Chapter 11
Towards a Psychology of Climate Change

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Abstract This paper gives a structured overview about possible contributions of psychology to the climate change debate. As a starting point, it assumes that understanding people's behaviour related to climate change (mitigation and adaptation) is crucial for successfully dealing with the future challenges. Climate change-related behaviour includes voting, support for climate lobbyists, individual consumption, adapting new technology, and taking adaptive actions. A framework model is presented that assumes the following psychological processes to be relevant for people's climate related behaviour (1) experiencing climate change, (2) developing an understanding for climate change, (3) building up knowledge about climate change, (4) emotionally reacting to climate change, (5) the perception of risk, (6) making behavioural decisions, and (7) evaluating behavioural outcomes. Based on psychological theory and empirical findings, it is argued that climate change possesses certain features that make it hard for laypeople to develop an understanding, build correct knowledge, and react emotionally. Furthermore, explanations are presented for why the risk of climate change has a rather low perception among laypeople, and what possible factors there are that interfere with individual mitigation and adaptation. Finally, based on the presented findings, suggestions for climate policy are made.

Keywords Adaptation · Behaviour models · Climate change · Emotional reaction · Human dimension · Knowledge · Mitigating behaviour · Perception · Psychology · Risk assessment

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W.L. Filho (ed.), *The Economic, Social and Political Elements of Climate Change*, Climate Change Management, DOI 10.1007/978-3-642-14776-0_11,

Introduction

Although psychology produces a quickly growing body of significant climate change-related publications and has been contributing to the climate change discussion for many years now, mainstream climate change research is still more or less ignoring psychological knowledge. If one scanned through the latest IPCC assessment report from 2007 (IPCC 2007a) and all its related working group reports (IPCC 2007b, c, d), for example, the words "psychology" or "psychological" can be found not more than approximately 20 times on almost 3,000 pages of text. The most "psychological" IPCC workgroup is workgroup 2 that included psychological findings on nine of their almost 1,000-page report about impacts, adaptation, and vulnerability. Analysing the proceedings of the big scientific climate change congress in Copenhagen in March 2009 (http://climatecongress.ku.dk/), it becomes obvious that only about 10% of the 58 sessions more or less directly relate to social sciences, including psychology, and even that seems like a big step forward compared to less recent conferences. It is astonishing that the human dimension that climate change obviously has, which means the effects of climate change on humans' experiences and behaviour as well as the psychological explanations behind humans' climate related behaviour, is not adequately reflected in an extensive use of psychological knowledge. Mostly, the human factor in the climate change discussion is still reduced to an economic and/or rational worldview, which assumes that people will behave in the desired way if we only inform them about climate change and use economic tools to guide their behaviour. This leads to intervention strategies, such as increasing prices of unwanted behaviour (or reducing prices of wanted behaviour) or informing people about climate change and possible scenarios. Although both approaches undoubtedly have some potential, they often fall short addressing the average human being and psychology has some answers to offer as to why it is that way.

One explanation for that the value of psychology in climate change mitigation and adaptation seems so much underestimated might be that non-psychologists often consider psychology to be basically clinical psychology, which means the science of understanding and curing mental diseases. However, psychology as "the science that makes use of behavioural and other evidence to understand the internal processes leading people and members of other species to behave in the way they do" (Eysenck 2000, p. 3) has a much broader focus and especially its sub-disciplines environmental psychology (analysing environment–person-interactions), social psychology (analysing people's relation to other people and society), and cognitive psychology (analysing internal processes such as perception, thinking, reasoning, and decision-making) provide a lot of useful non-clinical knowledge about climate change-related psychological processes. This short paper aims to give a brief structured introduction to psychological knowledge about climate change for non-psychologists. Of course, a 19-page paper is far from being comprehensive and there are more climate-related findings in psychological literature than I am able to report here. However, I hope to make

a case for the relevance of psychology in the climate change debate. Findings from clinical psychology about the impact of climate change on mental health are explicitly excluded.

Figure 11.1 displays the theoretical framework for this paper, which distinguishes between different psychological processes related to climate change that will be analysed in more detail in the subsequent sections. Again, it has to be stated that the aspects mentioned are far from being the only relevant psychological

