has exploded in what has been termed a behavioral revolution in economics, management, and across the social and human sciences. The field of research on cognitive biases is large, thus organizing biases has been attempted in multiple ways. Caputo (2013) identified broad 21 biases in the context of negotiations. Flyvbjerg (2021) reviewed the top 10 biases in project management. However, to the best of our knowledge, there is presently no exhaustive list nor collection of all empirically proven cognitive biases, as each one tends to be based on a specific setting (for example, negotiations, project management...). The list of cognitive biases on *Wikipedia* currently has more than 200 items ("List of cognitive biases," 2023). Given the dynamic and growing nature of human cognition research, it is expected that the number of documented biases will continue to grow. Nonetheless, despite its potential for expansion, the existing list offers the most complete access point to the vast array of human cognitive biases known as suggested by Engler, Abson and Wehrdenwe (2019). Because human cognition is a very active field of research, the list can be expected to grow. We thus recognize that this is not a stable list but maintain that it is the best access point available to the wide array of human cognition biases. In today's society, decisions can be made on an individual basis, but they frequently involve several participants or stakeholders who each bring their own viewpoints and experiences to the table. These stakeholders may include individuals, decision-makers in government, business representatives, and interest groups (e.g., Steg & Vlek, 2009). With these initial concerns in mind, we focused our review of the current research on cognitive biases related to sustainability that bear relevance to decision-making within contexts marked by risk, uncertainty, or inter-group dynamics. These elements are crucial to the majority, if not all, sustainability concerns (Dovers & Handmer, 1992).

In conclusion, two main pillars served as the foundation for our method of choosing biases for inclusion and debate in this study: 1) Pre-selection based on a bias or theme: The list stated previously served as our initial guide for identifying biases based on the thematic or situational context in which they appear. 2) Screening of literature: To gain important insights regarding cognitive biases, we undertook an extensive review of pertinent books, including works by Taleb (2001, 2007), Kahneman (2011) and Dobelli (2014). Our refined list of biases was produced as a result of this comprehensive screening process and was divided into two primary categories: "individual/risk-related" and "group contexts." Then, after narrowing down our list,

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we had talks and decided which biases were relevant to today's sustainability concerns. We also discussed effective ways to use examples to convey and stress their importance. The list of biases that is displayed here is the outcome of this collective effort. Our technique can be regarded as combining elements of both a "conceptual review/synthesis" and a "traditional review," as stated by Petticrew and Roberts (2008). Traditional since our approach of selecting relevant papers is a semi-structured methodology that is consistent with the more traditional method of reviews (Heal & Millner, 2014). Conceptual since our method of analyzing research on cognitive biases targets the context of sustainability, and conceptual reviews can be regarded as an effort to combine conceptual knowledge that might enhance our understanding of specific situations (Petticrew & Roberts, 2008). In light of our selection approach, our methodology implies that we only select cognitive biases that are well-established, that is, they have been repeatedly replicated by numerous studies in a variety of contexts, leaving out emerging studies regarding risk, uncertainty, and inter-group dynamics. It's crucial to note that the list of cognitive biases exhibited by people that is provided in this study by no means encompasses all possible biases that could be relevant to sustainability. It would take an enormous effort that would go far beyond the parameters of a focused and brief research report to achieve "exhaustiveness" in this sense. Instead, we want to encourage a way of thinking about sustainability—both its problems and potential solutions—that we think is essential but might not be sufficiently prominent on the agenda of those who are trying to make an impact.

3. Understanding cognitive biases and sustainability: insights from social and behavioral psychology

In the next section, is divided into two parts: Individual-level biases and in group biases, both in which significant psychological contributions about cognitive biases in decision-making and assessment of their impact on sustainability are discussed. We also discuss possible solutions to these problems and propose instruments that can promote sustainable conduct. For a summary of all the biases discussed in this section, **see Table 1**.

3.1. Individual-level biases

The individual-level cognitive biases listed below all pertain in some manner to how individuals make decisions when faced with risk or uncertainty about what may occur in the future.

