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Public Communication as a Tool to Implement Environmental Policies

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Climate change is one of the greatest challenges of our times. We humans must change our behavior in the short run to mitigate the effects of climate change in the long run. Policymakers develop environmental policies to motivate this behavioral change. However, people may nonetheless fail to change to more sustainable practices, defeating the effectiveness of environmental policies. Public communications, such as mass media campaigns, can enhance compliance with environmental policies, but they have not yet lived up to their potential. In this contribution, I propose that environmental communication would be more effective if public communicators took account of the (often counterintuitive) social and psychological processes that influence sustainable behaviors. I present research evidence of the impact of cognitive biases (discounting, control perceptions, optimism bias, denial, defensive avoidance, and reactance), emotions (fear and hope), and expectations (about the intentions of the communication source and other people's environmental behaviors) on the power of environmental public communication as a tool to promote sustainable behaviors. If social and psychological processes are neglected in the design of environmental public communications, messages can backfire and achieve the opposite of what was intended. To improve environmental communications, I propose three communication design suggestions: keep it simple, balance the message, and provide an action perspective.

Climate change is one of the greatest challenges of our times. Its potential consequences include extreme weather, rising sea levels, and diminishing Arctic Ocean ice (Intergovernmental Panel on Climate Change [IPCC], 2018). A foremost driver of climate change is growing atmospheric concentrations of greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), water vapor (H_2O), and nitrous oxide (N_2O). In essence, greenhouse gases are useful. They

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provide for a liveable climate by trapping the solar heat radiated back from the earth's surface. Without greenhouse gases, the earth would be too cold for plants and animals to survive. However, when the amount of greenhouse gases increases, more heat is trapped than necessary. This causes the globe to warm up.

Scientists regard anthropogenic greenhouse gases—those resulting from human-induced sources—as the main contributor to climate change. These are more important than greenhouse gases produced by naturally occurring processes, such as the carbon dioxide that humans and animals breathe out and the methane released by wetlands and oceans (IPCC, 2014, 2018). The best known anthropogenic activity is the combustion of fossil fuels, such as coal, oil, and natural gas, to produce energy and electricity. However, agriculture and the industrial production of iron, steel, and cement also release greenhouse gases.

Many industrialized countries have formulated environmental policies to limit the impact of anthropogenic greenhouse gases. Because climate change is a global challenge, countries have coordinated these policies internationally in agreements such as the Kyoto Protocol (United Nations, 1998, 2012) and the Paris Agreement (United Nations, 2015). The overarching goal of these intergovernmental accords is to keep the increase in global average temperatures to well below 2°C above preindustrial levels, and preferably to limit the temperature increase to 1.5°C.

At the national level, governments formulate more specific policies covering different societal levels. At the microlevel, such policies aim to reduce individuals' energy consumption, for example, by encouraging investments in solar panels and home insulation. At the mesolevel, policymakers might stimulate manufacturers to develop energy-efficient appliances and incentivize industries to use fossil fuels more efficiently. At the macrolevel, countries might pursue a more balanced energy mix emphasizing renewable (nonfossil) sources such as water, biomass, wind, and sun.

Yet, it is not always easy for governments to bridge the gap between policy development and changes in behavior. To achieve environmental policy goals and sustainable behavior, policymakers need tools to encourage policy compliance among citizens and organizations. Examples of such tools are the traditional regulatory "command-and-control" instruments, such as emissions standards, toxic substance bans, and land use restrictions (European Environment Agency, 2016a). There are also market-based tools, such as taxes, fees, greenhouse gas emissions trading, and subsidies (OECD, 2017). Monetary incentives can be an effective tool to motivate organizations to act sustainably, but they have been less effective for citizens. Research has found that homeowners often postpone applying for subsidies and loans because they do not know where to apply, how to apply, and under what conditions they can get the incentives (e.g., Allcott & Greenstone, 2012; Allcott & Mullainathan, 2010; Department of Energy and Climate Change, 2011, 2013). This points to policymakers' need for more effective tools to implement environmental policies aimed at sustainable behavioral change. This need is urgent,

too, because according to international studies, global warming is accelerating, countries are not achieving key targets in global climate agreements, and humans must act rapidly to prevent a climate catastrophe (e.g., European Environment Agency, 2016b; European Commission, 2017; IPCC, 2014, 2018).

In addition to regulation and market-based incentives, policymakers often use public communication to encourage compliance with environmental policies (European Environment Agency, 2016b). Via public communication channels, such as media campaigns, leaflets, websites, and news items, governments send factual information to a broad audience (i.e., one-way mass communication) with the goal of raising awareness about climate change and educating people about environmental policies and how to act upon them (e.g., Cox & Pezzullo, 2016; Jacobson et al., 2019; Maibach, Roser-Renouf, & Leiserowitz, 2008). Indeed, evaluations show that public communication can be a successful educational tool. After visiting a website on energy efficiency, citizens were found to understand how they could save energy and had a more positive attitude towards taking sustainability measures (e.g., Brulle, 2010; Cox, 2007; European Commission, 2015; Lakoff, 2010).

However, the effectiveness of public communication as a behavior-change tool across a broad audience is contested. Recent research on sustainable behavior among homeowners suggests that even when people are environmentally educated and willing to act sustainably, they may still fail to adapt their behavior because they anticipate inconveniences and experience other psychological barriers to changing their behavior (De Vries, Rietkerk, & Kooger, 2019). Investigating these barriers—and exploring ways to reduce them—may help policymakers achieve the behavioral goals set in climate agreements.

Some scholars have suggested that environmental public communications underperform because they are based on so-called "linear" or rational choice models (e.g., Chandler, 2012; Hornsey & Fielding, 2020). These models assume a direct relation between information provided and behavioral change, without accounting for the (often counterintuitive) social and psychological processes that influence actual displays of environmental behavior. It is probably fair to say that public communicators neglect social and psychological processes when designing public communications because they are complex and less well understood. Public communicators are typically trained in the use of two linear models in particular: the knowledge-attitude-behavior model (see Chaffee & Roser, 1986) and the Shannon–Weaver model of communication (Shannon & Weaver, 1949).

The knowledge–attitude-behavior model draws a direct relation between knowledge, attitude, and behavior. According to this model, informational campaigns elicit behavioral change because they increase knowledge about the desired behavior (i.e., why and how), leading to improved attitudes towards that desired behavior. For example, educating citizens about the health risks of smoking causes them to develop a negative attitude towards smoking, in turn dissuading them

from starting smoking or stimulating them to stop. Some argue, however, that this chain of effects rarely unfolds this way, because it fails to take account of the social and psychological mechanisms that disrupt either the information–attitude or the attitude–behavior link (see, e.g., Bettinghaus, 1986). In fact, behavior might change regardless of knowledge levels or (changes in) attitudes, for example, because people copy the behavior of others (see, e.g., Aarts & Dijksterhuis, 2003) or because their physical environment "nudges" them to engage in a specific behavior (Thaler & Sunstein, 2008).

The Shannon–Weaver model, known as the "model-of-all-models" (Hollnagel & Woods, 2005), approaches communication as a technical matter in which a communication source sends a message through a channel to a communication receiver (Shannon & Weaver, 1949). Some scholars have elaborated on the Shannon–Weaver model, for example, Berlo (1960) proposed the sender–message–channel–receiver model of communication. But these revised versions remain linear (e.g., Al-Fedaghi, 2012; Cole, 1993). That is, they do not account for the social and psychological processes that are triggered when recipients are presented with communication aimed at changing their behavior.

The current review explores social and psychological processes that may impact the effectiveness of one-way public mass communication on environmental behavior. These processes are cognitive biases (discounting, control perceptions, optimism bias, denial, defensive avoidance, and reactance), emotions (fear and hope), and expectations (about the intentions of the communication source and other people's environmental behaviors). Only recently have researchers begun to empirically investigate how these processes impact the effectiveness of public communications in the environmental policy domain (e.g., De Vries, 2017). In other policy domains, such as promoting healthy lifestyles, fostering compliance with laws, and enhancing take up of new technologies, a growing body of empirical evidence demonstrates that taking these processes into account can enable communicators to improve the impact of their public communications. Successful examples relate to the improvement of tax discipline (Martin, 2012), countering the overprescribing of antibiotics (Hallsworth et al., 2016), attracting more diverse job applicants (Linos, 2017), and promoting the use of e-government services (Faulkner, Jorgensen, & Koufariotis, 2019).

This review builds on evidence from these other policy domains. It advances public policy research by introducing knowledge about human behavior derived from the fields of (social) psychology and the emerging domain of "behavioral public administration." Application of these findings may allow public communication departments and "behavioral insight teams," which blend lessons from psychology and public administration, to improve the effectiveness of public communication in the environmental domain (see, e.g., Grimmelikhuijsen, Jilke, Olsen, & Tummers, 2017; Schillemans & De Vries, 2016).