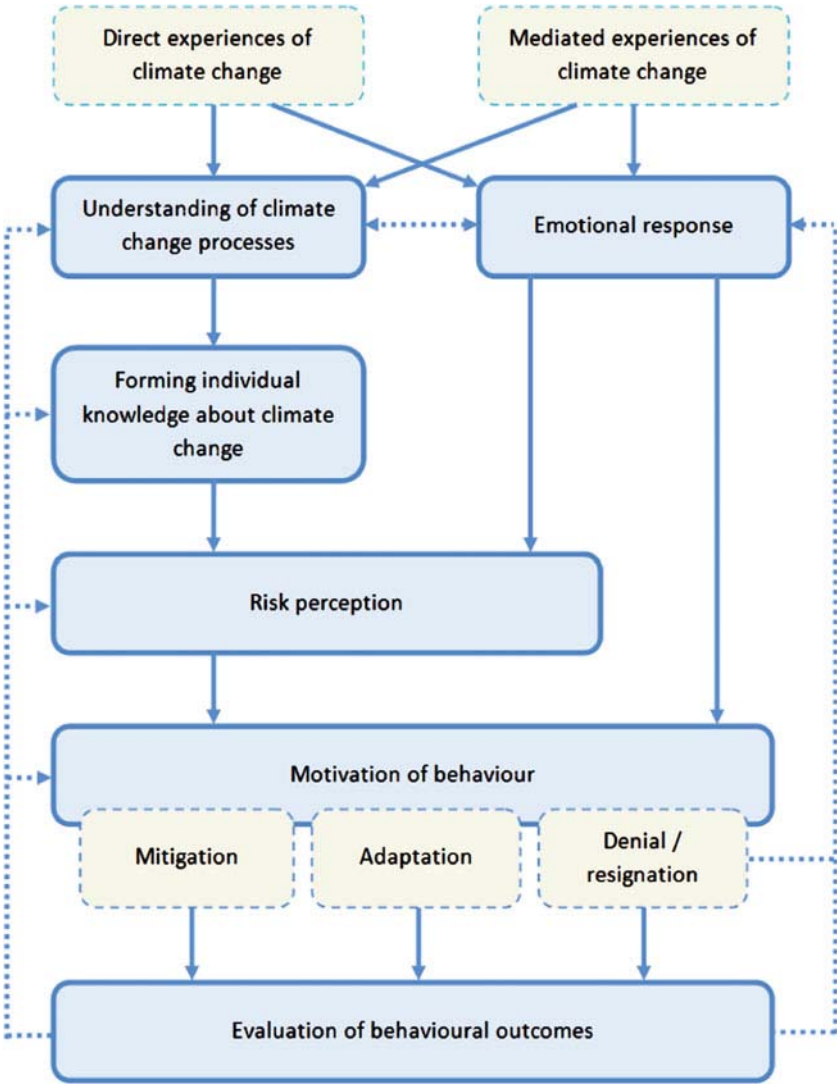

Fig. 11.1 A framework of psychological processes involved in people's climate change related experiences and behaviour

processes. The selection appears, however, to be a good starting point for pinpointing the genuinely psychological perspective on climate change. The theoretical framework assumes that people's reactions to climate change start with single or multiple experiences of climate change in their everyday lives. These experiences can either be direct, through, for example, personally witnessing extreme weather events or changes in the local flora and fauna, or mediated by media or conversations with other people. Both kinds of experiences can trigger immediate emotional responses as well as more deliberate cognitive processes. An important part in people's reaction to climate change seems to be if and how they develop an understanding of the underlying processes. Over time, more and more individual knowledge about climate change is built up, mental models of causes and effects with regard to the different components of climate change are formed, and assumptions about effective behaviour are made. Those individual constructions are usually simplified and to a certain degree incorrect, even if the person is an expert in climate change.

Emotional responses and the processes of understanding and forming knowledge about climate change interact with each other. Difficulties in understanding climate change might, for example, enhance negative emotions; initial emotional reactions are integrated into the network of knowledge. Both emotional responses and individually constructed knowledge initiate a personal evaluation of the risk to be affected by negative outcomes of climate change. This risk evaluation is one important motivator of climate change-related behaviour; other motivators are discussed in more detail in the respective section below. Risk evaluation, emotional responses, and other factors lead in a complex process to a motivation to personally contribute to mitigation of climate change, to personally take adaptive action, or under certain conditions to deny climate change or resign.

In a final step, the model assumes that the outcomes of the actions taken are evaluated and the result of this evaluation is in a feedback loop reintegrated into knowledge structures and emotional response systems. Motivation of climate change related behaviour is therefore assumed to be not a linear but circular process that evolves over time and is shaped by personal experiences and evaluations. The different stages of the model are analysed in more detail in the following sections and selected research findings are presented to underline the assumptions. The importance of each aspect for approaching the human dimension of climate change is outlined. In the conclusion of the paper, the model is used to derive suggestions for climate change policy.

Understanding Climate Change: Human Difficulties with Complexity

The world's climate and processes of stability and change within it are so complex that the human mind is challenged beyond its capacity to fully understand them. An uncountable number of different variables influence each other in a non-linear and

highly interactive way. Causes and effects are often separated both geographically and temporarily. Most processes are slow, indirect and have long delays, others show stability for a very long time and suddenly destabilize (such as the melting of the summer ice cap on the North Pole). Most of the mechanisms are still not fully described scientifically. Furthermore, the processes of climate change affect people across different countries, societies, and cultures. These characteristics of climate change pose an interesting parallel to very complex technological or economic systems, which makes research about causes of accidents or breakdowns in those systems a promising approach for analysing humans' problems with understanding climate change.

Already in the late 1960s, Forrester (1969) had made the claim that systems with certain characteristics are too complex for the human mind to comprehend. How those systems behave over time cannot therefore validly be predicted by humans. Forrester (1971) argues that evolution led to human brains that are highly capable of dealing with simple, linear systems where cause and effects are not separated in time or space. People usually gather an understanding for such a system by a procedure of trial and error, observing the outcomes of simple manipulations of single variables in the system and correcting behaviour if the outcome does not match the desired state. If a system, however, involves a large number of variables, if those variables interact, if feedback loops lead to unpredictable resonating processes in the system, or if relations between variables are not linear human strategies for understanding, those systems fail. Understanding a system becomes especially difficult for humans if causes and effects are separated either temporarily (the effect is seen years after the cause) or geographically (the effect of a cause in one country is seen in another country on another continent). All of these characteristics can be found to a high degree in climate change: the number of variables interacting to form the world's climate seems virtually infinite, they interact in a highly complex way, the relations between them are often non-linear, and causes and effects are often largely separated both in time and space. Furthermore, complex systems often behave against human intuition (Forrester 1971). Reducing CO_2 emissions by refraining from burning fossil fuels, for example, might in the short run even increase global warming because the cooling effect of the comparatively short-lived aerosols is deteriorating much faster than the warming effect of the longer lasting CO_2 (Andreae et al. 2005).