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3.1.1. Default bias

The default bias is a bias towards the default option in a given choice set (Brown & Krishna, 2004; Johnson et al., 2002; Johnson & Goldstein, 2003). In other words it is a tendency towards previously used designs even if another option might be better in terms of expected outcome, which hinders innovation for sustainability (Beamish & Biggart, 2012). To investigate this prejudice, multiple approaches have been examined. One strategy is to use the participants' past decisions as defaults in the experiment's subsequent rounds (Krieger & Felder, 2013). Another method offers people a variety of fresh options, but the way the question worded emphasizes one of the choices as the default (Geng, 2016; Suri et al., 2013) or at least what would be the default in an alternative scenario (Korobkin, 1997). When a particular option (the default) is preselected, the default bias becomes evident. This circumstance may involve upholding the norm, but it may also involve fresh circumstances. Individuals may, for example, install new technology (breaking their norm) yet keep the default password setting, thus posing a security vulnerability (Kankane et al., 2018). Another example is renewable energy adoption which is nearly tenfold when it is offered as the default option for utility customers, in contrast to brown electricity. Yet, customers can still choose a traditional electrical blend if they want to (Ebeling & Lotz, 2015). These examples highlight that the default bias affects many areas of decision-

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Table 1: Overview of the selected cognitive biases relevant for sustainable behavior, with possible mitigation strategies

Name	Definition	Mitigation strategies
Default bias	"A default is a preset option that occurs if no alternative is actively selected" (Ozdemir & Finkelstein, 2018, p. 3).	• Feedback loops and benchmark mechanisms.
Status quo bias	"Doing nothing or maintaining one's current or previous decision" (Samuelson & Zeckhauser, 1988, p. 8).	• Ex., Positional bargaining should be given more weight in international policy.
Sunk cost fallacy	"Greater tendency to continue an endeavor once an investment in money, effort, or time has been made" (Arkes & Blumer, 1985, p. 124).	• Structuring of decision process by facilitators
Zero-risk bias	Although alternative options may be superior in terms of overall risk reduction, people tend to choose the chosen option that guarantees zero risk when faced with a risky selection. (Rottenstreich & Hsee, 2001).	• Emphasizing on the opportunity costs rather than the risk reduction

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Neglect of probability	"The tendency to disregard probability during decision-making" (Mohanani et al., 2018, p. 21).	• Visioning and scenario generation through developing plausible depictions of anticipated threats
Affect heuristic	"Affect refers to the specific feeling of "goodness" or "badness" evoked by a stimulus" (Peters et al., 2006, p. 46).	• Promoting positive messages instead of guilt tripping
In-group/ Out-group Bias	Preparing one group (in-group) over the other (out-group) based on individual psychological similarities (Brewer, 1979).	• Educating and training decision makers
Group polarization	''The exaggeration through group discussion of initial tendencies in the thinking of group members'' (Brehm et al., 2002, p. 272).	• Adopting random intentional selection to avoid consistency in formal deliberative contexts

Source: Author

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making, in some cases It has been suggested that, while upholding individual freedom and liberal values, the default bias might be a beneficial instrument for promoting desirable behavior or decisions. By providing suitable default settings, this is accomplished (Thaler & Sunstein, 2003, 2009). Examples of these subliminal suggestions, or "nudges" in the context of sustainability include travel sites that automatically select the "purchase carbon offset" feature as the default (Simões, 2016).