Indeed, reduction of and adaptation to global warming is one of the foremost issues of our times. I provide a structured overview of when, why, and how behavioral insights can improve public environmental communication to stimulate environmentally sustainable practices. I then suggest concrete design recommendations to enable communicators to tap into social and psychological processes to enhance the effectiveness of their public communications. Although this contribution specifically targets public communicators, these suggestions are also relevant to others who design communications for a broad audience, such as marketeers.[1]

Psychological and Social Processes That Impact on Public Communication

If we want to understand how public communication can be an effective tool for environmental policy achievement, we need insight into the social and psychological processes that influence people's decision-making and behavior regarding environmental sustainability. For example, it is hard to understand—from a rational viewpoint—why even when people know that the climate is changing and acknowledge that they should adapt their behavior, minimal appropriate action is taken. For instance, people might endorse the construction of large wind farms as a general principle but resist when a wind farm is planned close to their home (Wolsink, 2000). Likewise, experimental research shows that when people are presented with fear-evoking messages in environmental public communications, they may feel bad about their behavior but remain inactive and unengaged (O'Neill & Nicholson-Cole, 2009). Expectations can overcome barriers to acting green. For example, people are more likely to reduce their energy use when they become aware that their neighbors are saving more energy than they are because they then expect "energy saving" to be the desired behavior in their community (Allcott, 2011).

Though display of such behavior may seem irrational (if one were to assume that humans are rational actors), it actually is adaptive from a psychological point of view. We humans live in webs of social relationships, dependencies, and sensory information. These all impact the choices we make, often without careful deliberation on our part. Stated differently, human behaviors are driven not only by slow and deliberate decision-making, but also by cognitive shortcuts that help us function under time pressure, information overload, and fatigue (e.g., Gifford, 2011; Kahneman, 2011; Simon, 1955).

Scholars have suggested that attempts to motivate people to act more sustainably through public communication are more effective when the targets of these

[1] A difference between marketeers and public communicators is the scope of the change their campaigns typically pursue. While marketeers often aim to seduce people to make a one-time decision to do something, public communicators typically seek to convince the public to make a long-term, more effortful behavioural change, in the hope of avoiding future problems.

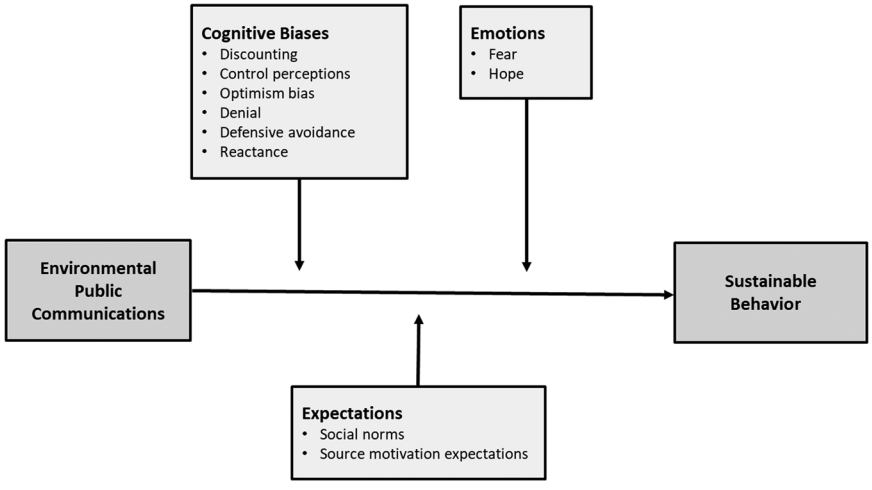

Fig. 1. Cognitive biases, emotions, and expectations that impact the transmission of environmental public communications to receivers, thereby influencing the communications' effects in terms of behavioral change.

communications are recognized as social beings with cognitive biases, emotions, and expectations (e.g., De Vries, Terwel, & Ellemers, 2016; Gifford, 2011; Mols, Haslam, Jetten, & Steffens, 2015; O'Neill & Nicholson-Cole, 2009). To do this, however, requires insight into how and why cognitive biases, emotions, and expectations impact the transmission of a message from a communication source to the receiver and how they may affect a receiver's behavior. Figure 1 provides an overview of this process.

Cognitive Biases

When people read a communication on environmental policy, they decide (consciously or not) whether they will comply with it. This is not a straightforward process, because sustainability messages are steeped in uncertainty. The Dutch campaign "Energy Savings, Do It Now" provides an illustration. The goal of this multimedia campaign was to increase the number of houses insulated for energy efficiency. The campaign sought to lower the barriers to energy savings and increase the urgency felt by homeowners to make their houses more sustainable (Energy Savings, Do It Now, 2019). Unfortunately, but in line with the failure of past public communications on environmental issues (Gardner & Stern, 2008; Ölander & Thøgersen, 2014), the campaign was not very successful. Evaluations revealed relatively low communication value in its first year; in other words, the

campaign did not reach many citizens (Schalkwijk, 2017). Furthermore, messages about the urgency of energy savings and the ease of taking measures did not take hold among the general public. Evaluations further found that relatively few homeowners were aware of the funding available to offset costs. One reason for the campaign's failure was recipients' confusion about how and when to act green, as several parties were issuing communications about energy savings, emphasizing different aspects and values (Schalkwijk, 2017). Another reason, which was not mentioned in evaluations but proposed by research as contributing to uncertainty, was disbelief in whether climate change exists at all (Gifford, 2011).

People facing decisions under uncertainty are particularly susceptible to cognitive biases. Cognitive biases are systematic patterns of deviation from rationality in judgment. On the one hand, it is adaptive to fall back on biases in times of uncertainty, because human attention is limited and biases provide shortcuts that help us make decisions. On the other hand, biases can produce systematic errors that might be harmful (Tversky & Kahneman, 1974). For example, when people are (too) optimistic about our future climate (i.e., optimism bias) they are less likely to change their environmental behavior after reading a motivating environmental message, as they perceive no urgency to act now (e.g., Gifford, 2011; Pahl, Sheppard, Boomsma, & Groves, 2014). Therefore, it is important for public communicators in the environmental domain to take account of biases when they develop communications.

Researchers have already identified a large set of biases and continue to identify new ones (e.g., Bazerman, 2006; Gifford, 2011; Pahl et al., 2014; Van den Broek & Walker, 2019). However, this large set of biases may be overwhelming for public communicators aiming to promote sustainable behavior. Here I focus on six biases that are arguably most important in the context of environmental behavioral change: discounting, control perceptions, the optimism bias, denial, defensive avoidance, and reactance.

Discounting. There are two types of discounting: spatial and temporal (Gifford, 2011; Gifford et al., 2009). Spatial discounting occurs when people presume that the consequences of climate change are worse elsewhere. For example, people in Western Europe might be wrongly under the impression that global warming is detrimental mainly in the polar regions, where the ice is melting, or in South-East Asia, where tsunamis occur. A comparative survey of 18 globally dispersed countries found that most respondents thought "things are better here than there" (Gifford et al., 2009). Spatial discounting might be explained by people's failure to perceive how the risk of global warming affects them personally. Or, a motivational factor could be at work: People may know that global warming affects them, but may not be concerned as long as it is not causing them personal suffering (warmer summers may be a welcome effect of climate change, e.g., Ridley, 2013). When people do start to suffer, they might respond with denial of

the danger, defensiveness, or message avoidance, in addition to discounting (e.g., Gifford, 2011).

Temporal discounting occurs when people assume that environmental consequences will manifest in the far future, long after their own death. Indeed, it is difficult for people to consider what life will be like many decades ahead. The effects of global warming are emerging only gradually, and acute risks are seldom plain to see. In this case, the temporal discounting effect is strengthened by uncertainty about the exact impact of global warming and how nature will adapt to it.

Spatial and temporal discounting has similar consequences: People feel little urge to take personal responsibility for solving environmental issues (Gifford, 2011; Pahl et al., 2014; Weber, 2017). To make people aware of the importance of acting now, public communicators might design messages that not only provide factual information about environmental issues relevant to their audience but also provide them with an action perspective (e.g., Stajkovic & Luthans, 1998). For example, an effective message to counter spatial discounting could emphasize that warmer summers often bring torrential rainfalls and flooding and point out that saving energy (e.g., taking the bus instead of the car) could help to mitigate this effect.

Control Perceptions. Control perceptions are considered a cognitive bias when people wrongly infer that they have low (or high) control. In this bias, two elements are key: perceptions of self-efficacy and perceptions of effectiveness.

Perceptions of self-efficacy concern confidence in one's own ability to achieve a behavioral outcome, and these perceptions are a good predictor of behavior (Manstead & Van Eekelen, 1998). People who perceive low self-efficacy believe they can do little to counter climate change threats. They might therefore be disinclined to take personal responsibility for solving environmental issues, instead assigning responsibility to others, such as the national government or other countries (e.g., Gifford, 2011).

Effectiveness perceptions relate to appraisals of the usefulness of actions. As such, people might view their own sustainable actions as only "a drop in the bucket" with minimal effect in solving global environmental issues. For example, people might refrain from acting sustainably until others do (e.g., Gifford, 2011; Weber, 2017). This is in fact a social dilemma. If everyone defects, the whole group suffers from inaction. However, it is tempting to defect if there are no sanctions for defecting and people are unsure of what others will do.