Sterman and Booth Sweeney (2002, 2007) demonstrated in two experiments that even highly educated students have severe problems in accurately predicting the likely time-delayed reaction of the global temperature to different simple scenarios of development of CO_2 emissions. This is due to feedback loops and the response delay of the climate system. Sterman and Booth Sweeney used three simplified IPCC scenarios: a zero emission scenario, a 400 parts per million scenario stabilizing CO_2 emissions at a higher level in the year 2100, and a 340 parts per million scenario stabilizing CO_2 emissions at a lower level in the year 2100. Then they provided the students with some information about the dynamics of the system and asked how the students expect the global temperature to develop until 2100. Most of the students were totally wrong in their predictions. Sterman and Booth Sweeney

(2002) used a bathtub metaphor to make the observed effects comprehensible: they compare the students' false predictions to the assumption that a bathtub with a larger amount of water flowing in than out will not overflow even if the amount of inflowing water stabilized at a level still exceeding the level of water flowing out. This example demonstrates that even if the number of variables to take into account is limited, humans have severe problems understanding systems that include feedback and time delay. In a comparable experiment, Moxnes and Kerem Saysel (2009) demonstrate that providing participants with easy to understand analogies significantly increases the accuracy of their predictions.

Gardner and Stern (1996) identified another characteristic of climate change that interferes with the usual human trial-and-error learning strategy: climate change has the potential for catastrophic effects for the whole planet; at least some of them seem irreversible. Furthermore, due to the global nature of the climate system, people responsible for developing strategies against climate change in one part of the world usually do not have access to the results of their strategies in other parts of the world. This means that trying to adjust local strategies is most likely not to be successful with climate change.

Taken together, the presented findings suggest that due to a mismatch between human capacity for understanding complex systems and the highly complex characteristics of the climate system, people are in need of developing a simplified understanding of the processes. Often those simplified theories about climate change seem counterproductive. As it seems impossible to make people fully understand the climate system, communication about climate change should much more actively provide people with easy to understand analogies or metaphors. Ungar (2000) argued, for example, that the ozone hole problematic was much better understood by the public compared to climate change, because scientists made use of easy to understand metaphors there from the very beginning.

Forming Individual Knowledge

The next section is closely related to the previous, but aims to present some psychological findings that help to understand how people organize their knowledge about climate change. When psychologists speak about "knowledge", they analyse mental representations people form of objects (real world objects or objects of imagination). These representations store only a selection of information about the objects, and the way this information is stored can be very different. Eysenck and Keane (2000) distinguish between analogical and propositional representations. Analogical representations are considered to be simplified "image-like" representations of the object. They are holistic and linked to a specific sensory experience with the object. In contrast are propositional representations: "language-like" representations that store knowledge in an abstract system of objects and their relations to each other ("a bird sits on a tree"). Objects are discrete, rules about relations between the objects are explicit, and the representation is not connected to a specific

sensory experience. Classical psychological concepts within the propositional way of storing knowledge are schemata (e.g. Bartlett 1932) and scripts (e.g. Abelson 1981). A schema is "a structured cluster of concepts" (Eysenck and Keane 2000, p. 252) that is used by people to form expectations about how the world behaves. It can be considered as an abstract and schematic blueprint of how things work together, about relations in the world, causes and effects, etc. People use their schemata to guide attention, reconstruct their experiences before storing them into memory and recollecting things. Schemata help people to create meaning. A script is a special type of schema storing information about sequences of "stereotypical" actions. On the one hand, knowledge structures such as schemata and scripts help us to structure our everyday life and enable us to deal with the virtually infinite amount of information floating into our system. On the other hand, the nature of those processes leads to the fact that we usually adapt information we get in a new situation to what we already know, or put very simply: it is very hard to see things we do not already expect.

In a survey of climate change experts, journalists, politicians, and laypeople in Sweden, Sundblad et al. (2008) show that general knowledge of the facts about climate change is comparatively high. They presented their participants with a list of 44 statements about the actual status of the world's climate, the causes of climate change and the future consequences (for the weather, the sea and glaciers, and health) and asked if they were true or false. Although all groups performed better than chance (which means that all groups know at least something about climate change), there were differences between the groups: climate change experts had the most correct knowledge (81% correct answers), followed by journalists (75% correct answers), politicians (71% correct answers), and laypeople (67% correct answers). Furthermore, there was a difference between the domains: people in all groups knew most about the causes of climate change, less about the current state of the climate, and least about the future consequences (especially relating to health). In a study of 9–14 year old children in Germany, Klöckner et al. (2009) show that children have some understanding of measures to mitigate climate change and that they especially focus on individual mobility (66.9% of all answers to the open-ended question as to what mankind could do to mitigate climate change focused on mobility). Both studies show that there is a rather high level of abstract knowledge about climate change, however, with some significant blind spots.

However, studies by a number of authors (e.g. Bostrom et al. 1994) demonstrate that people consistently tend to confuse "climate change" and "ozone layer depletion" as being the same, and that people tend to confuse local weather phenomena with climate. Although most of those studies are rather old and some of those misconceptions might have been addressed in the mean time by intensive media coverage about climate change, the results display a typical psychological phenomenon that was introduced at the beginning of this section: people construct their knowledge about something like climate change by integrating new information into their already existing knowledge structures (e.g. schemata). When climate change made it into the headlines, ozone layer depletion had already successfully been communicated and most people had knowledge structures (and easy to

understand analogies!) for this phenomenon. A lot of people therefore just adapted their knowledge structures and integrated climate change in an improper way. Their mental models of how climate change is caused and could be addressed were therefore faulty.