3.1.2. Status quo bias (SQB)

The status quo bias (SQB), which is closely related to the default bias, refers to a preference for the current state of affairs over potential alternatives. The current status quo serves as a reference point, and any change in that reference point is seen as a loss (Kahneman et al., 1991). The term was first introduced by Samuelson and Zeckhauser, who used an actual example of a coworker who routinely ate the same sandwich for lunch for several years with only a single instance of deviation from this routine. Samuelson and Zeckhauser (1988) ran an experiment with participants, giving them two different treatments to show how widely applicable this prejudice is. Participants in Treatment 1 were given four different investment alternatives and told they had inherited money from a deceased uncle. In contrast, participants in the second treatment were given the same situation but were told that their uncle had already put the money in one of the alternatives. Notably, when it came to Treatment 2, participants tended to choose the choice that had already been made for them. This experiment brought to light how the SQB affects the way individuals make decisions. Any initiatives targeted at changing the current situation may face considerable challenges as a result of the SQB. As a result, it might obstruct policy initiatives that call for reforms in our current lifestyle in order to move toward a more sustainable future. Even when it is obvious in advance that these improvements would result in positive net gains, this nonetheless happens (Eidelman & Crandall, 2012; Fernandez & Rodrik, 1991). Another example is the perception of energy transition as a potential solution to forthcoming issues as dangerous by many individuals, not only to their entrenched comfortable way of life but also to their social basic needs. A change to more sustainable habits may thus result in negative sentiments of loss of security and belongings, which is frequently referred to as the ‘fear of falling’ (Korteling et al., 2023). In contrast to the default bias, the SQB cannot be used as a nudge to promote more sustainable decision-making and behavior. Therefore, it needs to be aggressively addressed and diminished. For instance, in the context of climate negotiations, policies should place a high priority on equity, individual interests, the creation of

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solutions that benefit both parties and the attainment of agreements that are advantageous to all sides (Engler et al., 2019). Despite the obvious benefits of such ethical negotiation strategies (for ex., Bazerman & Neale, 1993; Fisher et al., 1991), positional bargaining seems to be given more weight in international policy.

3.1.3. Sunk cost fallacy

Also known as Irrational escalation or Concorde effect is the tendency to consistently continue a chosen course with negative outcomes rather than alter it. The effort previously invested is the main motive to continue (Arkes & Ayton, 1999; Staw, 1976). In a broader context, sunk costs can extend to encompass skills associated with the prior methods of operation that individuals may forfeit as a result of a change. This could include the time and effort individuals have dedicated to training for the current mode of operation. For instance, if a new technology is introduced, the training they've received may become obsolete and thus regarded as a sunk cost (Kim & Kankanhalli, 2009). Sunk costs always result in SQB because the existence of sunk costs necessitates the existence of a status quo on which they have been spent (Korteling et al., 2023). In the field of entrepreneurship, Yang et al. (2015) have posited that technological entrepreneurs are more prone to the sunk cost bias compared to their non-technological counterparts. When these technical entrepreneurs are self-driven and lack a mental budget for their business, their risk is increased. The sunk cost fallacy is frequently cited as a significant driving reason for the sustained public and commercial investment in fossil fuels despite the availability of more viable alternatives and the erratic nature of the consequences of global warming (Arbuthnott & Dolter, 2013). By increasing awareness through decision-maker training and implementing a systematic decision-facilitation process, the sunk cost fallacy can be addressed most successfully. The costs that are explicitly identified as sunk costs should not be considered in the decision-making process (Engler et al., 2019).

3.1.4. Zero-risk bias

The zero risk bias is the propensity to value choices that offer perfect safety or zero risk greater than those that involve some level of threat (Rottenstreich & Hsee, 2001; Viscusi et al., 1987). Most decision makers exhibit a strong inclination toward risk aversion and prioritize security when making decisions (De La Vega et al., 2018). This tendency is fueled by humans' intrinsic loss aversion, which causes individuals to empathize with potential losses more strongly than corresponding benefits (Tversky & Kahneman, 1991). The zero-risk bias is relevant for