Inaction resulting from low perceptions of self-efficacy and effectiveness can occur when public communications only raise awareness about environmental issues, without informing people of what action they can take to address the issues. A recent example of communication that raised awareness without providing an action perspective is the British nature documentary *Our Planet*, created for

the streaming service Netflix. The end goal of this documentary was to make people aware of climate change and persuade them to adopt a more sustainable lifestyle (e.g., Jones, 2019). The documentary succeeds in showing viewers climate change's negative impacts on nature—it does this vividly, often frighteningly. Yet, it gives no clear action perspective. At the end of the documentary viewers are referred to a website that provides the opportunity to donate money to the World Wide Fund for Nature (WWF, the initiator of the documentary). But getting to the right webpage is not so easy, preventing viewers from taking action (e.g., De Vries et al., 2019). Moreover, it may be unclear to viewers how donating money to WWF will contribute to resolving climate change.

What is more, raising awareness about climate change issues without providing an action perspective can trigger a backlash. If viewers receive information warning them about a risk without specific information on how to counter that risk, a conflict could arise between attitude ("I should act sustainably") and behavior ("I don't know what to do"). This can produce cognitive dissonance; that is, psychological stress arising from contradicting beliefs, ideas, or values. People may try to reduce this dissonance, using various strategies to do so (Festinger, 1957). Possible strategies are denial of the problem, apathy, and downplaying the issue ("nature is good at restoring itself, so humans probably do not need to interfere anyway"; e.g., O'Neill & Nicholson-Cole, 2009; Thompson, Barnett, & Pearce, 2009; Witte & Allen, 2000). As a result, public communication—such as the documentary *Our Planet*—may paradoxically have the opposite effect to that intended.

So again, the best strategy for policymakers is to raise awareness about environmental issues with a clearly defined call for action describing how the issues can be addressed. A meta-analysis of research on self-efficacy and work-related performance found that calls for action work best when accompanied by accurate information and clear, concise instructions (Stajkovic & Luthans, 1998). Translated to environmental public communications, that means it is better to urge people to "reduce their car use" than to "reduce their carbon footprint." The odds of achieving action and compliance with environmental policies are further increased when recipients understand the message and feel the topic is relevant to them. In practice, meeting these two requirements can be quite challenging, as outlined below.

Complexity. The extent to which a communication is understood hinges on both the cognitive ability of the receiver and the complexity of the message. Because climate change is an extremely complex issue, it is difficult for public communicators to express environmental risks and mitigation policies clearly and simply for a broad audience (e.g., Faulkner, Jorgensen, Sampson, & Ghafoori, 2018; Nerlich & Koteyko, 2009). This was in fact one of the conclusions of the earlier mentioned evaluation of the "Energy Savings, Do It Now" campaign;

complexity was identified as a key reason for the disappointing results (Schalkwijk, 2017).

A recent literature review on the impact of the perceived inconvenience of sustainable choices among homeowners suggests that informational complexity leads to inaction because of stress (De Vries et al., 2019). "Hassle"—as the authors called the perceived inconvenience—is a microstressor related to "effort" (e.g., Gatersleben, Steg, & Vlek, 2002). It stems from communications that are difficult to read, understand, and remember. The more hassle people perceive, the more they suffer from it, leading to stress and ultimately to inaction (De Vries et al., 2019).

Complexity is partly created by the heaping of information: conveying lots of facts and details at once in the hope that these will cumulatively persuade individuals to support implementation of an environmental policy. The reason for heaping is the assumption that lengthy communications are perceived as more truthful and convincing (i.e., the length-implies-strength heuristic; Stec & Bernstein, 1999). Certainly, an advertisement displaying many positive statements about a product can convince consumers that the product is "good" (Petty & Cacioppo, 1984). However, the pitfall of heaping information is that the main message gets lost, as it is buried in trivia. Although, in principle, only the most important message should dictate judgments and beliefs about an environmental policy, nondiagnostic (i.e., irrelevant) details can dilute judgments and weaken beliefs rather than strengthening them (De Vries et al., 2014).

Stated differently, informational complexity—caused by the heaping of irrelevant details—can trigger a backlash, undermining the effectiveness of environmental public communications. Thus, the most effective environmental public communications are those that present one simple message.

Relevance. The research of De Vries et al. (2014)) confirms the power of simplicity, while also demonstrating that environmental communications need to be relevant to the recipient in order to be successful in calling them to action. This raises a difficulty facing public communicators using mass communication as an instrument to stimulate behavioral change: the relevance of a topic differs for different groups. For example, information about the construction of a large wind farm is more relevant to people who live near that farm than to those living farther away. People near the planned farm will be more inclined to read and understand information about the project—predominantly because they want to know how the farm might affect them.

However, policymakers should be aware that due to the so-called NIMBY effect (Not In My Backyard), residents living close to the planned development may focus more on negative than on positive information. This is because locals are more likely to oppose these projects than to support them, due to concerns that property values will fall and accidents might occur (Terwel, Ter Mors, & Daamen,

2012). Furthermore, they might feel unfairly treated, perceiving the local price paid to obtain global environmental benefits disproportionately high, leading to their resistance (distributive injustice; e.g., Sovacool & Dworkin, 2015). Furthermore, selective exposure (or the "echo-chamber phenomenon"; see Hornsey & Fielding, 2020) leads people to pay greater attention to arguments that support their existing views than information that counters their views (Brewer, 2001; Frey, 1986; Hart et al., 2009; Joslyn & Haider-Markel, 2002; Smith, Fabrigar, & Norris, 2008).

On the bright side, empirical research has revealed that locally focused environmental communications can induce people with a local attachment to take action—if the message contains a clear call for action (e.g., Brügger, & Pidgeon, 2018; Scannell & Gifford, 2013). Even after negative information has captured attention, public communications with a local focus and action perspective can still positively influence residents. Experimental research shows this to be especially true if communications refrain from calling for sacrifice-oriented actions, such as "I am going to have to get used to driving less, turning off the lights, and turning down the heater." More effective are motivationally oriented calls to action that emphasize the achievement of a valued idea. An example would be, "We help solve climate change when we take public transport, engage in composting, and buy green energy" (Gifford & Comeau, 2011).

Tailoring messages even more—to personally relevant values—may further increase the effectiveness of environmental communications. The literature suggests that emphasizing, for example, saving money, promoting health, and avoiding waste, can motivate people to act sustainably, since such values are typically more personally relevant than more abstract benefits for the environment (Ecologic Institute, 2014). A nationally representative online experimental survey of U.S. residents found that news articles about climate change that emphasized public health (rather than risks to the environment or national security) were more likely to elicit emotional reactions consistent with support for climate change mitigation and adaptation. In fact, the national security frame was found to actually boomerang among citizens already doubtful or dismissive of the issue, eliciting feelings of anger rather than support (Myers, Nisbet, Maibach, & Leiserowitz, 2012).

The policy implication of the literature on relevance is that public communicators should consider targeting their campaigns to specific regions or groups. That means they might have to produce various types of communications, emphasizing different aspects, for specific target audiences (see also Hornsey & Fielding, 2020, on how to tailor messages to climate-sceptic audiences). Social media demonstrate that it is technically possible to microtarget messages, using information such as individuals' preferences, group characteristics, prior

knowledge, and involvement with an environmental issue. However, customized communications can be a challenge because they require more preparation time (e.g., to investigate the preferences and interests of the different groups), larger budgets, and greater effort to deliver the appropriate message to each target group. Time, money, and effort are—unfortunately—resources that public organizations usually lack. Therefore, one-message-fits-all mass campaigns remain the norm. Furthermore, use of such personalized messages may present ethical dilemmas for public organizations. Nonetheless, microtargeting may be well worth trying, as it could improve the effectiveness of communications (Hornsey & Fielding, 2020).

Level of Information Processing. Information processing theories help explain the importance of offering a relevant, motivating, simple message with a clear action perspective. Dual process theories, such as the elaboration likelihood model (Petty & Cacioppo, 1986; Petty, Cacioppo, Strathman, & Priester, 2005), the heuristic-systematic model (Chaiken, 1980), and similar approaches suggest that people process information via a "fast" and a "slow" route (Kahneman, 2011). The "slow" (system 2) route is more elaborate and systematic, while the "fast" (system 1) route is more peripheral and heuristic—though a combination of both is also possible. System 2 processing of an environmental communication means that a person gives focused attention to the message, deliberates on it, and comes to an informed attitude or decision. Systematically formed opinions are more persistent, resistant, and predictive of future behavior than more immediate, heuristic (system 1) responses to information (Petty, Haugtvedt, & Smith, 1995). Therefore, policymakers looking for long-term sustainable behavior change should aim for "slow" processing of communications.

However, recipients who are not highly motivated, involved, or able to process a message, for instance, because they do not understand it or perceive it as less relevant to them, have a greater tendency to process environmental public communications in a more superficial and heuristic manner. That is, they act upon coincidental—not necessarily relevant—cues unrelated to the content of the message, such as the amount of information in the message (i.e., the length-implies-strength heuristic; Stec & Bernstein, 1999) or stereotypical "expert" cues, such as a spokesperson wearing a white coat (Chaiken, 1980; Petty & Cacioppo, 1986). Furthermore, people fall prey to cognitive biases when they process information in a fast and instinctive (system 1) way. This can be prompted by information overload (Kahneman, 2011). Empirical research shows that heuristic information processing may lead people to voice uninformed (negative) opinions about environmental policies (de Best-Waldhober, Daamen, & Faaij, 2009). This is another reason why environmental public communications need to be simple, relevant, and include clear action implications.