Böhm and Pfister (2001) suggest a multi-level framework of people's mental models about climate change: they assume a five-level causal chain that starts with people's attitudes and goals which motivate specific activities on level two. The activities cause emissions and pollution on level three, which on level four lead to global environmental changes. The last level is the level of long-term consequences for humans. A typical chain of reasoning according to this multi-level framework could be that people's laziness leads to use of cars instead of bicycles; this leads to air pollution, which leads to climate change. Climate change in the end might cause more storms and flooding with implications for humans. In their paper, Böhm and Pfister (2001) summarize some of their studies and report consistent support for their five-level framework. Recently presented and still unpublished data that builds on this five-level framework suggests that people's mental models with respect to climate change seem to be fragmented (Böhm 2009). This means that although some parts of the mental model on some levels are rather elaborate, the mental models have huge gaps and often lack connection between the levels. For example, emissions and pollution (level 3) and global changes (level 4) are often rather unconnected in the mental models.

To conclude this section, it can be stated that the psychological processes of knowledge organization can lead to misconceptions of climate change, its causes, and possible mitigation or adaptation strategies. It is therefore important to analyse what people know about and how they conceptualize climate change.

Emotional Responses to Climate Change and Their Role in Motivating Behaviour

The aspect of emotional responses to events and their importance for motivating people's behaviour is well researched in psychology. Emotional experiences include a combination of physiological reactions, expressions, action tendencies and cognitive appraisals of external stimuli. Parkinson (1994) proposed that cognitive appraisal of external stimuli or situations leads to simultaneous activation of bodily reactions (e.g. increased heart rate), facial expressions (e.g. the display of fear), and action tendencies (e.g. an impulse to take flight). All four aspects together form the emotional experience. Some psychological theories assume that emotion and cognition are separate systems that can work independently (Zajonc 1984); others conceive of cognitive appraisal as an essential part of emotions (Lazarus 1982).

Pfister and Böhm (2008) suggest a theoretical framework that analyses the role of emotions in decision-making and understands emotions as an integrated part of that process. They categorize emotions into four types that have different functions

in decision-making: "reducible emotions", such as joy or disliking, provide the decision-maker with additional information about the decision to make, which is integrated with other information like attitudes. "Affect programmes", such as fear, disgust, or sexual lust, provide people with the possibility to quickly respond to specific stimuli without cognitive consideration. "Complex discrete emotions", such as regret, disappointment, or envy, guide attention to specific characteristics of the decision to make, and thereby shapes the cognitive appraisal. Finally, "moral sentiments", such as guilt, love, or anger, have primarily the function of social coordination and ensuring perseverance against obstacles in enacting the decision. What is appealing about Pfister and Böhm's (2008) approach is that they broaden the view on emotions. The often mentioned emotion-related "fight or flight" impulse is only related to certain types of emotions, the positive-negative dimension is primarily related to another type of emotions, but complex emotions can have totally different functions in the decision-making process. Emotions seem to be multidimensional and multifunctional.

There are some studies that directly link climate change, emotional responses, and people's behaviour. Meijnders et al. (2001) induced fear in one half of the participants of their experiment by showing a short emotional video about climate change. These participants processed given information about energy saving more deeply and developed a more positive attitude to energy saving than participants who were shown an emotionally neutral video providing the same information. Fear therefore seems to motivate the search for adequate behavioural strategies (which means searching for information about what to do). Böhm (2003) analysed people's emotional responses to different environmental risks (among them sea level rise, storms, species extinction that can be understood as climate change-related) and categorized emotions into two main categories: consequence-based emotions such as regret, sadness, fear, or worry are motivated by evaluating anticipated or already occurred consequences. Ethic-based emotions such as disgust, anger, disappointment, guilt, or shame are motivated by violation of ethical principles; whether a consequence eventually occurs or not is not important for ethic-based emotions. Consequence-based emotions and ethic-based emotions should lead to different action impulses: whereas consequence-based emotions should lead to impulses to help, improve the situation, or prevent (further) consequences, should ethic-based emotions target the negative feelings directly by either showing moral behaviour or aggressive tendencies to punish the person responsible for the event. Böhm and Pfister (2000) were able to show that the type of emotional reaction to environmental risks decides the prevalence of specific action tendencies in the expected direction. Klöckner et al. (2009) showed that children, who experience a feeling of guilt (an ethic-based self directed emotion) when confronted with the discussion about climate change, have a higher motivation to engage in everyday pro-climate behaviour than children who react with fear or denial.

Given these results, it is important to analyse whether and how people emotionally react to climate change. Böhm (2003) shows that ethic-based self-directed emotions (which seem to be rather good motivators of generalized pro-climate behaviour because they are not linked to specific consequences) are rather weak

compared to consequence-based emotions. Furthermore, Sundblad et al. (2007) show that compared to cognitive judgements about climate change, affective judgements are less strong. Women, however, had stronger worries about climate change in their study than men, even though they displayed the same cognitive risk judgement. Worry about climate change was greater the more people knew about the causes and consequences of climate change, which underlines the interdependency of knowledge and emotional reactions. In a study, Lorenzoni et al. (2006) analysed what images laypeople in the US and the UK associate with climate change and how their affective reaction to those images was. The differences between the images of climate change in the two countries were astonishing: for people in the US, ice melting, heat, impacts on non-human systems, and ozone were the most salient images; for people in the UK, they were changes in weather, global warming, ozone, and changing climate (which is just a rewording of climate change). The affective connotation of those images was considerably negative but only very few people mentioned personally relevant impacts, causes, and solutions to climate change. Most of the people reacted affectively on a very abstract level.