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sustainability in that it promotes the inadequate allocation of resources to policies that appeal to zero risk instead of policy alternatives that could be far more successful in total risk reduction but do not bear the zero-risk guarantee. As indicated by the study conducted by Stockhammer et al. (2021) environmentally friendly modes of transportation are unfavorable for decision makers since they are viewed as being riskier. Rail and inland waterways are often utilized for high-volume shipments only, and less frequently than roadways. Rail and inland waterways have a higher relative involvement, so when safety or timeliness issues do develop, they tend to be more apparent. For instance, a single error made while processing ten transports can be seen as having a greater severity than a hundred mistakes made when handling a thousand transports (Stockhammer et al., 2021). In addition, compared to truck shipments, the effects of transportation damage tend to be more severe for barge shipments. This increases the perceived hazards connected with these modes of transportation because barge cargoes have a higher risk of harm to a bigger number of goods (ibid). In decision-making situations involving risk reduction, Baron (2003) contends that the zero-risk bias can be reduced by communicating entire quantities rather than percentage. In relation to that, we believe emphasizing the opportunity costs of the various policies available may be beneficial. Opportunity costs should highlight the risk reduction given up by choosing not to participate in, say, climate change mitigation, in the context of the zero-risk bias. These suggested mitigation techniques bring to light the challenge of effectively communicating risk and the requirement for greater caution in this area in upcoming societal discussions and political decisions.

3.1.5. Neglect of probability

According to Sunstein (2002), it can be extremely harmful to fully disregard probability when making decisions in uncertain circumstances, especially when dealing with uncommon and unpredictable outlier events that have a huge impact and are frequently referred to as "black swans." Such events have occurred throughout history, including the discovery of America (from the viewpoint of the indigenous population), WWI, the crash of the Titanic, the fall of the Soviet Union and the Subprime mortgage crisis. These occurrences stand out for both their exceptional rarity and the weighty implications they entail. Although they can have the most significant and far-reaching impacts, these unusual events tend to occur at the boundaries of a statistical distribution. Nevertheless, many individuals tend to ignore this possibility. Taleb (2007) emphasized that these black swans, rarely affect our planning, economics, politics, business models, and daily lives. Despite the fact that these occurrences have never happened

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before and cannot be accurately predicted, they should be given a lot more thought and consideration than they usually do. Many sustainability problems include dealing with inevitably unknown future possibilities, necessitating prompt action. The argument about climate change is arguably the most well-known example of this (Sunstein & Zeckhauser, 2011). The Intergovernmental Panel on Climate Change (IPCC) produces scenarios that represent several possible outcomes under varying levels of CO2 emissions as probability distributions in the context of climate change. According to Weitzman (2009) several of these distributions contain modest but not zero possibilities of outcomes with high ramifications. The accuracy of these estimates has to be improved, especially for events with high impact/low probability. Given that it involves factors like assessing climate sensitivity and forecasting future weather patterns, this endeavor is inherently difficult (IPCC, 2022).

3.1.6. Affect heuristic

Human information processing, decision-making and behavior are significantly influenced and guided by affect and emotions (Brosch et al., 2013). This is known as affect heuristic (Kahneman, 2011). Affect and emotions experienced in relation to climate change have repeatedly been demonstrated to be among the most significant determinants of judgments and behaviors connected to climate change in recent empirical and meta-analytic studies. Negative affect toward climate change was the single biggest predictor of all studied elements in a comprehensive review of factors influencing climate change risk perception that incorporated cognitive, experiential, and socio-cultural variables (van der Linden, 2015). Furthermore, in a replicate use of the model, negative affect was again the strongest predictor of individual readiness to engage in climate change mitigation actions such as taking public transportation or using green energy (Xie et al., 2019). In an effort to inspire sustainable behavior, numerous intervention tactics have been established that invoke emotions or magnify already present emotions. Thus, messages concerning climate change have either stressed arousing negative emotions like fear and guilt or, more recently, arousing positive emotions like hope and optimism (Moser, 2016). The question of whether fear-based messages should be avoided because they might make people feel helpless or avoidant because they may believe that the threat posed by climate change is too great to be resolved successfully is currently being discussed in the literature on climate change communication (Chapman et al., 2017; Stern, 2012).

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3.2. Group biases

The group-level cognitive biases listed below all pertain in some manner to how decisions are made within groups when faced with risk or uncertainty about what may occur in the future.

