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„(Un)changeable Climate Change – The Influence of Implicit Theories on Construals in Pro-Environmental Behavior“

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Felix Dilger, BSc

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Abstract

Implicit theories of climate change describe the extent to which the course of climate change is perceived as changeable (incremental beliefs) or not (entity beliefs) and substantially affect environmental behaviors. The aim of the present study is to investigate the influence of implicit theories of climate change on level of construal in pro-environmental behavior. Following previous findings, it was hypothesized that incremental beliefs about climate change would lead to greater cognitive flexibility, subsequently enabling more high-level construal in information processing for environmental behavior.

In an experimental design, $N = 317$ participants were manipulated by fictional newspaper articles inducing either incremental or entity beliefs about climate change. Their subsequent changeability assumptions about climate change, as well as their cognitive flexibility were measured through self-reports. Level of construal was assessed through choice-scenarios, in which participants chose between a more eco-friendly and thus desirable option (high-level construal) and a less eco-friendly but more feasible option (low-level construal).

The experimental groups did not show significant differences in changeability beliefs about climate change after the manipulation. No significant influence of implicit theories of climate change on the level of construal was found, and cognitive flexibility did not mediate this effect. Exploratory analysis revealed a significant, positive relationship between incremental beliefs about climate change and a more high-level construal in pro-environmental behavior.

The results, interpreted considering the weak manipulation, partly support previous findings on incremental theories enabling more high-level construal and offer directions for future research on this effect in the context of climate change.

Introduction

Climate change threatens human existence on planet earth. Despite the fact that science has been rigorously and increasingly pointing to this challenge, it has not been possible to conclusively determine the course of climate change (IPCC, 2022). Nevertheless, most consequences of climate changes such as the dramatic increases in water scarcity (Gosling & Arnell, 2016), the drastic extinction of endangered species (Thomas et al., 2004) and the ever larger forest fires (Grünig et al., 2023) are clearly traceable to human behavior (Swim et al., 2011). Consequently, behavioral changes on a broad scale play a decisive role in mitigating climate change and its far-reaching consequences (Bouman et al., 2020; Jakučionytė-Skodienė & Liobikienė, 2021; Kim & Wolinsky-Nahmias, 2014; Wibeck, 2014). In particular, the discrepancy between the threat of climate change and the lack of engagement in environmentally friendly behavior has become the subject of various studies (Gifford, 2011; Semenza et al., 2008; Van Valkengoed & Steg, 2019). Focusing on cognitive, as well as motivational aspects, factors such as the absence of knowledge (Weichselgartner & Kasperson, 2010) or the low individual risk perception (Van Der Linden, 2015) have already been identified as causes for this deficiency, while possible influences of many other of the multifaceted variables influencing human behavior remain much less clear.

For instance, individual beliefs about whether the course of climate change can be changed have only recently become the subject of research (Soliman & Wilson, 2017). These changeability assumptions, which are conceptualized in the implicit theories (Dweck et al., 1995a), have shown to influence decision making and behavior in a variety of contexts (Chiu et al., 1997; Dweck, 1996). Therefore, a deeper understanding of implicit theories of climate change could play an important role in explaining why humans engage in or refrain from environmentally friendly behaviors. A promising, but so far under-studied reference point is the

relationship between implicit theories and the construal level theory, which focuses on information processing, analyzing how humans overcome mental distances (Trope & Liberman, 2010). As different aspects of climate change, such as the fact that most of its consequences will unfold in the future, it is often perceived as very distant (Pahl et al., 2014; Van Lange & Huckelba, 2021). Construal level theory has already been applied to climate change and pro-environmental behaviors in various studies (Gifford, 2011; Reczek et al., 2018; Tang & Chooi, 2022). Nevertheless, the only study to examine the link between implicit theories and the construal level theory was conducted by Bullard, Penner and Main (2019), who found that implicit theories influence the level of abstraction at which information is processed.

Therefore, the present study has two objectives: First, to investigate implicit theories of climate change by examining their influence on level of construal in environmental behaviors; secondly, to evaluate the applicability of Bullard, Penner and Main's (2019) theoretical framework in broader contexts. In the following section, implicit theories, construal level theory and cognitive flexibility as components of this framework are described in more detail. Thereby, the focus is on findings in the fields of climate change and environmental behaviors.

Implicit Theories

Implicit theories describe relatively stable patterns in the perception and evaluation of changeability assumptions (Dweck et al., 1995a). In respect of intelligence, for example, people tend to assume that it is malleable and can be shaped by education, while others assume that intelligence is a rather rigid matter and largely determined by genetics. Regardless of the numerous contexts, be it creativity (Bereczki & Kárpáti, 2018; Sternberg, 1985), emotions (De Castella et al., 2018; King & Dela Rosa, 2019), or body weight (Bruchmann et al., 2022), implicit theories represent a continuum between two opposing and mutually exclusive changeability assumptions: incremental beliefs, which suppose that matters can and possibly do change over

time and entity beliefs, which state that matters hardly and possibly never change (Dweck et al., 1995a). Since implicit theories exist along a spectrum, individuals typically do not hold purely incremental of purely entity beliefs, but they differ in the extent of their beliefs (Dweck et al., 1995a). However, individuals do not view all matters through the same lens, but rather have a plethora of glasses that they wear depending on the context (Dweck et al., 1995b; Hughes, 2015; Schroder et al., 2016). For example, an individual might conceive intelligence as a rigid trait that changes little throughout life, while assuming that body weight is largely self-controlled given the correct decisions about diet and exercise.