Interpreting the results together it seems that emotions may have a central role in motivating especially persistent pro-climate behaviour. Unfortunately, most people react either weakly to climate change or with types of emotions that do not lead to individual changes in behaviour. This might be explained by the way people perceive individual risk related to climate change (see next section) and that most experiences of climate change are indirect, which makes emotions less salient (Weber 2006).

The Perception of Individual Risk Related to Climate Change

How people perceive a large variety of risks is also a well researched area of psychology. Usually, the risk that experts calculate from objective numbers has little to do with people's individual risk perception (although there is a correlation between real and perceived risk). One of the most prominent approaches to explain deviations between objective and perceived risk is the so-called psychometric model (Fischhoff et al. 1978). The model proposes that perceived risk of a hazard is dependent on the evaluation of certain characteristics the risk has: something that is new or unknown is usually evaluated as risky; something that has the potential for dreadful outcomes is evaluated as riskier (even if the probability of such a dreadful event is very low); something that people volunteer to do is usually perceived to be less risky, etc. The dimensions Fischhoff et al. (1978) suggest can be reduced to three basic underlying dimensions: new vs. old, dread, and number of people exposed. Sjöberg (1996, as cited in Sjöberg 2000) demonstrated the need to extend the psychometric model by at least one factor that could be called unnatural and immoral risk. This last factor including aspects such as "tampering with nature", "violating moral principles", etc. could be especially important for people's perception of climate change as a risk. Unrealistic optimism is another phenomenon in

risk perception: especially for risks that people perceive to have some control over (e.g. consuming alcohol, smoking, or sun tanning), they estimate the general risk for the public to be much higher than the personal risk (Sjöberg 1994, as cited in Sjöberg 2000). People tend to have the illusion of invulnerability. Sjöberg (2000) furthermore demonstrates that risk perception is also influenced by the attitude towards the risk object (which means that people who, for example, have a positive attitude towards nuclear power also consider it less risky), the general risk sensitivity of a person (some people perceive risks generally higher than other people – irrespective of the risk object), and a specific sensitivity to certain types of risks (e.g. everything that includes the risk to be radiated).

Leiserowitz (2006) showed that Americans have a moderate perception of the risks related to climate change. Furthermore, the participants expressed most concern for "people all over the world" (50% selected this as their primary concern related to climate change) and "non-human nature" (18% named this as a primary concern). Only 12% related the primary concern about climate change to themselves and their families. This shows that [unlike in the study by Sjöberg (1996, as cited in Sjöberg 2000)], climate change-related risk displays signs of optimistic bias (climate change will affect other people, not me). How high risks of climate change were estimated was predicted by how strong the affective reaction to climate change was, if people neglected climate change and/or human contribution to it, and if people had egalitarian values. Furthermore, females and members of environmental organizations gave higher risk ratings even if the other factors were controlled. A cross-country comparison showed that compared to "environment and health", "exploitation of natural resources", and "generation of waste", climate change generated the least extreme worries concerning future developments (EOS Gallup Europe 2002, as cited in Lorenzoni and Pidgeon 2006). However, there was a large variation in estimates between European countries.

McDaniels et al. (1997) analysed people's overall ratings of riskiness of several environmental influences on water environments based on the psychometric paradigm. Interestingly, climate change was rated as carrying the highest risk of having an ecological impact of all analysed aspects. At the same time, it was among the aspects which were judged most uncontrollable and least understood. In a study by Poortinga and Pidgeon (2003, as cited in Lorenzoni and Pidgeon 2006) climate change was rated moderate on the dimensions: dread, well-informed, and unfair distribution of risks. It was rated rather low on the control: any risks to the individual. A rather high rating was achieved for moral concerns, and the highest ratings for unknown consequences and risks to future generations.

Bord et al. (2000) analysed how risk perception and correct understanding of the causes of climate change predict willingness to engage in pro-climate action. Their analysis showed that people are more motivated if they have a correct understanding of the causes (in contrast to false assumptions) and if they consider global warming a societal threat. Pro-environmental values and a correct understanding of the causes of climate change were the most important predictors for supporting governmental initiatives against climate change. Considering climate change a societal threat also contributed to explaining political support.

An interesting question is why laypeople estimate the climate change-related risks to be relatively low in spite of scientists' alarming findings. A bundle of psychological explanations based on risk research might account for that (1) People tend to show an optimistic bias, usually downsizing personal risks compared to risks for others. The effect has been shown for climate change risks (Leiserowitz 2006). (2) The visible signs of climate change are ordinary natural phenomena (melting ice, storms, heavy rainfall, droughts, flooding, etc.). Mankind has thousands of years of experience of such events, which means that climate change might lack the characteristic of "newness" that the psychometric paradigm claims to be one factor determining a high risk evaluation. (3) Although climate change clearly has the potential for dreadful outcomes, there is an extreme degree of uncertainty connected to who, when, and where might suffer from climate change: scientists present highly diverse predictions of climate change effects, and especially on the local level, scenarios are extremely uncertain. Furthermore, changes usually occur slowly (in human dimensions) along decades or even centuries, which makes it hard for people to detect the dreadfulness. As no single weather event (e.g. a single hurricane) can be directly connected to climate change, the more dreadful events can easily be attributed to normal variations in weather. (4) The "tampering with nature" aspect of climate change risk evaluation might still be impaired by the long discussion about human impact on climate change. If climate change is understood as a natural variation in the world's climate (the idea that it has often happened in the history of the world), there is no "tampering with nature", which means risk should be evaluated lower. (5) A specific characteristic of climate change that also might affect people's risk perception is that the scale of climate change is so far removed from the ordinary risks humans usually deal with that people do not have the emotional and/or cognitive capacities to make an adequate risk evaluation. Never before has humankind been faced with a risk on such a global level. We do not have any experience of dealing with such risks and the discrepancy between globality and size of the risk and one's personal resources for dealing with it could hardly be greater. A mismatch between risk perception and coping resources usually leads to denial of a risk or resignation (as stated for example in Protection Motivation Theory, Rogers 1975).