3.2.1. In-group/outgroup bias

The primary theoretical foundation for in-group/out-group bias is the minimal group paradigm, which holds that the only requirement for biases like favoritism toward one's own group and prejudice against other groups is membership in a group (Everett et al., 2015; Hewstone et al., 2002; Wilder & Allen, 1978). The in-group/out-group bias is a natural part of both domestic and foreign politics, and it can encourage or even sustain inter-group conflicts. Most sustainability-related concerns, if not all of them, revolve around the needs and desires of various groups. Therefore, we consider acknowledging the in-group/out-group bias to be essential for sustainability. Because actions aimed at stopping or adjusting to the environmental disasters that are likely in the future rely on the collective decision-making, collaboration, and coordination of various groups, the in-group/out-group bias can be particularly relevant when dealing with worldwide environmental shifts (Pearson & Schuldt, 2018). Such biases are more likely to manifest when there are large group differences, real or perceived intergroup dangers, and little information exchange between groups. This way of thinking, according to Bazerman (2006), results in a counterproductive situation where developed nations accuse developing nations of burning too many fossil fuels while developing nations accuse developed nations of attempting to deny them the legal right to use their natural resources. The problematic message is that even when a nation is genuinely interested in finding a just solution to a worldwide environmental or sustainability problem, in-group/outgroup bias will result in a self-serving interpretation of the facts and a feeling of being in some way threatened by others, leading to a less-than-ideal outcome overall (Fielding & Hornsey, 2016). However, a few approaches might be used to cope with it. Essentially, the bias favors a novel, more comprehensive strategy for Earth system governance, especially a global democratic institution that emphasizes environmental sustainability by stressing that all humanity is on the same boat (Biermann et al., 2012). Promoting the idea that mankind as a whole, rather than certain countries or groups, should be concerned would have to be one of this institution's main objectives. This issue may appear unimportant, but institutional change would take time and a lot of political, social, and financial resources.

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3.2.2. Group polarization

Group polarization poses a serious threat to the public realm both inside and outside of liberal democracies (Sunstein, 2009). Group polarization frequently happens during debate within like-minded groups, which has the effect of pushing decisions "to extremes" rather than the center (ibid). Keep in mind that ‘more extreme' may not imply that collective decisions are, for example, always risky. In fact, depending on initial individual viewpoints, group polarization in terms of risk taking can be toward more risky or more prudent decisions (Aronson et al., 2010; Isenberg, 1986). Even organizations that are concerned with making balanced, significant decisions in their day-to-day professional activities, such as legislators and judges have been observed to exhibit group polarization (Iyengar & Westwood, 2015; Main & Walker, 1973). This problem has been addressed by using techniques like "discursive representation" or random intentional selection to avoid consistency in formal deliberative contexts (Baber & Bartlett, 2015; Dryzek, 2012). However, a key issue arises regarding who is in charge of the process. In the larger public eye, group polarization offers a more serious problem. In fact, increasing evidence indicates that changes in media and communication habits are enabling people to organically form like-minded groups, which may polarize public discourse (Sunstein, 2018). Although there is conflicting evidence about party sorting, at least in the United States, this phenomena could be made worse by physical separation along ideologies (Mummolo & Nall, 2017). Changes in social conditions may affect the efficacy of deliberative processes to foster a revitalization of the public sphere that will lead to a sustainability transition.

4. General discussion and recommendations

4.1. Biases in group settings play a key role for sustainability

Without a doubt, biases at the individual and group levels affect sustainability. Group processes typically affect political and societal decisions, whereas market outcomes that reflect consumer preferences are largely the consequence of individual actions (navigating...). However, only few articles on sustainability shed light on group settings, specifically, there is a lack of discussion on how conflict and collaboration interact (Celino & Concilio, 2011; Díaz et al., 2011; Von Korff et al., 2012), and the vast majority portray conflict as a disruptive force for collaboration. In the context of stakeholder diversity, Curșeu & Schruijer (2017) contend that stakeholder diversity affects sustainability decision comprehensiveness through two mechanisms: a cognitive synergy approach and a relational dissolution approach. Through

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deliberative processes in which different interests are investigated, fresh insights are formed, and a collaborative framework results in a shared knowledge of duty, the cognitive synergy approach explains the beneficial influence of stakeholder diversity on decision comprehensiveness. Deliberative democracy's fundamental guidlines have been acknowledged as useful for directing initiatives regarding sustainable decision making (Huitema et al., 2010; Salter et al., 2010). These principles stress the extensive knowledge improvement, and the inclusion of all parties a remedy for group favoritism. The relational dissolution path describes the detrimental consequence linked with the suppression of heterogeneity via illusory homogeneity. Many scholars (such as Curșeu & Schruijer, 2017) suggest the following three principles that can improve the quality overall of group decision-making.