Due to this domain specificity of implicit theories, individuals are generally familiar with incremental as well as entity beliefs (Chiu, Hong, et al., 1997). For instance, early evidence shows that ITs about the world are independent of changeability assumptions at the personal level (Chiu, Dweck, et al., 1997; Dweck et al., 1995b). Familiarity with both concepts allows the expression of changeability assumptions, even though implicit theories are considered to be relatively time-stable, to be manipulated in an intentional direction on the continuum (Burnette et al., 2022; Kneeland et al., 2016; Schleider et al., 2020). This effect can also be found in complex contexts: After reading an article highlighting the changeability of social groups, both Israelis and Palestinians had more positive attitudes toward the respective outgroup and were more open to peace negotiations (Halperin et al., 2011; Wohl et al., 2015).

The inter- and intraindividual differences in the perception and evaluation of changeability assumptions described by implicit theories provide explanations for resulting attitudes and behaviors. Social-cognitive theories of motivation, which describe goals as crucial directional guides for behavior, are considered an important basis of implicit theories (Dweck & Leggett, 1988). Based on this, implicit theories form a value system from various context-specific experiences, in which new experiences are processed and upon which the selection of goals is

made (Dweck, 1996). Changeability assumptions therefore shape attitudes and behaviors in a variety of ways, including their effect on motivation (Dweck, 2000; Dweck & Leggett, 1988), performance (Dweck & Leggett, 1988) and the way challenges are approached (Dweck, 2000). For example, individuals with stronger incremental beliefs tend to be less likely to be held back by setbacks (Dweck et al., 1995b), more likely to choose challenging tasks (Dweck, 2000) and more optimistic about their own potential for improvement (Burnette et al., 2013) compared to individuals with stronger entity beliefs.

Implicit Theories of Climate Change

The possibilities of influencing changeability assumptions and thus behavioral intentions make implicit theories an important tool in the fight against climate change (Cuadrado et al., 2022; Soliman & Wilson, 2017). However, while implicit theories about the world have been subject to numerous research (e.g., Chiu et al., 1997; Dweck et al., 1995b), only few scholars directly address changeability assumptions in an environmental context (Cuadrado et al., 2022).

Soliman and Wilson (2017) were the first to examine the relationship between implicit theories and pro-environmental behaviors. Using a survey in which subjects read a text about the devastating magnitude of climate change, they showed that general changeability assumptions about the world significantly influence willingness to engage in pro-environmental behaviors. People who hold stronger incremental beliefs about the world are more likely to engage in environmentally friendly behavior than people who hold rather entity beliefs. Building on these results, Duchi and colleagues (2020) demonstrated that people with stronger incremental beliefs about the world not only have a higher propensity to engage in pro-environmental behaviors, but that this effect can also be demonstrated at a later measurement, indicating a long-lasting behavioral change. Furthermore, the various effects of implicit theories about the world were

evident in the tendency to be more positive about coping with climate change when stronger incremental beliefs predominated.

The only study with experimental design on implicit theories and environmental behavioral intentions was conducted by Cuadrado and colleagues (2022), not referring to implicit theories about the world, but directly to implicit theories of climate change. Using fictional newspaper articles, they manipulated participants either into a more malleable mindset by describing the course of climate change as stoppable or into a more fixed mindset by describing it as unchangeable. Cuadrado and colleagues (2022) were able to demonstrate that implicit theories of climate change can also be altered in an intentional direction. Moreover, their results show that individuals with stronger incremental beliefs about climate change are more likely to report environmentally friendly behavioral intentions compared to individuals with stronger entity beliefs about climate change. Thus, the kind of changeability assumption an individual possesses seems to play an important role in the fight against climate change given the impact on individuals' willingness to engage in environmentally friendly behaviors.

Drawing from these findings, practical implications can be inferred, for example, in terms of crafting effective communication strategies for sustainable hotel offerings that align with the changeability assumptions held by the respective clientele (Septianto et al., 2022). However, delving into the underlying mechanisms of how implicit theories of climate change influence environmentally friendly behaviors could help derive more practical implications and precise interventions. Specifically, the effect of implicit theories on cognitive processes, which significantly shape behavioral decisions in environmental contexts (Yousefpour & Hanewinkel, 2016), remain unclear. Bullard, Penner and Main (2019) provide an initial attempt to address this gap by assessing the link between implicit theories and the construal level theory, which describes the role of mental abstraction in information processing. In three experiments, they

demonstrated that implicit theories decisively influence the level of mental abstraction in which an object is processed, concluding that stronger incremental beliefs lead to a more abstract processing of information.

The Construal Level Theory

The construal level theory by Liberman and Trope (2010) describes different levels of abstraction in information processing to explain how individuals can overcome mental distances. When individuals process information in the form of an object or an event, such as a birthday party, that they do not experience directly, they must overcome mental distances as they inevitably lack parts of sensory information. To fill these gaps and therefore be able to process the birthday party in a senseful way, they automatically create abstract representations, so-called construals, and arrange them on hierarchical levels of abstraction (Trope & Liberman, 2010). For example, when individuals think about their next birthday party, they have clear ideas about which friends they would like to invite, what kind of music their peer group currently likes to listen to, and they know their favorite bar where the party could take place, all situational characteristics of a birthday party. Due to the relative proximity to the event, various subordinate details can be referred to and a concrete and contextualized representation of a birthday party takes place at a low-level construal (Liberman & Trope, 2014; Trope & Liberman, 2010). In contrast, at a greater distance, higher-level aspects are inferred, which are accompanied by an abstract and decontextualized representation at a more high-level construal (Liberman & Trope, 2014; Trope & Liberman, 2010). If individuals were to think about a birthday far in the future, it remains much more unclear which friends will accompany them at that stage of their life, what music they like to listen to, or what bar they would like to go to. Therefore, not only are more gaps of missing information to be filled with abstract construals, but they tend to be filled with rather general characteristics such as that at a birthday party, people usually celebrate together, and

guests hand out presents to the person celebrating. Therefore, one and the same event can be represented at different mental levels of abstraction depending on the perceived mental distance to it (Trope & Liberman, 2010). Moreover, the construal level theory describes a positive relationship between psychological distance and the level of construal in which information are processed. This suggests that the greater the mental distance of an individual to an event or an object is, the more abstract are its construal to process this information.