Motivation of Behaviour: The Multi-determination of Behaviour

Environmental psychology has focused in recent years on explaining and changing people's behaviour with respect to the environment. A lot of different behaviours have been targeted, among which some are directly or indirectly related to climate change (e.g. car use, energy use, purchase decisions, voting behaviour, support for climate change policies, etc.). This paper is too short for a comprehensive description of behavioural models that have been developed and successfully tested in this domain. However, in the following section an attempt is made to present two possible models, one for behaviour related to mitigation of climate change, one for adaptive

behaviour. This distinction, although somehow artificial as both mitigation and adaptation are relevant to face the problem of climate change, is characteristic for environmental psychology. Whereas the aspect of mitigation is already well researched and has been in the focus of environmental psychology for decades now, the aspect of adaptation and how to understand people's individual adaptive action has only recently entered the environmental psychological discussion.

Research in other domains of psychology has taught environmental psychologists that behaviour is very seldom determined by a singular cause. Usually, motivation behind people's behaviour is a balance of different, often contradictory individual aspects. Numerous psychological action models emphasizing different aspects in this decision-making process have been developed. Two of the most successful in environmental psychology are the Theory of Planned Behaviour (TPB) proposed by Ajzen (1991) and the Norm-Activation Theory (NAT) (Schwartz 1977). TPB focuses on people's intentions as the main motivation of behaviour and their interaction with perceived behaviour control, which is the feeling of being able to control one's own behaviour. NAT focuses on personal norms (which means feelings of moral obligation) as a main predictor of behaviour.

Klöckner and Blöbaum (2009) recently proposed a more comprehensive model of ecological behaviour that combines Ajzen's and Schwartz's theories and, furthermore, includes assumptions about the influence of routines or habits especially on everyday behaviour (such as energy use at home). This addition traces back to the work of Triandis (1980), who pointed out that behaviour that is performed very often is very unlikely to be under the control of deliberate processes. Finally, Klöckner and Blöbaum (2009) propose to analyse the situational context more thoroughly than the initial theories did. Figure 11.2 displays the Comprehensive Action Determination Model (CADM) as described by Klöckner and Blöbaum (2009).

The model conceives of behaviour to be predicted directly by three different motivational paths (1) What people intend to do has an impact on their behaviour or, in other words, a proportion of people's behaviour is assumed to be under the control of deliberate decision-making processes. Intentions are formed based (among other things, see below) on people's attitudes towards a certain action. An attitude is in turn the sum of all beliefs people carry about the action to be taken. They have assumptions about a number of possible positive or negative outcomes of the action in question and their probability. This links forming an attitude directly to perception of risks (and benefits) as described in the previous section, which means all biases that have been described there also apply to the processes described here. The selection of accessible beliefs may, for example, vary from situation to situation and can be changed by external cues. (2) People's behaviour is also under the control of the objective situational conditions and their subjective perception. If people have no possibility to perform the pro-climate action (there could be, for example, no mode of transport available that saves CO_2 emissions), or if they subjectively perceive their freedom of choice impaired, they will not enact an action even if they intended to do so. Thus, situational influences not only directly predict behaviour, but also moderate the relation between intentions and behaviour. Furthermore, over time, they contribute to reshaping attitudes (beliefs

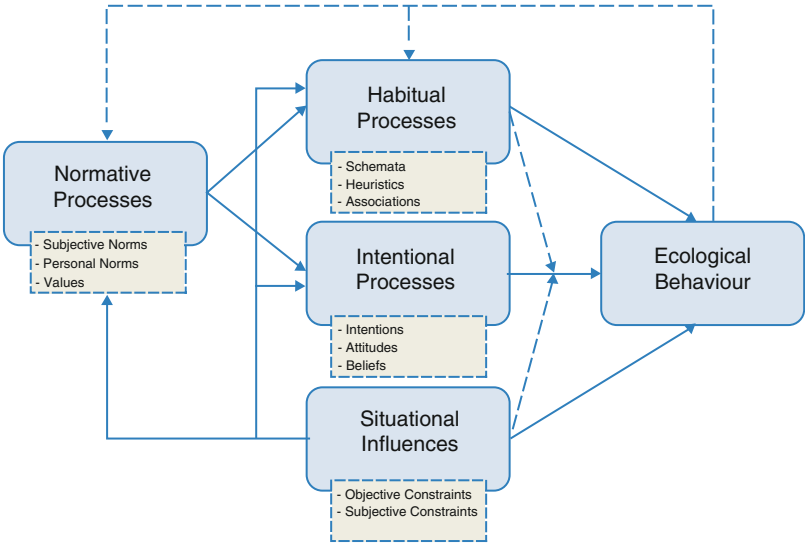

Fig. 11.2 The comprehensive action determination model for ecological behaviour (Klöckner and Blöbaum 2009)

are adjusted to situational conditions). (3) If people perform an action repeatedly, they start building routines and habits that, over time, take control over their actions. This mechanism has been described very often in psychology and serves the purpose of saving cognitive resources for situations that need attention and deliberation (Ouellette and Wood 1998). Usually, transferring control to automatic processes is a highly effective process that serves us well. Problems occur when our habits contradict new intentions (which happens often when people try to change health-related behaviour, but also related to pro-environmental actions). Therefore, habitual processes also have the power to moderate the relation between intentions and behaviour. Furthermore, habits are supposed to be linked to specific situations which connects them to the situational conditions. There are several theories what the cognitive basis of a habit might be, most prominently schemata (see section about knowledge above) and heuristics (simplified decision rules, rules of thumb), which are not discussed any further in this brief introduction.