Emotions

People who process information in a fast and intuitive way may also fall prey to emotional responses that overshadow or prevent rational and deliberate thinking about the content of a message.

Negative Emotions. Fear-inducing imagery and language are often used to emphasize the urgency of a message and communicate the serious consequences of inaction. However, this easily evokes negative emotions (e.g., Kahneman, 2011; O'Neill & Nicholson-Cole, 2009). In a qualitative study of beliefs about the impact of such fear appeals, participating intervention developers, policymakers, politicians, scientists, and advertising professionals revealed that they thought threatening information would attract more attention to a message or that confrontation would prompt self-reflection. The findings further showed that communicators too easily assumed that members of the target population would change their behavior in a rational response to a perception of elevated risk, disregarding other (more irrational) effects of communicating such risks (Peters, Ruiter, & Kok, 2014).

However, negative emotions evoked by a message can actually prevent effective decision-making and positive behavioral change. Reactance relates to the extent that people show the opposite behavior to that advocated in a communication (Brehm & Brehm, 1981; De Vries, 2017). This is explained as follows: Autonomy is a basic need that feeds intrinsic motivation (self-determination theory; Ryan & Deci, 2000). According to psychological reactance theory, people do not like to be manipulated; they want to make up their mind independently from others. Biased communications that nudge people towards "correct" behavior can give people the impression that their freedom to make up their own mind is under threat. In response, they seek to regain control. One way to regain control is by displaying the opposite behavior (Brehm & Brehm, 1981).

Maladaptive fear control actions—including denial, defensive avoidance (e.g., of information), and reactance—may manifest as a strategy to reduce cognitive dissonance, for example, when a strong appeal to fear is made (Kessels, Ruiter, Wouters, & Jansma, 2014; Thompson et al., 2009; Witte & Allen, 2000). An example of a strong appeal to fear is the visual depictions of the health consequences of smoking on cigarette packages (e.g., a photograph of advanced mouth cancer). Experimental research shows that these graphic depictions indeed evoke fear and increase intentions to quit smoking; the effect that policymakers aim for (Kees, Burton, Andrews, & Kozup, 2010). A meta-analysis of fear appeals in public health campaigns confirms this positive effect, but also points to the risk that appeals to fear can trigger maladaptive fear control actions (Witte & Allen, 2000). Psychological processes such as denial, defensive avoidance, and reactance occur particularly among the target population to which the health threat is most

relevant. This was demonstrated by neuroscientific research in which participants viewed threatening health commercials (Kessels et al., 2014).

In environmental communications, fear appeals lead to similar psychological effects. Negative emotions such as fear can be effectively used to motivate people to minimize their carbon footprint, as message recipients may feel ashamed or guilty about their current behavior and how it affects the climate (e.g., Baek & Yoon, 2017; Moser, 2007; Rees, Klug, & Bamberg, 2015; Salama & Aboukoura, 2018; Smith & Leiserowitz, 2014). However, fear appeals can also backlash. Two integrated empirical, multimethod studies on the influence of visual representations of climate change (e.g., melting ice) on people's sense of engagement with the issue indicate that even though fear may be effective in catching people's *attention* it is often ineffective in changing *behavior.* The authors concluded that people can become desensitized by repeated exposure to gruesome images and lose their trust in the communication source if they think that fear is being used to manipulate them to engage (O'Neill & Nicholson-Cole, 2009).[2]

In addition to visual messages, policymakers may evoke fear using alarmist language in environmental public communications. This language can take many forms. O'Neill and Nicholson-Cole (2009) cited examples such as "dangerous climate change," "climate of fear," and "climate chaos." In one experimental study, the term "global warming" was found to evoke more fear than the term "climate change," even when these terms were used interchangeably (Benjamin, Por, & Budescu, 2017). Specifically, 457 participants in an online survey were randomly assigned to one of two framing conditions. They were presented with a set of questions regarding either "climate change" or "global warming." The results showed that the term "global warming" induced associations with temperature increases, severe weather, greater concern, human causes, and negative effects. The term "climate change" evoked associations with changes in general weather patterns and the possibility of natural fluctuations, while leading to greater reported belief that the issue could have serious repercussions.

Thus, the mere choice of wording (i.e., framing) affects perceptions of environmental issues. This effect of language as a persuasive tool to instigate behavioral change directly or indirectly can be subtle and unnoticeable to recipients, due to the aforementioned psychological processes. This conclusion also emerges from other experiments on the effects of framing in environmental communications (e.g., De Vries, 2017; De Vries et al., 2016). However, the "global warming versus climate change" experiment found no direct effect of framing on people's intention to act sustainably. That study found significant predictors of behavior to be the perception that climate change was caused by humans, perceptions of

[2] See Hornsey and Fielding (2020) for a review of the effectiveness of pessimistic and optimistic messages and their critique of the studies by O'Neill and Nicholson-Cole (2009).

self-efficacy to address climate change/global warming, and knowledge of the causes of climate change (Benjamin et al., 2017).

Positive Emotions. Appeals to positive emotions in environmental public communications have been associated with support for environmental policies and even increased proenvironmental behavior. The scant empirical research on positive emotional appeals in environmental public communications focuses on how to fuel feelings of hope (e.g., Chadwick, 2015; Ojala, 2012, 2015; Smith & Leiserowitz, 2014).

Questionnaire studies among teenagers and young adults show, for example, that "constructive" hope (related to trust in oneself and other societal actors, as well as positive reappraisal) positively influences proenvironmental behavior. In contrast, hope based on denial of the seriousness of climate change was negatively correlated with proenvironmental behavior (e.g., Ojala, 2012, 2015). According to Ojala, the negative effect of denial-based hope could relate to optimism bias; that is, if attempts to provide hope cause people to underestimate the scope or severity of a problem, they may remain inactive or even increase their unsustainable behavior (Gifford, 2011; Ojala, 2015).

A nationally representative survey in the United States found a positive impact of hope (Smith & Leiserowitz, 2014). Respondents were asked to rate the intensity of different emotions felt when thinking about global warming. Furthermore, they were asked how much they supported or opposed a range of different climate and energy-related policies, including research on renewable energy sources and regulation of carbon dioxide as a pollutant. The authors found hope to be strongly associated with increased policy support. Interest and worry were also strongly associated with increased policy support (Smith & Leiserowitz, 2014). These research findings indicate that positive emotional appeals (i.e., hope) may be effectively applied in environmental public communications—as long as they do not lead to optimism bias or denial.

Practically, policymakers can conclude from the literature that positive emotional appeals in environmental public communications can be an effective behavioral change tool. However, scholars also emphasize that an action perspective to cope with environmental threats must be provided to enhance perceptions of self-efficacy and prevent inaction (e.g., O'Neill & Nicholson-Cole, 2009; Ojala, 2012; Witte & Allen, 2000).

Expectations

Insights from social psychology and sociology indicate that how people feel and act in relation to environmental issues depends not only on their cognitive biases and emotions, but also on their expectations about other people who are important to them. Two social processes here can interact with the impact of

public communications on a person's sustainable behavior: (1) expectations about the sustainable behavior of others (i.e., social norms) and (2) expectations about the intentions of the communication source. Here, the communication source of primary interest is the government or another public service. Both processes are examined in more detail below.

Social Norms. People tend to compare themselves with members of their "in-group"; that is, others with whom they identify. They adapt their behavior to how they think these peers (would) behave. In regard to environmental sustainability, people might compare themselves to their neighbors, for example, in energy consumption or the purchase of an electric car (e.g., Allcott, 2011). The social norms that result from such comparisons are mental representations of appropriate behavior. These function as a guide in daily life and can be stronger than an individual's (rational) perceptions or attitudes (e.g., Aarts & Dijksterhuis, 2003). The relative impact of social norms on behavior is described by the theory of planned behavior. This theory states that norms, alongside attitudes towards a behavior and perceived behavioral control, shape individuals' behavioral intentions and, as a consequence, actual behaviors (Ajzen, 1991).[3]

Experimental research demonstrates the effectiveness of the use of social norms in environmental public communications with regard to water conservation (Goldstein, Cialdini, & Griskevicius, 2008), energy consumption (Allcott, 2011; Kantola, Syme, & Campbell, 1984; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007), littering and recycling (Cialdini, Reno, & Kallgren, 1990; Grasmick, Bursik, & Kinsey, 1991; Schultz, 1999), and transportation behavior (Kormos, Gifford, & Brown, 2015).

Research reveals two kinds of social norms that motivate human action: descriptive and injunctive. Descriptive social norms involve perceptions of the behaviors typically performed by people one identifies with. They are effective because they "describe" the wanted behavior—performed by a majority—and they nudge the minority in this direction. Injunctive social norms involve perceptions of what behaviors are typically approved or disapproved of by a person's in-group. Injunctive norms can steer people's behavior regardless of what the majority does. Injunctive norms are effective when people perceive the wanted behavior as consistent with their own identity and the characteristics of the in-group (Cialdini et al., 1990). Various studies demonstrate how descriptive and injunctive social

[3] Note that perceived behavioral control differs from perceived self-efficacy. Perceived behavioral control is the belief that an outcome can be influenced by own efforts. Self-efficacy is the confidence in ability to achieve the behavioral outcome. Examinations show that behavior is predicted better by self-efficacy than by behavioral control (Manstead & Van Eekelen, 1998; Parkinson, David, & Rundle-Thiele, 2017).

norms can be used effectively in environmental public communications and where the pitfalls lie.[4]

A classic field experiment on descriptive norms concerns the motivation of hotel guests to reuse their towels. Reuse of towels helps the environment by reducing laundry, thereby saving water and energy (Goldstein et al., 2008). The experiment demonstrated that after reading a note indicating that prior guests had reused their towels (i.e., a descriptive social norm message) hotel guests were more motivated to reuse their towels than after reading a note merely stating that towel reuse is good for the environment (i.e., an informational message).