At which level of construal events are processed and thus perceived depends systematically on the psychological distance between the individual and the object (Trope & Liberman, 2003, 2010). Psychological distance refers not only to temporal distance but describes the distance of an object to an individual on different dimensions. The three other central dimensions of psychological distance include: where something happens (spatial distance), to whom something happens (social distance), and whether something happens at all (hypothetical distance) (Liberman & Trope, 1998; Trope et al., 2007). Therefore, high psychological distance must be overcome when processing events or objects that happen in a distant place, are experienced by unknown or unfamiliar people, or have a low probability of happening at all.

Differences in mental abstraction offer explanations of situational predictions, evaluations, and behaviors (Tang & Chooi, 2022; Trope & Liberman, 2010). When information are processed at a more high-level construal, individuals tend to prefer desirability (e.g., why an action is performed), over feasibility (e.g., how an action is performed; Liberman & Trope, 1998). For example, in a purchase situation in the distant future, individuals tend to focus on the reason for the purchase rather than the actual implementation. When comparing car models under these circumstances, people pay more attention to values and norms associated with the car rather than to focus on more incidental details (Trope & Liberman, 2010). In general, at more high-level construals, information relate stronger to the relevance and the valence of an object (Semin &

Fiedler, 1988). Therefore, changes in aspects of high-level construals tend to result in a greater change in the overall meaning of an object (Trope & Liberman, 2010). Therefore, the construal level theory and its explanatory approaches to behavioral intentions and preferences have great applicability in a variety of different contexts, such as consumer research and more recently also climate change (Adler & Sarstedt, 2021).

The Construal Level Theory and Climate Change

Research on construal level theory and climate change reveals a link between perceived distance to climate change and environmentally friendly behavior intentions: perceiving climate change at a low distance makes it seem more threatening, leading to a more positive attitude toward environmental awareness (Sacchi et al., 2016) and a greater willingness to engage in environmentally friendly behaviors (Wang et al., 2019). In contrast, with greater psychological distance, the willingness to participate in climate change mitigation decreases (Carmi & Kimhi, 2015; Verplanken et al., 2020). Across a variety of samples and settings, studies have shown that many individuals experience climate change and its facets as distant, as its consequences are not visible in their immediate environment and its threatening nature tends to unfold in future (Berger et al., 2019; Brügger et al., 2015; Kollmuss & Agyeman, 2002; Leiserowitz, 2005). Therefore, perceived psychological distance from climate change is considered a key limiting factor in the fight against climate change (Keller et al., 2022; Tang & Chooi, 2022). However, the relationship between psychological distance and climate change seems to be more complicated: studies show that some individuals perceive climate change as close and distant at the same time (Brügger & Pidgeon, 2018; Spence et al., 2012). Moreover, contrary to what one might assume, experiments show that "proximising" climate change does not automatically lead to more engagement in the fight against climate change (Brügger et al., 2016; Shwom et al., 2008; Spence et al., 2012).

The Link between Implicit Theories and the Construal Level Theory

Despite the fact that previous research has identified important links to climate change for both implicit theories and construal level theory, many aspects of these relations remain unclear. As findings for some of these links are contrary to others, practical implementations are hard to derive. Therefore, a better understanding of how changeability assumptions influence critical parts of information processing could be helpful for both fields of research. The first and only study that investigated the relationship between implicit theories and the construal level theory was conducted by Bullard, Penner and, Main (2019). Searching for initial evidence on this relationship, they were able to demonstrate that stronger incremental beliefs of personality lead to a more high-level construal of information. In two follow-up studies, they succeeded in confirming this finding in an experimental setting, when participants' changeability assumptions about personality were manipulated by reading a short text. The assessment of the level of construal was operationalized by asking participants to evaluate a product and to choose between two hotel room options, highlighting the researchers focus on consumption decisions. Furthermore, the two studies identified cognitive flexibility as a crucial factor in the influence of changeability assumptions on information processing.

Cognitive Flexibility

Cognitive flexibility describes the readiness to alter mental concepts based on incoming information from the environment (Scott, 1962). The degree of cognitive flexibility of an individual depends, among other things, on their adaptability to the environment: Individuals who are less rigid in character and behaviors show higher cognitive flexibility (Martin & Rubin, 1995). Furthermore, people holding stronger incremental beliefs show similarities in information processing to individuals with high cognitive flexibility and tend to have less problems adjusting their attitudes based on new information when compared to individuals who hold stronger entity beliefs (Erdley & Dweck, 1993).

On the other hand, cognitive flexibility is needed to successfully process information and therefore relates to the construal level theory. Individuals with high cognitive flexibility find it easier to create mental representations from situational cues, to constantly update these representations with incoming information, and ultimately select the representation that is most plausible (Liberman et al., 2002).

The Hypothesis of the Present Study

Different studies provide links between implicit theories (e.g., Cuadrado et al., 2022; Soliman & Wilson, 2017) as well as construal level theory (e.g., Sacchi et al., 2016; Wang et al., 2019) and climate change. Bullard, Penner and Main (2019) showed that incremental beliefs about personality lead to higher cognitive flexibility, which in turn enables information processing in a consumption context at a more high-level construal. Based on Bullard, Penner and Mains (2019) findings and applied to changeability assumptions about climate change and information processing of environmental behavior, I therefore assume that

H1) An incremental theory (vs. an entity theory) regarding climate change leads to a more high-level construal (vs. low-level construal) of environmental behavior.

H2) Cognitive flexibility mediates the effect of implicit theories of climate change on the perceived level of construal in environmental behavior.

To test the hypotheses, a between-subjects design study with two conditions was set up. The conditions differed between stronger incremental beliefs, (e.g., the course of climate change is changeable) and stronger entity beliefs (e.g., the course of climate change is barely changeable). Methods used by Bullard, Penner and Main (2019) were adapted to the environmental context of this study to measure implicit theories of climate change, cognitive flexibility, and level of construal.