The CADM finally assumes that normative processes, such as values, subjective norms (which are assumptions about the expectation of relevant other people or – briefly put – social pressure), and personal norms, do not directly influence behaviour but determine intentions together with attitudes. They might also decide about the set of salient beliefs that form the attitude of a person in a given situation. In accordance with the NAT, the CADM assumes that the normative aspects have to be activated in a situation, which means people have to go through a process of norm activation before norms are relevant in decision-making. This process is not described here due to limited space. See Klöckner and Matthies (2009) for a discussion. Because norms and values are stable constructs, a close connection to

habits and routines is assumed. After an action is performed, the evaluation of this action is supposed to feedback on the model constructs, especially those with a relatively high stability over time (normative and habitual processes). The CADM makes no prediction about the relative importance of each of the four aspects in determination of a specific behaviour. This question has to be carefully analysed empirically for a specific behaviour, performed by a specific target group at a specific point in time. So far the model has been successfully applied to travel mode of choice of students (Klöckner and Blöbaum 2009), where situational influences were the strongest predictor of behaviour, and waste recycling by students (Oppedal and Klöckner in preparation), where the influence of habits came out comparatively strong for recycling behaviour that is performed regularly.

The CADM as one example of environmental psychological action models shows that people's decision-making is a complex process, integrating several aspects that might contradict each other. This makes it obvious that developing strategies to change people's behaviour with respect to pro-climate actions makes a thorough analysis of all influencing aspects active in a certain situation necessary. Furthermore, a segmentation of target groups characterized by a specific set of strong predictors of their behaviour (e.g. the "normatively guided" or the "habitualized") seems absolutely necessary for successful intervention planning, an approach that is also proposed by social marketing (e.g. Weinreich 1999).

Less well researched is the understanding of people's individual motivation of adaptive behaviour. Grothmann and Patt (2005) are one of the few that propose a complex model of private proactive adaptation to climate change (e.g. taking precautions against flooding). The core of their model is based on protection motivation theory (Rogers 1975). They assume that people's intention to take adaptive action is predicted both by a high climate change risk appraisal and a high adaptation appraisal. This means people take action if they feel threatened by climate change but also capable of taking effective adaptive actions. Climate change risk appraisal is a combination of perceived severity of personal climate change consequences and perceived probability. Adaptation appraisal is a combination of perceived adaptation efficacy (how effective are the measures), perceived self-efficacy (how capable am I to take the measures), and perceived adaptation costs. If a high risk appraisal is combined with a low adaptation appraisal, the model predicts avoidant maladaptation (fatalism, denial, or wishful thinking). Grothmann and Patt's (2005) model assumes that individual perceptions of the social discourse on climate change influence both risk and adaptation appraisal. Adaptation incentives (e.g. subsidies) can strengthen adaptation intentions (filtered through processes of individual perception), as the objective adaptation capacity is influencing adaptation appraisal also filtered through subjective perception. The objective adaptation capacity might also interfere with translating an adaptation intention into behaviour (as described in the CADM above). Grothmann and Patt (2005) describe, furthermore, three specific processes that influence risk and adaptation appraisal (a) Cognitive biases and heuristics might lead to unrealistic and simplified appraisals (see the section about risk perception). (b) Experience or familiarity with a certain risk (e.g. living on the riverbank for generations and

being used to flooding) might bias risk appraisal. This could lead in both directions, increasing perceived risk and reducing it. An increase in risk appraisal would occur if people have vivid images of the outcomes of a risk factor in mind (as predicted by the availability heuristic). A decreased risk perception would be the result of mental adaptation to a risk over time. (c) Especially with adaptation to climate change, people might rely on public adaptation strategies. If people think that the authorities will take the necessary precautions, the individual risk appraisal is reduced, given people trust the authorities. Unfortunately, the model of private proactive adaptation to climate change has not been thoroughly tested empirically yet.

Comparing the two models, they show some similarities. Both assume that behaviour is determined simultaneously by several aspects and that most of those aspects are subject to individual perception and interpretation. Grothmann and Patt's model focuses more on the risk and adaptation appraisal as a central part; the CADM focuses on the integration of intentional, situational, and habitual processes. The CADM is more general and Grothmann and Patt's model may be integrated. However, both models underline that human behaviour is complex, and simple interventions strategies are likely to fail because people have the strong ability to shape reality according to their perceptions and mental models. Again, the claim can only be to carefully analyse predictors of people's behaviour before strategies are implemented.

Evaluation of Behavioural Outcomes

So far, this paper has described the processes depicted in Fig. 11.1 as a linear process leading from experiences with climate change to action through a series of well-defined steps. Cognition and behaviour, however, are by no means linear, but influence each other vice versa. Bem's (1972) Self-Perception Theory poses that – just as external observers – people infer their motives and attitudes by observing their own behaviour: "If I signed the petition for a pro-climate policy in the city centre, I have to have a positive attitude towards pro-climate acts". In this process, it seems to be rather irrelevant what led to signing the petition in the first place (perhaps it was just social pressure). Although Bem's theory might seem radical at first glance, there are studies that seem to make it likely that people at least sometimes do not go the way from attitudes to actions, but take the trip backwards.