Though the hotel towel study, conducted in the United States, is often cited, it is worth mentioning that a similar study in two German hotels did not replicate the findings (see Schubert, 2017). In these failed replications, descriptive social norm messages ("75% of other guests reused their towels") were just as effective as informational messages appealing to environmental concerns. As a possible explanation, the authors suggested that European participants might have greater engagement with environmental issues than the U.S. participants. Therefore, the European participants might have based their behavioral decisions more strongly on the merits of the issue (i.e., a content cue) than on the descriptive norms (a noncontent, heuristic cue; Bohner & Schlüter, 2014).

The impact of descriptive social norms on energy consumption was also shown by a classic field experiment initiated in 2008 by the U.S. company Opower and its partnering energy providers (Allcott, 2011). More than 600,000 households were divided into a treatment group and a control group. The households in the treatment group received regular reports with data on their energy consumption relative to their neighbors (i.e., a descriptive social norm). The households in the control group did not get this information. The households in the treatment group reduced their energy consumption after being informed that they consumed more than the average household in the area with the same number of occupants (Allcott, 2011). This study replicates a finding from a similar field study conducted almost 25 years earlier in Australia (Kantola et al., 1984).

Well-known studies such as these have inspired other companies and policy-makers to provide descriptive social norm information, as they presume this to be most effective in influencing customer and citizen behavior. However, some of these attempts have been ineffective or even backfired. For instance, a descriptive norm can discourage people from making a requested change if it reveals that most of one's peers persisted in the unwanted behavior (Cialdini, 2003). As such, provision of information about other people's energy consumption might make an economical consumer aware that their neighbors consume *more* energy than they do. This might actually prompt them to adapt their own energy consumption to the

[4] See also how Hornsey and Fielding discuss the role of norms in this issue.

higher norm; that is, to change their behavior in a direction counter to the original communication goal.

Policymakers faced with a situation in which a negative norm prevails—leading to unwanted behavior—might still consider communicating the negative norm, but to accompany it with a disapproving message that appeals to the audience and in-group's identity (i.e., an injunctive norm) (e.g., Cialdini, 2003). Examples of the successful use of an injunctive, negative norm are the "Don't mess with Texas" and "Don't lay that trash on Oklahoma" media campaigns, to reduce highway littering. Littering dropped drastically (up to 72%) when it was presented as behavior that "true Texans" and "true Oklahomans" considered unacceptable (e.g., Grasmick et al., 1991; Mols et al., 2015; Schubert, 2017).

However, public communicators must be alert when designing assertive slogans. Their persuasiveness seems to depend on the perceived relevance of the environmental issue communicated. People respond well to pushy requests, such as "Keep the highway clean," if they view the topic (i.e., clean roads) as important. However, if they do not find the topic very relevant, they need more suggestive—gentle—appeals to convince them to act in a more sustainable fashion (Kronrod, Grinstein, & Wathieu, 2012).

In sum, communicators need to consider the perceived relevance of their topic among their target audience before designing environmental public communications. Furthermore, descriptive norms can be effective, but only if the norm steers towards the wanted (sustainable) behavior. If a negative norm prevails, a disapproving message may work, but should be formulated with care.

Source Expectations. Expectations about the perceived agenda of the source of environmental public communications can play an important role in how and whether citizens act upon a message communicated. As pointed out earlier, people can lose their trust in a communication source if they think that fear has been used repeatedly to manipulate them to engage with an issue (O'Neill & Nicholson-Cole, 2009). Studies further suggest that compliance can fail if expectations about a source's motivations for communicating environmental policies are at odds with the message, for example, if a polluting oil and gas company emphasizes only environmental benefits in its communications (e.g., De Vries, 2017; De Vries et al., 2016; De Vries, Terwel, Ellemers, & Daamen, 2015; European Environment Agency, 2016b; Rabinovich, Morton, & Birney, 2012; Ter Mors, Weenig, Ellemers, & Daamen, 2010; Terwel, Harinck, Ellemers, & Daamen, 2009).

Expectations about the source's motivations can influence compliance with environmental policies because expectations in general are an important driver of behavior (e.g., Burgoon & Le Poire, 1993). Citizens will probably be more willing to comply with environmental policies if they expect the policymakers responsible for the policies (i.e., the government) to be fair and serve the needs of

the general public. They will be less apt to comply if they expect policymakers to serve other needs (e.g., individual, political, industrial). These expectations derive mainly from prior performance, both actual and perceived (e.g., James, 2011). If expectations of fair and public-serving policymaking are violated, people get aroused and try to make sense of the violation (expectancy violations theory; Burgoon & Le Poire, 1993; Hinnant, Len-Ríos, & Jee Oh, 2012).

Negative violation of expectations leads to negative appraisals (e.g., Burgoon & Hale, 1988), including perceptions of illegitimate manipulation (De Vries et al., 2016; O'Neill & Nicholson-Cole, 2009). In a series of experiments on the effectiveness of public communication as a way to increase acceptance of environmental policies, researchers examined how participants responded to randomly distributed news articles on a low-carbon technology: CO_2 capture and storage (De Vries et al., 2016). The communications varied in type of source (news agency versus oil company) as well as in degree of imbalance in reporting the advantages (i.e., combating global warming) and disadvantages (i.e., the risk of groundwater acidification). Such imbalance is also known as emphasis framing. The main findings were that people perceived biased environmental public communications as more manipulative than balanced communications, regardless of whether advantages or disadvantages were emphasized. However, manipulation was only perceived as inappropriate when there was an expectation that the source should be fair and balanced. This suggests that people who expect public communicators to be unbiased, but are presented with biased communications, will appraise the source negatively and as manipulative.

Perceptions of manipulation, or "greenwashing," can have a backlash effect on sustainable behavior due to the earlier mentioned psychological process of reactance (i.e., showing the opposite behavior to that advocated in a communication) (Brehm & Brehm, 1981; De Vries, 2017). The following example of a mass public campaign from an oil and gas company illustrates how well-intentioned communications can backfire when implications relating to source expectations are not considered (e.g., De Vries et al., 2015). In 2000, British Petroleum (BP) launched the "Go Green" campaign to demonstrate its environmental concern to the public. The campaign introduced a new logo, a green and yellow sun. A new slogan was also launched: "Beyond Petroleum." However, the public challenged the credibility of the slogan and BP's true commitment to alternative energy sources, as the company was still heavily invested in fossil fuels. In 2008, BP faced public accusations of greenwashing (i.e., deliberately framing activities as "green" to gain undeserved commercial benefit; Laufer, 2003). So, instead of boosting its image as a green company—and sales of renewable energy—BP lost credibility and customers.

Experimental research provides further evidence for the hypothesis that communicators should consider recipients' expectations about a source's motivations for environmental policy development (De Vries et al., 2015). Three experiments

showed that people were quick to suspect greenwashing when they were informed that an energy company had invested in environmental measures. Suspicions of greenwashing can be allayed if communications acknowledge economic motivations as well as environmental motives. This is because people expect oil and gas companies to want to make a profit and be self-serving, in contrast to public-serving organizations. An economic motive is more aligned with this expectation than an environmental motive, regardless of the organization's true intentions. Stated differently, an economic motive is more credible than an environmental motive for an oil and gas company. Environmental motives might be effective promotors of sustainable behavior if the audience perceives the source's "green" intentions as credible; however, this was not specifically examined in De Vries et al. (2015).

In sum, it is important for policymakers and governments to consider the public's expectations regarding their intentions in developing environmental policies. To achieve compliance with these policies, communications need to align with these public expectations. If recipients expect environmental, public-serving motives, these may be communicated. However, if other motives are (also) expected, they need to be acknowledged as well (De Vries et al., 2015; Terwel et al., 2009).

Design Suggestions for Environmental Public Communications

The discussed insights about psychological and social mechanisms—and findings concerning the way these impact the effectiveness of public communications—can be boiled down to three design suggestions: keep it simple, balance the message, and provide an action perspective. These design suggestions are highly relevant to any attempts to influence environmental behavior because their application can help prevent inaction and backlash effects. This section discusses how to use these suggestions, providing examples, recapping from the previous discussion why they are so relevant, and warning of possible pitfalls when applying them.

Keep It Simple

Simple messages have one core idea and omit irrelevant details (De Vries et al., 2014). Furthermore, the language is easy and sentences are not too long. An example of a simple message is that of the antilittering campaign referred to earlier: "Don't lay that trash on Oklahoma" (Grasmick et al., 1991). As the literature reviewed confirms, simple messages tackle multiple psychological processes. Simplicity makes it easier for people to read, understand, and remember information about environmental policies (e.g., De Vries et al., 2019; Sousa Lourenço, Ciriolo, Rafael Almeida, & Troussard, 2016). As a result, people process the

information more systematically, which can lead to more persistent opinions and stable behaviors (e.g., Petty et al., 1995).