Method

This study was approved by the Instiutional Review Board of the Department of Work, Economy, and Social Psychology of the University of Vienna (approval code 2022/S/007). For preregistration, a detailed plan of the experiment was uploaded before data collection to the AsPredicted website on 17.03.2022 (available at https://aspredicted.org/3DW_L22).

Sample

The required sample size to test the hypotheses was calculated using G*Power 3.1 (Faul et al., 2009). In line with the results of Bullard, Penner & Main (2019), Soliman & Wilson (2017), and other comparable literature (e.g., Duchi et al., 2020), a medium effect size of $d = .3$ was assumed. With a type 1 error probability of $\alpha = .05$ and a power of ß = .8, this results in a required sample size of $n = 278$ participants.

A total of 506 participants started the study. Of these, 143 subjects were excluded because they did not complete the study, 4 indicated that they did not carefully process the study, and 42 subjects did not pass an attention check. Therefore, for further analyses, data from 317 participants (*M* age = 35.56, *SD* age = 17; 63.4% female; 1.2% diverse) were included. 82 participants were recruited from the University of Vienna, consisting mainly of undergraduate psychology students, whose participation in the laboratory of the University of Vienna was compensated with 2 course credits. Since the required number of participants could not be reached via the pool of the University of Vienna, additional data of 235 participants was recruited on different social-media websites such as Facebook and collected online.

Procedure

The experiment was created using Qualtrics (https://www.qualtrics.com/) and conducted on a computer. Participants who were not tested in a laboratory at the University of Vienna were asked to perform the study on a computer or laptop for optimal feasibility. Allocation to the

control or experimental group was randomized. The entire experiment lasted approximately 10 to 15 minutes.

Prior to the experiment, participants were informed about the brief procedure and their rights during participation and informed consent was obtained (see Appendix B). To start, participants read a short excerpt from a fictitious newspaper article, which was the only part in the procedure that differed between the two conditions. After a minimum reading time of 60 seconds, participants were able to answer a short attention check consisting of three items with simple content questions about the text they had read. To strengthen the experimental manipulation, they were asked to think of and describe a situation from their life in which they had experienced an event that was consistent with the article (e.g., a discussion they had about greenhouse gas emissions with friends). In addition, they were asked to express the feelings and thoughts that emerged during this situation. Subsequently, they answered the scale to measure implicit theories of climate change. After filling out the questionnaire to measure their cognitive flexibility, their perceived level of construal was assessed by two choice scenarios. Finally, participants provided demographic information, answered a seriousness check, and were informed about the study and its aims through a debriefing (see Appendix C).

Materials and Measurements

Implicit Theories of Climate Change

As an experimental manipulation, participants read a fictious newspaper article in which a researcher comments on the course of climate change. In the first condition, reference was made to the power of individuals to influence the course of climate change through their actions (see Appendix D). Thus, this group was manipulated toward stronger incremental beliefs about the course of climate change. In contrast, the content of the article in the second condition promoted stronger entity beliefs and stated that the course of climate change can hardly be changed at the

individual level as the influence of political and economic interest groups is too powerful and effective (see Appendix E).

As a manipulation check, Bullard, Penner and Main (2019) did not examine changeability assumptions in the context of climate change but used a scale to measure implicit theories of personality. Therefore, this study employed a scale by Chiu et al. (1997), which was used by Soliman and Wilson (2017) as well as Duchi et al. (2020). However, since the scale by Chiu et al. (1997) does not measure implicit theories of climate change, but rather of the world in general (e.g., “Our world has its basic or ingrained dispositions, and you really can't do much to change them.”), all three items were modified to focus on climate change (e.g., "Climate change has its basic or ingrained dispositions, and you really can't do much to change them.") and then translated into German. Participants were asked to rate the exemplary item above as well as the items “Though we can change some phenomena, it is unlikely that we can alter the core dispositions of the climate change.” and “Some weather trends may dominate for a while but the fundamental nature of climate change is something that cannot be changed much.” on a six-point Likert scales anchored by 1 (*strongly disagree*) to 6 (*totally agree*). Higher scores indicate stronger entity beliefs about climate change. A mean rating of the three items was calculated for further analysis. The scale showed good internal consistency ($\alpha = .81$).

Cognitive Flexibility

Bullard, Penner and Main used a questionnaire consisting of 12 items by Martin and Rubin (1995) and one consisting of 20 items by Dennis and Vander Wal (2010) to assess cognitive flexibility. In order to keep this study as concise as possible, the Cognitive Flexibility Scale (Martin & Rubin, 1995) was used. All 12 items such as "I can find workable solutions for my problems." were translated into German and scored on a 7-point Likert scales anchored by 1 (*strongly disagree*) to 7 (*totally agree*). An overall cognitive flexibility score was computed by

calculating the mean rating of all items, with a higher score corresponding to higher cognitive flexibility. The scale showed good internal consistency ($\alpha = .8$).

Level of Construal

Following Bullard, Penner and Main (2019), to measure the level of construal, subjects were given two choice scenarios in each of which they were asked to choose between two options. This method was also used by Bullard, Penner and Main (2019). The basis of this approach is abstract thinkers' preference for desirability, while concrete thinkers prefer feasibility (Liberman & Trope, 1998). Adapted to the environmental context of this study, participants had to choose between two waste separation systems in the first and between two coffee cups in the second scenario. In each case, participants could choose between an option A that was eco-friendly, but less convenient and thus highly desirable (e.g., “You use a reusable coffee cup with a very good eco-balance, but in return you have to pay a 2 euro deposit and return the cup to the same coffee shop.”) and a second option B that was convenient, but less eco-friendly and thus highly feasible (e.g., “You use a single-use cup with a poor eco-balance, but it doesn’t cost you anything extra and can be disposed of everywhere.”; see Appendix F). Preference was measured with a scroll bar on Likert scales from 0 (*strongly prefer option A*) to 10 (*strongly prefer option B*). The mean was taken from the two decisions, with a higher value corresponding to a more high-level construal and thus more abstract information processing. A significant positive correlation between the two choice-scenarios indicates that they measure the same construct ($r = .33$, $p = .001$).