First and foremost, it is crucial that all pertinent parties are invited to take part in the selecting process. Adequate participation and a reduction in the power gap will eventually result from the inclusive selection criteria in a system with several parties (Datta et al., 2012). For instance, the problems associated with the unbalanced appointment of important stakeholders by (powerful) politicians may be resolved through stakeholder self-nomination (Pieraccini & Cardwell, 2016). However, representation alone will not eliminate power disparity; in order for more distant stakeholders to be able to express their concerns, they must be given support. Modern tools, such as geographic information systems, may give auxiliary stakeholders (such as non-scientists involved in environmental management) reliable information and enable their informed involvement in sustainability decisions (Wright et al., 2009). Additionally, citizens' juries can be a useful tool for empowering and involving citizens in sustainability decision-making (Huitema et al., 2010). Furthermore, cooperation does not happen by accident. normative rules on how to collaborate with others, how to spark productive task conflict, and how to avoid false acceptance are extremely beneficial for in-group settings. Prior studies (Curseu et al., 2013; 2016) demonstrated that simple normative rules for valid acceptance, such as viewing initial agreement as suspect, viewing heterogeneity of opinion as organic and helpful, avoiding arguments about initial opinions, avoiding "win-lose" claims, and avoiding adhering to the majority only to avoid conflict, have a positive impact on the rationality of group decision making (Hall & Watson, 1970). Active discussions will eventually aid group systems in producing a thorough problem formulation, which is necessary for the caliber for decisions regarding environmental sustainability (Cuppen, 2012). Additionally, expressing the various points of view will promote understanding among people and prevent biased acceptance (Huber

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& Lewis, 2010; McGreavy et al., 2015; Wolfe, 2009). Lastly, relational breakdown of group systems can be avoided or dealt with by using process consultation. The fact that the structure concepts for cooperative systems with multiple parties overlook the socio-affective elements that are often present when collaborating across organizational borders (such as mistrust, or a culture of psychological safeguarding,) is a major criticism of them (Pomeroy et al., 2007; S. G. Schruijer, 2008). Groups may profit from process consultation in order to promote the development of trust and social security and prevent collusive dynamics (Schruijer & Vansina, 2008). Process consultation may also aid multiparty collaborative systems in concentrating on constructive task conflict and preventing it from developing into destructive relationship conflict.

4.2. Negative visualization: A Lesson from philosophy

Visioning and scenario generation are promising approaches for reducing roadblocks to a more sustainable future. This is accomplished through developing plausible depictions of anticipated upcoming changes (Wiek & Iwaniec, 2014). This practice dates back much further than psychology to the greatest Stoic philosophers such as Seneca, Marcus Aurelius and Epictetus. They even had a more fitting name for it: Premeditatio malo rum (forethought of evils). The thing many people miss whilst observing Stoicism is that it doesn't follow the typical standards of positive thinking that are pushed in today's philosophy. The philosophy of today would have you think that you should remain positive at all times with no exception. That differs greatly from how Stoicism works. For instance, Marcus Aurelius (2002) would spend a brief period of time each morning practicing a technique called negative visualization. He would think of all that could go wrong during the day, what he would do to remedy each problem, and after this allotted time, he would move on from it and go about his day not thinking about it unless something actually went wrong . If something did go wrong, he was already prepared for it and could better remedy the situation. This is not to say he was a negative person. Simply put, he was better equipped to deal with any negative events that might arise (ibid). This is where the problem of positive thinking at all times is lies. If people are not well prepared beforehand, they are more susceptible to a greater weight of a negative situation even greater than if they have already been prepared for it. The same thing goes for policymakers, researchers stressed out the importance of such risk anticipation in relation with climate change (Kunreuther et al., 2013). In the context of engineering more research is necessary to understand how designers evaluate climate change threats. For instance, how does (or should) a structural engineer evaluate the

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risks of bridge collapse with the potential dangers of materials employed in its design that lead to climate change? This kind of study would contribute to a better understanding of the linkages between human and environmental hazards and problems, which is a critical requirement for sustainability (Klotz et al., 2018).