A pitfall in designing a simple message is that communicators need to take more effort to assess the relevance of the topic for their target population. As demonstrated by several of the earlier mentioned (empirical) studies on cognitive biases and relevance, communications are more persuasive when they address relevant, often local, topics (e.g., Brügger & Pidgeon, 2018; De Vries et al., 2014; Kronrod et al., 2012; Scannell & Gifford, 2013). Since the perceived relevance of topics might differ between people, different communications may need to be developed for different groups. As noted, though microtargeting costs, time, money, and effort, it might be worth trying because of its greater potential effectiveness (Hornsey & Fielding, 2020).

Balance the Message

Balanced messages communicate both advantages and disadvantages of an environmental policy. Furthermore, both the advantages and disadvantages are equally emphasized. An example of a balanced message on the environmental policy of favoring public transport over car use may read: "The bus might not get you there as fast, but it is good for the environment." This acknowledges a disadvantage of taking the bus, as well as an advantage.

As discussed earlier in relation to source expectations, balancing is relevant because it enhances the credibility of the source and the message. This holds particularly true for communications from sources that should, in the eyes of the public, be objective, such as public agencies (De Vries et al., 2015, 2016). Importantly, scholars have theorized that balanced communications can produce positive long-term effects, such as increased trust in the integrity of a source (e.g., De Vries, 2017; Terwel et al., 2009). Future research is recommended to test this hypothesis empirically.

A pitfall of balancing is the difficulty of deciding what a good balance is. In their study on the effects of emphasis framing in environmental communications, De Vries et al. (2016)) observed that balanced reporting can in itself paint an incorrect picture of an issue if two opposing viewpoints appear equally plausible while one has the preponderance of evidence on its side. An example is if equal argumentation is given for the primacy of anthropogenic (human-induced) and naturally occurring causes of climate change. As such, concern for balance might in fact undermine true objectivity, a phenomenon also referred to as "false balance," which can create controversy and perceptions of misinformation (e.g., Dearing, 1995). Discerning an equal balance between advantages and disadvantages with regard to a topic requires preparation and research among communicators.

Provide an Action Perspective

The discussion on cognitive biases, emotions, and expectations indicates the importance of providing a clear action perspective to change people's behavior. First, as discussed in relation to social norms, a factual, informative description of the desired behavior can be enough to change behavior (e.g., "Reuse your hotel towels"; Bohner & Schlüter, 2014). Providing an example demonstrating that people like you perform the desired behavior can be an even stronger way to change behavior (e.g., "Previous guests in this hotel room also reused their towels"; Goldstein et al., 2008).

However, communicators should be wary of using social norms if a negative norm prevails (e.g., regarding road littering). In that case, the action perspective should be accompanied with a message that disapproves of the unwanted behavior ("Don't mess with Texas"; Grasmick et al., 1991). Furthermore, communicators should be aware of the experimental finding that in-group members can elicit a negative (contrasting) response if they make others feel morally inadequate. Bolderdijk, Brouwer, and Cornelissen (2018) provided the example of the discouragement one might feel when a neighbor shows off their electric car. Even though the neighbor's motives might be sound (e.g., environmental concern), their enthusiasm might actually threaten others' moral self-concept because the individual had not pursued this course of action themselves (e.g., Bolderdijk et al., 2018).

This demonstrates how perceived low control can trigger defensive responses. As explained, an action perspective can increase perceptions of self-efficacy and effectiveness if it clarifies to the audience how they can contribute to solving environmental problems. Furthermore, it can reduce the occurrence of cognitive biases and cognitive dissonance (and the strategies used to reduce these). Telling people how they can minimize their carbon footprint (e.g., "take the bus") can empower them.

Finally, communicators should be wary of using emotional appeals when providing an action perspective. The research introduced earlier indicates that if these appeals are perceived as irrelevant, they could weaken the call for action (i.e., dilution effect, De Vries et al., 2014). Furthermore, positive emotions such as hope only work when they do not evoke denial (e.g., Ojala, 2012, 2015). Appeals to negative emotions, such as fear, can easily backfire and lead to perceptions of manipulation (e.g., O'Neill & Nicholson-Cole, 2009). Moreover, there are ethical considerations regarding whether a public service should trigger emotions, even if it is for a good cause. This suggests that emotional appeals should be used with care in action statements.

Conclusion

The goal of this contribution was to scrutinize social and psychological processes that can impact the effectiveness of public communication. A review of relevant theory and research revealed that environmental public communication can be an effective tool to motivate sustainable behavior, provided that attention is paid to cognitive biases (discounting, control perceptions, denial, defensive avoidance, and reactance), emotions (fear and hope), and expectations (about the motivations of the communication source and other people's environmental behaviors).

Of course, it can be argued that the processes described in this review are not the only relevant ones. However, though not comprehensive, this contribution can raise awareness among public communicators of the types of social and psychological processes that can impact the effectiveness of their communications. Furthermore, this review provides an academic starting point for the collection and mapping of the variety of processes that impact the effectiveness of public communications. A noteworthy example in this regard is the work of Robert Gifford, who has spent many years collecting his "Dragons of Inaction." These "dragons" are cognitive biases and psychological mechanisms that explain inaction towards environmental issues. He hosts a website open to scholars and nonscholars alike which enables him to continuously expand and improve his collection (www.dragonsofinaction.com). In line with Gifford, fellow researchers might regard the current contribution as an invitation to elaborate, expand, and improve on the framework presented in Figure 1.

Nevertheless, even when all of the social and psychological processes are mapped and explained, the exact effects of environmental public communications on sustainable behavior remain unpredictable. The success of public communication depends on the interplay of different elements and processes, concerning the message, the recipient, and the sender. That interplay can, however, be better understood and revealed through further scholarship and practice.

References

Aarts, H., & Dijksterhuis, A. (2003). The silence of the library: Environment, situational norm, and social behavior. *Journal of Personality and Social Psychology*, *84*, 18–28.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211.

Al-Fedaghi, S. (2012). A conceptual foundation for the Shannon–Weaver model of communication. *International Journal of Soft Computing*, *7*, 12–19.

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, *95*, 1082–1095.

Allcott, H., & Greenstone, M. (2012). Is there an energy efficiency gap? *Journal of Economic Perspectives*, *26*, 3–28.

Allcott, H., & Mullainathan, S. (2010). Behavior and energy policy. *Science*, *327*, 1204–1205.

Baek, T. H., & Yoon, S. (2017). Guilt and shame: Environmental message framing effects. *Journal of Advertising*, *46*, 440–453.
Bazerman, M. H. (2006). Climate change as a predictable surprise. *Climatic Change*, *77*, 179–193.
Benjamin, D., Por, H. H., & Budescu, D. (2017). Climate change versus global warming: Who is susceptible to the framing of climate change? *Environment and Behavior*, *4*, 745–770.
Berlo, D. K. (1960). *The process of communication: An introduction to theory and practice*. New York, NY: Holt.
Bettinghaus, E. P. (1986). Health promotion and the knowledge-attitude-behavior continuum. *Preventive Medicine*, *15*, 475–491.
Bohner, G., & Schlüter, L. E. (2014). A room with a viewpoint revisited: Descriptive norms and hotel guests' towel reuse behavior. *PloS One*, *9*, e104086.
Bolderdijk, J. W., Brouwer, C., & Cornelissen, G. (2018). When do morally motivated innovators elicit inspiration instead of irritation? *Frontiers in Psychology*, *8*, 2362. Available from https://www.frontiersin.org/articles/10.3389/fpsyg.2017.02362/full
Brehm, S. S., & Brehm, J. (1981). *Psychological reactance*. New York, NY: Academic Press.
Brewer, P. R. (2001). Value words and lizard brains. *Political Psychology*, *22*, 45–64.
Brügger, A., & Pidgeon, N. F. (2018). Spatial framing, existing associations and climate change beliefs. *Environmental Values*, *27*, 559–584.
Brulle, R. J. (2010). From environmental campaigns to advancing the public dialog: Environmental communication for civic engagement. *Environmental Communication*, *4*, 82–98.
Burgoon, J. K., & Hale, J. L. (1988). Nonverbal expectancy violations: Model elaboration and application to immediacy behaviors. *Communication Monographs*, *55*, 58–79.
Burgoon, J. K., & Le Poire, B. A. (1993). Effects of communication expectancies, actual communication, and expectancy disconfirmation on evaluations of communicators and their communication behavior. *Human Communication Research*, *20*, 67–96.
Chadwick, A. E. (2015). Toward a theory of persuasive hope: Effects of cognitive appraisals, hope appeals, and hope in the context of climate change. *Health Communication*, *30*, 598–611.
Chaffee, S. H., & Roser, C. (1986). Involvement and the consistency of knowledge, attitudes, and behaviors. *Communication Research*, *13*, 373–399.
Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology*, *39*, 752–766.
Chandler, D. (2012). The transmission model of communication. The University of Wales, Aberystwyth, UK. Retrieved from https://archive.fo/20120716111950/http://www.aber.ac.uk/media/Documents/short/trans.html.
Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, *12*, 105–109.
Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, *58*, 1015–1026.
Cole, C. (1993). Shannon revisited: Information in terms of uncertainty. *Journal of the American Society for Information Science*, *44*, 204–211.
Cox, R. (2007). Nature's "crisis disciplines": Does environmental communication have an ethical duty? *Environmental Communication*, *1*, 5–20.
Cox, R., & Pezzullo, P. C. (2016). *Environmental communication and the public sphere* (4th ed.). Los Angeles, CA: Sage.
Dearing, J. W. (1995). Newspaper coverage of maverick science: Creating controversy through balancing. *Public Understanding of Science*, *4*, 341–361.
Department of Energy and Climate Change. (2011). *Understanding potential consumer response to the green deal*. London, England: Author.
Department of Energy and Climate Change. (2013). *Removing the hassle factor associated with loft insulation: Results of a behavioural trial*. London, England: Author.
de Best-Waldhober, M., Daamen, D., & Faaij, A. (2009). Informed and uninformed public opinions on CO_2 capture and storage technologies in the Netherlands. *International Journal of Greenhouse Gas Control*, *3*, 322–332.