Data Analysis

All statistical analyses were performed using IBM SPSS Statistics (Version 29). PROCESS (Version 4.2) for SPSS Statistics was used to calculate the mediation analysis (Hayes, 2017). The level of significance for all statistical analyses was set at $\alpha = .05$.

Results

Manipulation Check

To test whether the manipulation by the fictional newspaper article led to differences in change assumptions about climate change, an independent samples t-test was calculated with condition as the independent variable and implicit theories of climate change as the dependent variable. The results show no significant difference in change assumptions about the climate change between the experimental group manipulated towards stronger entity beliefs (M = 2.08, SD = 0.94) and the experimental group manipulated towards stronger incremental beliefs (M = 2.24, SD = 1.04; t[315] = 1.43; p(one-tailed) = .077; d = 0.16).

Main effect

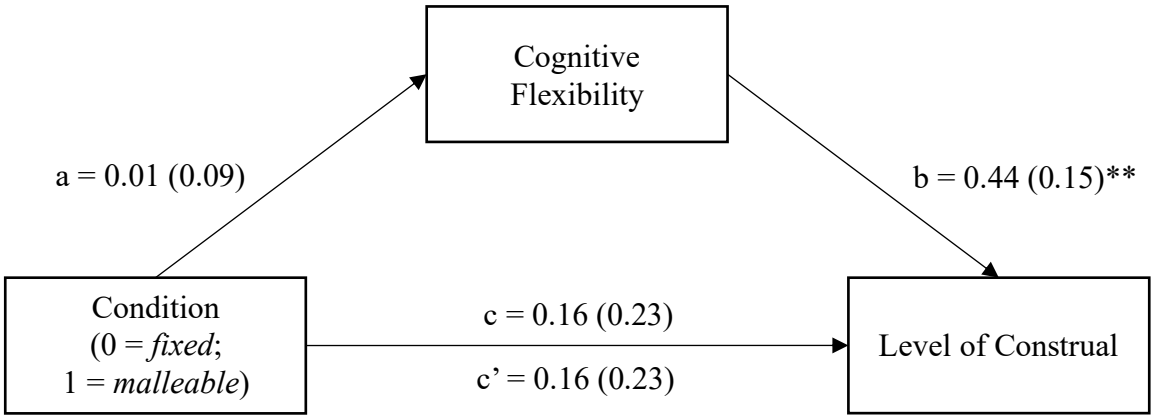
A t-test for independent samples was calculated with condition as the independent variable and the mean value for level of construal as the dependent variable to test whether a malleable mindset regarding climate change leads to a more high-level construal of environmental behavior. The study found that there is no statistically significant difference in level of construal of environmental behavior between individuals manipulated toward entity beliefs (M = 7.60, SD = 2.09) and individuals manipulated toward incremental beliefs (M = 7.76, SD = 2.03; t[315] = 0.70; p (one-tailed) = .244; d = 0.08).

Mediation

To test the underlying mechanism involved in the relationship between implicit theories of climate change and level of construal, a simple mediation analysis (see Figure 1) was performed in PROCESS (model 4; 5000 bootstraps) with condition as the independent variable, level of construal as the independent variable and cognitive flexibility as the mediator.
The analysis revealed no significant indirect effect of the manipulation on changeability assumptions about the climate change via cognitive flexibility (b = 0.05, SE = 0.04, 95% CI = [-

Figure 1

Results of the mediation analysis with implicit theories of climate change as the independent variable, level of construal as the independent variable and cognitive flexibility as the mediator



Note. Regression coefficients are indicated and standard errors are depicted in brackets.

** $p < .01$

0.07, 0.09]). The total effect of the manipulation (b = 0.16, SE = 0.23, t[314] = 0.69, p = .488, 95% CI = [-0.29, 0.61]) remained not significant after entering cognitive flexibility as a mediator to the model (b = 0.16, SE = 0.23, t[312] = 0.68, p = .497, 95% CI = [-0.29, 0.61]).

Exploratory Analysis

A correlation table including all central variables revealed a significant correlation between level of construal and implicit theories of climate change for both experimental groups (see Table 1). To investigate and estimate the relationship between implicit theories of climate change and level of construal, a simple linear regression with implicit theories of climate change as the predictor and level of construal as the outcome variable was calculated. The results showed that there is a highly significant relationship between implicit theories of climate change and level of construal (β = -.23, SE = .11, t(315) = 4.03, p = .001). The proportion of variance explained by the regression model was r^2 = .05.

Table 1

Descriptive Statistics and Correlations for Study Variables

Variable	*n*	*M*	*SD*	1	2	3	4
1. ITCC[a] - Incremental Group	160	2.24	0.94	-			
2. ITCC[a] - Entity Group	157	2.08	1.04	-	-		
3. Cognitive Flexibility	317	5.23	0.76	-.16*	-.17*	-	
4. Level of Construal	317	7.67	2.06	-.23**	-.23**	.16*	-
5. Age	315	35.56	17.00	.05	-.07	.14*	.07

[a] ITCC = Implicit theories of climate change. Higher values correspond to stronger entity beliefs about climate change.

* $p < .05$; ** $p < .01$

Discussion

The present study set out to investigate the influence of implicit theories of climate change on level of construal in environmental behavior. The manipulation of implicit theories of climate change did not result in different changeability assumptions between the two experimental groups. No influence of implicit theories of climate change on level of construal in environmental behavior was found and a following mediation analysis based on the theoretical framework of Bullard, Penner and Main (2019) including cognitive flexibility as a mediator of this potential

effect did not show significant results. However, an exploratory correlation analysis revealed a significant relationship between implicit theories of climate change and level of construal in environmental behavior.