The "foot-in-the-door" intervention technique builds on self-perception theory and works like this: first people are asked for a small favour which is related to the area (e.g. saving energy) but so small that hardly anyone denies it. After people have committed themselves to the first action, they are usually more likely to take another, much more demanding, action related to the first. The assumption is that people observe their own behaviour concerning the small favour and infer a positive attitude towards the behaviour and related behaviours. Katzev and Johnson (1983) used this technique to motivate people to save energy in their homes. They first asked the participants of their study to answer a questionnaire about energy saving.

Then they asked them to commit themselves to saving 10% energy in their homes. Compared to control groups that only answered the questionnaire, only were asked for the commitment to save 10%, or neither of the two, the foot-in-the-door group contained the highest percentage of energy conservers.

Self-perception is, of course, not the only way behaviour feeds back on cognitions. A much simpler assumption is that people analyse the outcomes of their actions and use the verdict if the outcome was satisfactory or not in order to determine whether they will repeat the same action the next time, when they face a similar situation. Once people have encountered a situation and made a decision about how to act, they learn more about the situation, which may change their beliefs, risk perceptions, adaptation appraisals, perceived behavioural control, etc. Although there are processes in human decision-making such as norms, values, or habits that provide for some stability in human action, decision-making is constantly changing because no decision is exactly like the one made before. This makes it even more difficult to understand how people make decisions related to climate change, because static models do not help. Like climate change itself, human behaviour related to climate change is also complex and non-linear.

Direct Versus Mediated Experiences of Climate Change

The final aspect of climate change this paper would like to address is related to the fact that climate change cannot be perceived directly by the individual. Unlike other risks (e.g. car traffic), it is impossible to directly experience the impact of climate change. People may experience weather events such as storms, floods, droughts, etc., but no single event can be clearly linked to climate change, which means the single experiences people have are only with a high degree of uncertainty related to climate change. Weber (2006) proposes that climate change does not concern most of us (yet), because of a lack of direct experience of single events with serious consequences. According to Weber (2006), the emotional reaction to climate change is especially reduced because of climate-related risk perception based on descriptions and not experiences. The section on emotional reactions underlined their importance in motivating behaviour and persevering. Weber (2006) suggests impressive simulations that might at least be a surrogate for a direct experience. Artistic approaches (films, music, paintings, etc.) could be another way to enable people to make direct emotional experiences related to climate change. After the 2004 blockbuster The Day After Tomorrow, studies were conducted on the effect on people who watched the movie, but the results are inconclusive: Leiserowitz (2004) found short-term influences on the viewer's risk perception related to climate change. Balmford et al. (2004) report that British people reported higher levels of concern after the movie, but displayed less understanding of climate change and an unchanged motivation to engage in personal pro-climate activities. Lowe (2006) found in a controlled experiment that viewers of the movie considered climate change to be a more distant threat than people who read information about

climate change, perhaps because of the film posing a threat to people they felt incapable to deal with. It would be interesting to read studies that analysed the effect of Al Gore's more scientific movie An Inconvenient Truth (2006). Generally speaking, it seems that the impact of media on risk perception and ultimately behaviour, however, is smaller than expected (Wahlberg and Sjöberg 2000).

Conclusion

Taking all the presented findings together, psychology has a lot to say about how to design policy that deals successfully with climate change. Firstly, a careful analysis of behaviour is necessary. People's behaviour is related to climate change in many ways: people vote for parties that support more or less extreme climate change strategies; people support lobbyists for climate protection measures or they do not; people make decisions about what types of cars, household equipment, insulation, etc. they want to use; people make decisions about what kind of new technology they adopt; people implement CO_2-saving behaviour into their everyday lives or they do not; people decide where they want to live and how to protect themselves against predicted changes in their local climate. Understanding all these different types of behaviour and influencing them might be the key to successful mitigation and adaptation to climate change. I hope that the preceding sections have displayed how complex people's behaviour is and what psychological mechanisms are that have to be taken into account. I would like to finish this paper with just one suggestion for each section, based on theory and empirical findings about necessary changes in facing and communicating the challenge of climate change.

If we want people to show adequate mitigation of and adaptation to climate change, we have to make sure that the basic principles of climate change are understood. As the climate system is too complex to be fully understood, helpful but still sufficiently correct metaphors are necessary to communicate climate change to laypeople. People's mental models about climate change have to become more integrated; the link between personal behaviour and global processes have to be particularly addressed in the future. Climate scientists should not be afraid to simplify as much as necessary in order to connect to ordinary people's needs. Climate change needs to be experienced more directly and more emotionally by ordinary people. Powerful images, art, simulations, documentaries, or the use of symbolic icons that are emotionally loaded (like the polar bear) might help to achieve this more direct and emotional experience of climate change. Even if a single hurricane is probably not directly connected to climate change, it could become a symbol for a possible future where such events are much more likely. Examples of (possible) climate change effects "in the own backyard" might help decrease the personal irrelevance of climate change compared to the effects on people in other places in the world or non-human nature. The multi-determination of behaviour makes it necessary to identify relevant predictors of the behaviour in question in all important subgroups of people at a given time. Intervention

strategies have to be tailored carefully to the result of this analysis. One intervention package that fits all people at all points in time does not exist. Finally, it is necessary to take people's feedback and experiences seriously. They determine how they organize their future behaviour. It seems that there is a need for much more psychology in the climate change debate.

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