De Vries, G. (2017). How positive framing may fuel opposition to low-carbon technologies: The boomerang model. *Journal of Language and Social Psychology*, *36*, 28–44.

De Vries, G., Rietkerk, M., & Kooger, R. (2019). The hassle factor as a psychological barrier to a green home. *Journal of Consumer Policy*. Advance online publication. https://doi.org/10.1007/s10603-019-09410-7.

De Vries, G., Terwel, B. W., & Ellemers, N. (2014). Spare the details, share the relevance: The dilution effect in communications about CO_2 capture and storage. *Journal of Environmental Psychology*, *38*, 116–123.

De Vries, G., Terwel, B. W., & Ellemers, N. (2016). Perceptions of manipulation and judgments of illegitimacy: Pitfalls in the use of emphasis framing when communicating about CO_2 capture and storage. *Environmental Communication*, *10*, 206–226.

De Vries, G., Terwel, B. W., Ellemers, N., & Daamen, D. D. L. (2015). Sustainability or profitability? How communicated motives for environmental policy affect public perceptions of corporate greenwashing. *Corporate Social Responsibility and Environmental Management*, *22*, 142–154.

Ecologic Institute. (2014). *Influences on consumer behavior: Policy implications beyond nudging*. Policy Brief for the European Commission, Environment DG. Retrieved from http://ec.europa.eu/environment/enveco/economics_policy/pdf/Behaviour%20Policy%20Brief.pdf.

Energy Savings, Do It Now. (2019). Retrieved from https://www.rijksoverheid.nl/actueel/nieuws/2018/01/22/nieuwe-campagne-energiebesparendoejenu-promoot-energiebesparing-woning.

European Commission. (2015). *Generation Awake*. Retrieved from http://ec.europa.eu/environment/generationawake/index_en.htm.

European Commission. (2017). *Third report on the state of the energy union*. Retrieved from https://ec.europa.eu/commission/publications/third-report-state-energy-union_en.

European Environment Agency. (2016a). *Policy instruments*. Retrieved from https://www.eea.europa.eu/themes/policy/intro.

European Environment Agency. (2016b). *Communication, environment and behaviour: A scoping study on the links between public communication, environment policy implementation and behavioural science* (European Environment Agency Report No. 13/2016). Luxembourg: Publications Office of the European Union.

Faulkner, N., Jorgensen, B., & Koufariotis, G. (2019). Can behavioural interventions increase citizens' use of e-government? Evidence from a quasi-experimental trial. *Government Information Quarterly*, *36*, 61–68.

Faulkner, N., Jorgensen, B. S., Sampson, J., & Ghafoori, E. (2018). Improving compliance with medical fitness to drive reviews: The role of behaviourally-optimised letters. *Transportation Research Part F: Traffic Psychology and Behaviour*, *55*, 1–8.

Festinger, L. (1957). *A theory of cognitive dissonance*. Evanston, IL: Row, Peterson.

Frey, D. (1986). Recent research on selective exposure to information. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 19, pp. 41–80). New York, NY: Academic Press.

Gardner, G. T., & Stern, P. C. (2008). The short list: The most effective actions US households can take to curb climate change. *Environment: Science and Policy for Sustainable Development*, *50*, 12–25.

Gatersleben, B., Steg, L., & Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior*, *34*, 335–362.

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, *66*, 290–302.

Gifford, R., & Comeau, L. A. (2011). Message framing influences perceived climate change competence, engagement, and behavioral intentions. *Global Environmental Change*, *21*, 1301–1307.

Gifford, R., Scannell, L., Kormos, C., Smolova, L., Biel, A., Boncu, S., … Kaiser, F. G. (2009). Temporal pessimism and spatial optimism in environmental assessments: An 18-nation study. *Journal of Environmental Psychology*, *29*, 1–12.

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research*, *35*, 472–482.

Grasmick, H. G., Bursik, R. J., Jr, & Kinsey, K. A. (1991). Shame and embarrassment as deterrents to noncompliance with the law: The case of an antilittering campaign. *Environment and Behavior*, *23*, 233–251.

Grimmelikhuijsen, S., Jilke, S., Olsen, A. L., & Tummers, L. (2017). Behavioral public administration: Combining insights from public administration and psychology. *Public Administration Review*, *77*, 45–56.

Hallsworth, M., Chadborn, T., Sallis, A., Sanders, M., Berry, D., Greaves, F., . . . Davies, S. C. (2016). Provision of social norm feedback to high prescribers of antibiotics in general practice: A pragmatic national randomised controlled trial. *The Lancet*, *387*, 1743–1752.

Hart, W., Albarracín, D., Eagly, A. H., Brechan, I., Lindberg, M. J., & Merrill, L. (2009). Feeling validated versus being correct: A meta-analysis of selective exposure to information. *Psychological Bulletin*, *135*, 555–588.

Hinnant, A., Len-Ríos, M. E., & Jee Oh, H. (2012). Are health journalists' practices tied to their perceptions of audience? An attribution and expectancy-value approach. *Health Communication*, *27*, 234–243.

Hollnagel, E., & Woods, D. D. (2005). *Joint cognitive systems: Foundations of cognitive systems engineering*. Boca Raton, FL: CRC Press.

Hornsey, M. J., & Fielding, K. (2020). Understanding (and reducing) inaction on climate change. *Social Issues and Policy Review*. Advance online publication. https://doi.org/10.1111/sipr.12058.

International Energy Agency. (2013). *Energy policy highlights* (executive summary). Paris, France: Author.

Intergovernmental Panel on Climate Change. (2014). Summary for policymakers. In O. Edenhofer (Ed.), *Climate change 2014: Mitigation of climate change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press.

Intergovernmental Panel on Climate Change. (2018). Summary for policymakers. In V. Masson-Delmotte (Ed.), *Global warming of 1.5°C: An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Geneva, Switzerland: World Meteorological Organization.

Jacobson, S. K., Morales, N. A., Chen, B., Soodeen, R., Moulton, M. P., & Jain, E. (2019). Love or loss: Effective message framing to promote environmental conservation. *Applied Environmental Education & Communication*, *18*, 252–265.

James, O. (2011). Managing citizens' expectations of public service performance: Evidence from observation and experimentation in local government. *Public Administration*, *89*, 1419–1435.

Jones, L. (2019). Our planet: We are already into the sixth mass extinction-Attenborough's new Netflix series is just not urgent or radical enough. Retrieved from https://www.independent.co.uk/arts-entertainment/tv/features/our-planet-netflix-david-attenborough-climate-change-extinction-a8853216.html.

Joslyn, M., & Haider-Markel, D. (2002). Framing effects on personal opinion and perceptions of public opinion: The cases of physician-assisted suicide and social security. *Social Science Quarterly*, *83*, 690–706.

Kahneman, D. (2011). *Thinking, fast and slow*. New York, NY: Farrar, Straus and Giroux.

Kantola, S. J., Syme, G. J., & Campbell, N. A. (1984). Cognitive dissonance and energy conservation. *Journal of Applied Psychology*, *69*, 416–421.

Kees, J., Burton, S., Andrews, J. C., & Kozup, J. (2010). Understanding how graphic pictorial warnings work on cigarette packaging. *Journal of Public Policy & Marketing*, *29*, 265–276.

Kessels, L. T., Ruiter, R. A., Wouters, L., & Jansma, B. M. (2014). Neuroscientific evidence for defensive avoidance of fear appeals. *International Journal of Psychology*, *49*, 80–88.

Kronrod, A., Grinstein, A., & Wathieu, L. (2012). Go green! Should environmental messages be so assertive? *Journal of Marketing*, *76*, 95–102.

Kormos, C., Gifford, R., & Brown, E. (2015). The influence of descriptive social norm information on sustainable transportation behavior: A field experiment. *Environment and Behavior*, *47*, 479–501.

Lakoff, G. (2010). Why it matters how we frame the environment. *Environmental Communication*, *4*, 70–81.

Laufer, W. S. (2003). Social accountability and corporate greenwashing. *Journal of Business Ethics*, *43*, 253–261.

Linos, E. (2017). More than public service: A field experiment on job advertisements and diversity in the police. *Journal of Public Administration Research and Theory*, *28*, 67–85.