Manipulation of Implicit Theories of Climate Change

Reading the fictional newspaper article did not result in different changeability assumptions about climate change between the two experimental groups. There are two possible reasons for this. First, one may point to possible limitations in the measurement of implicit theories of climate change. Implicit theories of climate change were assessed using a three-item scale by Chiu et al. (1997), which has already been used successfully in comparable studies that investigated this topic (e.g., Soliman & Wilson, 2017). However, to fit the German-speaking sample the scale was translated into German and items were slightly adapted to the environmental context rather than referring to the world in general. It is possible that these adaptions affected the validity of the scale, such that a systematic manipulation by the article occurred, but changeability assumptions about climate change could not be assessed by the implicit theories of climate change measurement as intended. The use of the original scale by Chiu et al. (1997) or a different measurement, such as the more extensive scale by Cuadrado et al. (2022), which items address not only incremental, but also entity beliefs, could remedy this in future studies.

Secondly, the measurement of implicit theories of climate change might have been successful, but the manipulation itself might not have been powerful enough to induce a difference in changeability assumptions between the experimental groups. Considering the mean values, the belief that climate change is dynamic and changeable dominated across both experimental groups. Even though there was no significant difference between the experimental groups, the group that was manipulated toward stronger entity beliefs, tended to show stronger

incremental beliefs compared to the group that was manipulated toward stronger incremental beliefs, suggesting an inverse tendency compared to the expectations of this study. Reactance to the statements that were read by the entity group, indicating that individual efforts were of little effectiveness in mitigating climate change, may be one reason for this effect. However, the changeability of implicit theories has already been demonstrated in diverse contexts, including those with environmental content (e.g., Duchi et al., 2022). For successful manipulation, newspaper articles were frequently used in this context, making them a valid tool to manipulate changeability assumptions in experimental settings. Revised content, a more authentic presentation of the newspaper article, as well as the inclusion of photos could help to induce a stronger manipulation.

The Influence of Implicit Theories about Climate Change on Level of Construal

No influence of implicit theories about climate change on the level of construal was found. However, this result must be interpreted with caution and does neither contradict nor reinforce previous findings. Given the fact that it was not possible to induce - or provide evidence for - substantially different changeability assumptions between the two experimental groups, a potentially significant influence of implicit theories about climate change on level of construal could not be detected by a t-test. Thus, no reliable interpretation can be derived from this result. However, the highly significant correlation between implicit theories of climate change and level of construal, independent of experimental condition, points to a relationship between the two constructs, even if this relationship cannot be found to be causal given the current design. A simple linear regression revealed a negative correlation between implicit theories of climate change and level of construal, suggesting that strong incremental beliefs about climate change is related to more low-level construal of environmental behavior. However, the model explained only a small proportion of variance according to Cohen (1988). Thus, the results, which again

must be interpreted with caution, at least tend to follow the findings by Bullard, Penner and Main (2019) on the relationship between implicit theories and level of construal.

The Role of Cognitive Flexibility

Through a mediation analysis, the influence of cognitive flexibility on the relationship between implicit theories and the level of construal found by Bullard, Penner and Main (2019) was examined. Again, it should be noted that due to the possible deficiencies in the manipulation, the results of the mediation analysis with condition as the independent variable must be treated with caution. The mediation analysis showed no significant influence of changeability assumptions about climate change on the level of construal, neither when cognitive flexibility was included as a mediator, nor when it was excluded from the model. However, the model revealed that cognitive flexibility predicts level of construal positively, which means that high cognitive flexibility is linked to a more high-level construal of information. This result is in line with the findings from Bullard, Penner & Main (2019) as well as the findings from Liberman and colleagues (2002).

Limitations

In the previous sections, limitations in the interpretability of the results due to the manipulation and measurement of implicit theories of climate change have already been discussed. The measurement of the other two central variables, cognitive flexibility and level of construal, as well as possible limitations in their interpretability will therefore be discussed in the following.

Cognitive flexibility was measured by the Cognitive Flexibility Scale (Martin & Rubin, 1995), following the approach of Bullard, Penner and Main (2019). Like other questionnaires, the Cognitive Flexibility Scale is a self-report measurement, considered to be easy to administer as well as highly economically and therefore widely used in experimental settings (Johnco et al.,

2014). However, since self-report measurements are dependent on the respondents' own perceptions and truthfulness, report biases can occur, in particular, in the form of socially desirable response behavior (Howlett et al., 2021). In addition, cognitive flexibility as an abstract skill is difficult to separate from other parts of executive function when measured by a small number of items. Consequently, data on cognitive flexibility collected neuropsychologically (e.g., by the Wisconsin Card Sorting Test) often show substantially different results compared to self-report measurements (Howlett et al., 2021). This is a problem that has been documented in other domains of executive functions as well (Burmester et al., 2016). Note however, that this does not imply that data from self-report measurements such as in this study is erroneous. On the contrary, it rather highlights the need for a clear and precise definition of cognitive flexibility when interpreting results, especially when these are compared to results from other studies.

Moreover, despite its frequent use, applying construal level theory in the context of climate change often leads to limitations with regard to the interpretability of the results (Keller et al., 2022). While psychological distance plays a central role in construal level theory and effects of different psychological distances on attitudes towards climate change and willingness to engage in environmentally friendly behavior have been documented in various studies (Adler & Sarstedt, 2021), construal level theory does not always seem to be the appropriate theoretical framework for psychological distance in the context of climate change research. Recent meta-analyses and reviews show that the understanding of psychological distance varies significantly between studies on climate change, often deviating from the understanding of psychological distance in construal level theory (Keller et al., 2022; Maiella et al., 2020; Wang et al., 2021). In particular, the transient nature of psychological distance (Trope & Liberman, 2010) is often not adequately conceptualized in experiments, as psychological distance tends to be treated as a stable belief. In the present study, following the methods used by Bullard, Penner and Main

(2019), psychological distance was not varied, such that it may be argued that psychological distance loses parts of its transient character (Brügger, 2020). Therefore, if more precise predictions about the relationship of implicit theories and the construal level theory, as well as psychological distance on environmental behaviors were to be made, models other than construal level theory, such as risk perception models or a mental model approach, should be considered (Brügger, 2020).