4.3. Benchmarks and feedback loops that expand bounded rationality

The decision-maker is assisted in making judgments when he lacks sufficient time and knowledge to make the utility-maximizing choice thanks to feedback loops and benchmarks. A military facility in San Diego lowered its energy use employing an energy feedback system that focused on capturing and transmitting energy data on a monthly basis. The current month's energy costs and usage at the time were compared to the same month the previous year and displayed in relation to year-to-date data. The reports were sent to more than forty vessels and agencies via email (Delgado & Shealy, 2018). The feedback method established a reference for assessing energy savings. This feedback mechanism is comparable to how households participating in Opower's program compare their energy consumption to their peers (Kempton & Montgomery, 1982). Even though the gap lies in who has been addressed by the program. While Opower focuses on consumers the benchmark proposed here is for facility managers. Switching the emphasis from "downstream" customers to "upstream" facility managers could have a greater effect on energy savings (ibid).

4.4. Identifying root causes of heuristics.

Future studies should investigate how decisions are altered when decision makers rely on heuristics to cut down on time and thought (Payne et al., 1993). Although the use of heuristics is adaptive, it can also be deceptive when it is based on incorrect data. One instance is when we base our ideas about climate change on less important but readily available local weather reports rather than more useful but harder-to-get information, like Global Climate Change Patterns (Zaval et al., 2014). Studies that identify the root causes of heuristics (such as Daly et al., 2012) offer the first step in figuring out the reasons why and strategies needed for harnessing heuristics with immediate consequences for sustainability.

4.5. Emotional associations and spillover effects.

Learning how self-help behaviors contribute to positive spillover—when one action results in a string of similar decisions—would be very useful when planning for sustainability. For

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example, people who are persuaded to recycle are more inclined to carpool (Evans et al., 2013). Finding a single design innovation that generates beneficial spillovers and consequently inspires a succession of pro-sustainability decisions could have a significant impact. Research is also required to comprehend how emotional interactions, such as our perception of substantial effects and the craving for a lasting legacy, affect the behaviors of designers. For instance, the ability to metaphorically live on through their design decisions may encourage designers to consider more sustainable decisions when their goals and objectives are explicitly communicated (Wade-Benzoni et al., 2012). Such research is important since emotional associations with one environmental issue may impede action on another (Truelove et al., 2014). For instance, designers who support communities with sidewalks after watching a video about their advantages could be less likely to take into account alternative design solutions since they will rationalize that they have already done their part for sustainability (Klotz et al., 2018). Engineering is just one example among many that could promote sustainability if negative spillovers are correctly addressed.

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5. Conclusion

Cognitive biases are important to consider when discussing sustainability since they have a detrimental effect on the fairness of decisions made for both present and future generations. Cognitive biases do not always explain instances of unsustainable conduct, but we argue that they should be more extensively considered when making decisions and policies connected to sustainable development. Cognitive biases, in particular, may pose an obstacle to sustainable conduct that has gone unnoticed by scientists, policymakers, and common people. The complexity of individual and group contexts in particular, as well as biases in general, may be made more conscious through education towards sustainability. If human cognition biases are taken into consideration, sustainable behavior is more probable. Accordingly, our society has a greater need than ever for knowledge and a verified vision of the essential values that reflect us as humans and our world, about who we are, the way we want to live, and where we want to go. This is not just an ideal with long-term goals for the well-being of humanity, but it also builds on our natural wants and takes into consideration the contemporary world's hidden and inherent systemic hazards. This is critical in setting the route and agenda for humanity's destiny.

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