Maibach, E. W., Roser-Renouf, C., & Leiserowitz, A. (2008). Communication and marketing as climate change—intervention assets: A public health perspective. *American Journal of Preventative Medicine*, *35*, 488–500.

Manstead, A. S., & Van Eekelen, S. A. (1998). Distinguishing between perceived behavioral control and self-efficacy in the domain of academic achievement intentions and behaviors. *Journal of Applied Social Psychology*, *28*, 1375–1392.

Martin, S. (2012). 98% of HBR readers love this article. *Harvard Business Review*, *90*, 23–25.

Mols, F., Haslam, S. A., Jetten, J., & Steffens, N. K. (2015). Why a nudge is not enough: A social identity critique of governance by stealth. *European Journal of Political Research*, *54*, 81–98.

Moser, S. C. (2007). More bad news: The risk of neglecting emotional responses to climate change information. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change*. New York, NY: Cambridge University Press.

Myers, T. A., Nisbet, M. C., Maibach, E. W., & Leiserowitz, A. A. (2012). A public health frame arouses hopeful emotions about climate change. *Climatic Change*, *113*, 1105–1112.

Nerlich, B., & Koteyko, N. (2009). Compounds, creativity and complexity in climate change communication: The case of "carbon indulgences". *Global Environmental Change*, *19*, 345–353.

OECD [Organisation for Economic Co-operation and Development]. (2017). Policy instruments for the environment. Retrieved from http://www.oecd.org/environment/indicators-modelling-outlooks/policy-instrument-database/.

Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research*, *18*, 625–642.

Ojala, M. (2015). Hope in the face of climate change: Associations with environmental engagement and student perceptions of teachers' emotion communication style and future orientation. *The Journal of Environmental Education*, *46*, 133–148.

Ölander, F., & Thøgersen, J. (2014). Informing versus nudging in environmental policy. *Journal of Consumer Policy*, *37*, 341–356.

O'Neill, S., & Nicholson-Cole, S. (2009). "Fear won't do it" promoting positive engagement with climate change through visual and iconic representations. *Science Communication*, *30*, 355–379.

Pahl, S., Sheppard, S., Boomsma, C., & Groves, C. (2014). Perceptions of time in relation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, *5*, 375–388.

Parkinson, J., David, P., & Rundle-Thiele, S. (2017). Self-efficacy or perceived behavioural control: Which influences consumers' physical activity and healthful eating behaviour maintenance? *Journal of Consumer Behaviour*, *16*, 413–423.

Peters, G. J. Y., Ruiter, R. A., & Kok, G. (2014). Threatening communication: A qualitative study of fear appeal effectiveness beliefs among intervention developers, policymakers, politicians, scientists, and advertising professionals. *International Journal of Psychology*, *49*, 71–79.

Petty, R. E., & Cacioppo, J. T. (1984). The effects of involvement on responses to argument quantity and quality: Central and peripheral routes to persuasion. *Journal of Personality and Social Psychology*, *46*, 69–81.

Petty, R. E., & Cacioppo, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change*. New York, NY: Springer-Verlag.

Petty, R. E., Cacioppo, J. T., Strathman, A., & Priester, J. R. (2005). To think or not to think? Exploring two routes to persuasion. In T. C. Brock & M. C. Green (Eds.), *Persuasion: Psychological insights and perspectives* (pp. 81–116). Thousand Oaks, CA: Sage.

Petty, R. E., Haugtvedt, C. P., & Smith, S. M. (1995). Elaboration as a determinant of attitude strength: Creating attitudes that are persistent, resistant, and predictive of behavior. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 93–130). Mahwah, NJ: Erlbaum.

Rabinovich, A., Morton, T. A., & Birney, M. E. (2012). Communicating climate science: The role of perceived communicator's motives. *Journal of Environmental Psychology*, *32*, 11–18.
Rees, J. H., Klug, S., & Bamberg, S. (2015). Guilty conscience: Motivating pro-environmental behavior by inducing negative moral emotions. *Climatic Change*, *130*, 439–452.
Ridley, M. (2013). Why climate change is good for the world. Retrieved from www.spectator.co.uk/2013/10/carry-on-warming/.
Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78.
Salama, S., & Aboukoura, K. (2018). Role of emotions in climate change communication. In W. Leal Filho, E. Manolas, A. M. Azul, U. M. Azeiteiro, & H. McGhie (Eds.), *Handbook of climate change communication:* Vol. 1 (pp. 137–150). Cham, Switzerland: Springer International Publishing.
Scannell, L., & Gifford, R. (2013). Personally relevant climate change: The role of place attachment and local versus global message framing in engagement. *Environment and Behavior*, *45*, 60–85.
Schalkwijk, M. (2017). *Energie besparen doe je nu: Eindrapportage campagne-effectonderzoek*. Amsterdam, The Netherlands: Kantar Public.
Schillemans, T., & De Vries, G. (2016). De homo psychologicus op het schip van staat: Gedragskennis in bestuur en beleid. *Bestuurskunde*, *25*, 3–8.
Schubert, C. (2017). Green nudges: Do they work? Are they ethical?. *Ecological Economics*, *132*, 329–342.
Schultz, P. W. (1999). Changing behavior with normative feedback interventions: A field experiment on curbside recycling. *Basic and Applied Social Psychology*, *21*, 25–36.
Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, *18*, 429–434.
Shannon, C. E., & Weiumaver, W. (1949). *A mathematical model of communication*. Urbana: University of Illinois Press.
Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, *69*, 99–118.
Smith, S. M., Fabrigar, L. R., & Norris, M. E. (2008). Reflecting on six decades of selective exposure research: Progress, challenges, and opportunities. *Social and Personality Psychology Compass*, *2*, 464–493.
Smith, N., & Leiserowitz, A. (2014). The role of emotion in global warming policy support and opposition. *Risk Analysis*, *34*, 937–948.
Sousa Lourenço, J., Ciriolo, E., Rafael Almeida, S., & Troussard, X. (2016). *Behavioural insights applied to policy: European report 2016* (EUR 27726 EN). Brussels, Belgium: European Commission.
Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy*, *142*, 435–444.
Stajkovic, A. D., & Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. *Psychological Bulletin*, *124*, 240–261.
Stec, A. M., & Bernstein, D. A. (1999). *Psychology: Fields of application*. Boston, MA: Houghton, Mifflin and Company.
Ter Mors, E., Weenig, M. W. H., Ellemers, N., & Daamen, D. D. L. (2010). Effective communication about complex environmental issues: Perceived quality of information about carbon dioxide capture and storage (CCS) depends on stakeholder collaboration. *Journal of Environmental Psychology*, *30*, 347–357.
Terwel, B. W., Harinck, F., Ellemers, N., & Daamen, D. D. L. (2009). How organizational motives and communications affect public trust in organizations: The case of carbon dioxide capture and storage. *Journal of Environmental Psychology*, *29*, 290–299.
Terwel, B. W., Ter Mors, E., & Daamen, D. D. L. (2012). It's not only about safety: Beliefs and attitudes of 811 local residents regarding a CCS project in Barendrecht. *International Journal of Greenhouse Gas Control*, *9*, 41–51.
Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

Thompson, L. E., Barnett, J. R., & Pearce, J. R. (2009). Scared straight? Fear-appeal anti-smoking campaigns, risk, self-efficacy and addiction. *Health, Risk & Society*, *11*, 181–196.
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*(4157), 1124–1131.
United Nations. (1998). Kyoto protocol to the United Nations Framework Convention on Climate Change. Retrieved from http://unfccc.int/resource/docs/convkp/kpeng.pdf.
United Nations. (2012). Doha amendment to the Kyoto Protocol. Retrieved from http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf.
United Nations. (2015). Adoption of the Paris Agreement. Retrieved from https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf.
Van den Broek, K. L., & Walker, I. (2019). Heuristics in energy judgement tasks. *Journal of Environmental Psychology*, *62*, 95–104.
Weber, E. U. (2017). Breaking cognitive barriers to a sustainable future. *Nature Human Behaviour*, *1*, 0013. https://doi.org/10.1038/s41562-016-0013.
Witte, K., & Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education & Behavior*, *27*, 591–615.
Wolsink, M. (2000). Wind power and the NIMBY-myth: Institutional capacity and the limited significance of public support. *Renewable Energy*, *21*, 49–64.

GERDIEN DE VRIES after graduating cum laude from the Research Master programme Social and Organisational Psychology at Leiden University in the Netherlands, Gerdien continued to get her Ph.D. degree in behavioural sciences at the same university in 2014. She wrote her Ph.D. thesis on pitfalls in communications about CO_2 capture and storage (CCS). She tested—experimentally-how framing effects in these communications influence audience perceptions on the technology itself and the organizations involved, including government and private organizations. In 2015 Gerdien got a tenure track position at Delft University of Technology. In Delft, she continued her research on the interplay between psychology, technology, communication, and public administration. With predominantly quantitative research methods including surveys and experiments, she identifies psychological and social processes that affect decision-making in complex, multi-actor settings, mainly in the climate domain. Furthermore, Gerdien designs and tests techniques that can influence these psychological and social processes related to framing and nudging. Gerdien is one of the founders of the TU Delft Social Innovation and Energy Platform, has been a visiting scholar at Melbourne University and is regularly “in the press” with her research on climate psychology.