Further Considerations and Future Research

In addition to the limitations and corresponding suggestions for improvement adhered to above, the study's results highlight promising avenues for future research. The theoretical framework of Bullard, Penner and Main (2019), which describes an influence of changeability assumptions on the level of information construal through cognitive flexibility, seems to be transferable to contexts outside of consumer research. However, the results of this study must be interpreted with caution since no manipulation of changeability assumptions in the conditions could be shown and therefore the results of the planned analysis were not adequately interpretable. Nevertheless, trends confirming the considerations and connections between the theoretical constructs in the field of climate change research could be found in this study, despite the fact that causality was not found.

To gain a better understanding of the relationships in the theoretical framework, basic considerations should be made to increase its informative value. A promising approach could be to focus on the strong relationship between cognitive flexibility and level of construal, measuring cognitive flexibility through multiple questionnaires and behavioral instruments, such as those employed in the present study or neuropsychological testing procedures, to investigate convergence of results. On the one hand, it may be useful to rely on a comparable design and methods such as Bullard, Penner and Main (2019) to ensure high comparability of data. On the

other hand, future studies should consider potentially necessary modifications to the frameworks, in particular with regard to the applied context. In the context of climate change, precise consideration should be given to the extent to which the construal level theory serves as an appropriate framework for discussing effects of psychological distance.

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Appendix

A. Abstract

Implicit theories of climate change describe the extent to which the course of climate change is perceived as changeable (incremental beliefs) or not (entity beliefs) and substantially affect environmental behaviors. The aim of the present study is to investigate the influence of implicit theories of climate change on level of construal in pro-environmental behavior. Following previous findings, it was hypothesized that incremental beliefs about climate change would lead to greater cognitive flexibility, subsequently enabling more high-level construal in information processing for environmental behavior.

In an experimental design, $N = 317$ participants were manipulated by fictional newspaper articles inducing either incremental or entity beliefs about climate change. Their subsequent changeability assumptions about climate change, as well as their cognitive flexibility were measured through self-reports. Level of construal was assessed through choice-scenarios, in which participants chose between a more eco-friendly and thus desirable option (high-level construal) and a less eco-friendly but more feasible option (low-level construal).

The experimental groups did not show significant differences in changeability beliefs about climate change after the manipulation. No significant influence of implicit theories of climate change on the level of construal was found, and cognitive flexibility did not mediate this effect. Exploratory analysis revealed a significant, positive relationship between incremental beliefs about climate change and a more high-level construal in pro-environmental behavior.

The results, interpreted considering the weak manipulation, partly support previous findings on incremental theories enabling more high-level construal and offer directions for future research on this effect in the context of climate change.

Zusammenfassung

Implizite Theorien über den Klimawandel beschreiben das Ausmaß, in dem der Verlauf des Klimawandels als veränderlich (inkrementelle Überzeugungen) oder rigide (entitätsbezogene Überzeugungen) wahrgenommen wird und beeinflussen Umweltverhalten wesentlich. Ziel dieser Studie ist es, den Einfluss impliziter Theorien über den Klimawandel auf das Abstraktionsniveau von umweltfreundlichem Verhalten zu untersuchen. Aufbauend auf vorherigen Erkenntnissen wurde die Hypothese aufgestellt, dass inkrementelle Überzeugungen hinsichtlich des Klimawandels zu größerer kognitiver Flexibilität führen würden, was anschließend eine abstraktere Betrachtungsebene im Informationsverarbeitungsprozess bei umweltfreundlichem Verhalten ermöglicht.

In einem experimentellen Design wurden $N = 317$ Teilnehmende mittels fiktiver Zeitungsartikel manipuliert, die entweder inkrementelle oder entitätsbezogene Überzeugungen hinsichtlich des Klimawandels induzierten. Anschließende Annahmen zur Veränderbarkeit des Klimawandels sowie kognitive Flexibilität wurden mittels Selbstbeurteilung erfasst. Das Abstraktionsniveau wurde mittels Wahl-Szenarien bewertet, in denen die Teilnehmenden zwischen einer umweltfreundlicheren und somit wünschenswerteren Option (hohes Abstraktionsniveau) und einer weniger umweltfreundlichen, dafür praktikableren Option (niedriges Abstraktionsniveau) wählten.

Die experimentellen Gruppen zeigten nach der Manipulation keine signifikanten Unterschiede hinsichtlich ihrer Überzeugungen zur Veränderbarkeit des Klimawandels. Es wurde kein signifikanter Einfluss impliziter Theorien des Klimawandels auf das Abstraktionsniveau festgestellt, und kognitive Flexibilität fungierte bei diesem Effekt nicht als Mediator. Explorative Analysen zeigten eine signifikante, positive Beziehung zwischen inkrementellen Überzeugungen

hinsichtlich des Klimawandels und einer höheren Abstraktionsniveau von umweltfreundlichem Verhalten.

Die Ergebnisse, unter Berücksichtigung der schwachen Manipulation interpretiert, unterstützen teilweise vorherige Erkenntnisse zu inkrementellen Überzeugungen, die eine abstraktere Betrachtungsebene ermöglichen, und weisen auf zukünftige Forschungsrichtungen hin, die diesen Effekt im Kontext des Klimawandels beleuchten könnten.

B. Participant Information and Informed Consent

Liebe:r Teilnehmer:in,

herzlichen Dank für Ihre Bereitschaft, an dieser Studie des Instituts für Arbeits-, Wirtschafts- und Sozialpsychologie der Universität Wien teilzunehmen.

Im Rahmen dieser Studie beschäftigen wir uns mit dem Klimawandel und Verhalten im Umweltkontext. In einem ersten Teil wird es Ihre Aufgabe sein, einen Text zu lesen und dazu Fragen zu beantworten. Anschließend füllen Sie einen Fragebogen aus und bekommen Szenarien vorgestellt, bei denen Sie sich zwischen zwei Optionen entscheiden sollen.

Die Studie wird ungefähr 10 Minuten dauern.

Bei Fragen wenden Sie sich bitte an a12032134@univie.ac.at (Felix Dilger).

Einverständniserklärung

Die Studie dient ausschließlich wissenschaftlichen Zwecken. Die Befragung wird vom Institut für Arbeits-, Wirtschafts- und Sozialpsychologie der Universität Wien durchgeführt. Ihre Studienergebnisse werden streng vertraulich behandelt. Die Daten der Studien werden zu jedem Zeitpunkt vollständig anonymisiert. Die Ergebnisse und Daten dieser Studie werden unter Umständen veröffentlicht. Dies geschieht in anonymisierter Form, d.h., ohne, dass die Daten einer spezifischen Person zugeordnet werden können. Anonyme und anonymisierte Daten unterliegen nicht dem Datenschutz.

Die Teilnahme an der Studie ist freiwillig und mit keinen bekannten Risiken verbunden. Sie können die Teilnahme an dieser Untersuchung zu jedem Zeitpunkt ohne Angaben von Gründen abbrechen. Daraus ergeben sich keine Nachteile für Sie. Eine Löschung Ihrer Antworten zu einem späteren Zeitpunkt ist nicht möglich.

Ich habe die oben genannten Informationen gelesen und verstanden und erkläre mich mit den Teilnahmebedingungen einverstanden.

C. Debriefing

Sie haben das Ende der Studie erreicht. Vielen Dank für Ihre Teilnahme!

Ziel dieser Studie ist es zu untersuchen, inwiefern es einen Zusammenhang zwischen Veränderbarkeitsannahmen über den Klimawandel und der Verarbeitung von Informationen über umweltfreundliches Verhalten gibt.

Nicht alle Teilnehmenden haben dieselben Informationen wie Sie erhalten. Sie haben zufällig einen von zwei gegensätzlichen Texten zu lesen bekommen. Ein Artikel vermittelt die Information, dass die Entwicklung des Klimawandels (vor allem auf individueller Ebene) kaum veränderbar ist, wohingegen der zweite Artikel die Entwicklung des Klimawandels als etwas Veränderliches, vor allem durch Verhalten auf individueller Ebene, darstellt. Die in der Studie beschriebene Forscherin sowie ihre Rede sind dabei frei erfunden.

Unsere Hypothesen waren es, dass die Annahme, dass der Lauf des Klimawandels beeinflusst werden kann, zu einer komplexeren Verarbeitung von Informationen über umweltfreundliches Verhalten führt. Zudem gehen wir davon aus, dass bei diesem Zusammenhang kognitive Flexibilität als Mediator fungiert. Die Annahme, dass der Lauf des Klimawandels verändert werden kann, führt zu einer höheren kognitiven Flexibilität, die dann zu einer komplexeren Verarbeitung von Informationen führt.

Wir danken Ihnen für Ihre Teilnahme an dieser Studie. Mit Ihrer Teilnahme haben Sie einen wichtigen Beitrag zu unserer Forschung geleistet.

D. Fictional Newspaper Article to Manipulate towards Stronger Incremental Beliefs about the Changeability of Climate Change

"[...] Die Forscherin Prof. Dr. Lisa Clyne von der University of Michigan hielt vergangenen Oktober bei der Nachhaltigkeitskonferenz SEC in Toronto einen viel beachteten Vortrag:

„Klimaschutz beginnt beim Individuum. Erst wenn wir uns – als Privatpersonen – endlich dafür entscheiden, Umweltschutz ernst zu nehmen, kann die Erde klimagerechter werden. Jeden Tag haben wir mit unserem Verhalten und Kaufentscheidungen unmittelbar Einfluss auf unseren ökologischen Fußabdruck. Natürlich ist es ein harter Kampf und ein langer Weg hin zu einer klimagerechteren Zukunft, aber wir dürfen und können nicht mehr auf die Politik und die Wirtschaft warten, sondern müssen uns der enormen Macht unserer eigenen Handlungen bewusstwerden.“

Darüber hinaus berichtete sie von zahlreichen Längsschnittstudien, die belegen, wie effektiv Maßnahmen auf individueller Ebene sind. Zusätzlich stellte sie Forschungsergebnisse vor, die klar zeigen, wie das Einhalten der 1,5 Grad Ziele von Paris durch Verhaltensänderungen im Privatbereich erreicht werden kann. [...]"

Québec Times
"Stopping Climate Change is Doable, but Time is Short"
By David Beisley
23.03.2022
(übersetzt)

E. Fictional Newspaper Article to Manipulate towards Stronger Entity Beliefs about the Changeability of Climate Change

"[...] Die Forscherin Prof. Dr. Lisa Clyne von der University of Michigan hielt vergangenen Oktober bei der Nachhaltigkeitskonferenz SEC in Toronto einen viel beachteten Vortrag:

„Klimaschutz beginnt in der Wirtschaft. Solange großen Konzerne sich nicht dafür entscheiden, Umweltschutz ernst zu nehmen, kann die Erde auch nicht klimagerechter werden. Spätestens wenn man realisiert, dass allein Volkswagen mit über 500 Millionen Tonnen CO2 pro Jahr mehr Treibhausgas-Emissionen als ganz Australien ausstößt, wird klar, wer sich wirklich im Kampf gegen den Klimawandel bewegen muss. Dabei macht es mir große Sorgen zu sehen, wie Macht und Geld der Wirtschaft globale Fortschritte im Klimaschutz unmöglich machen.“

Darüber hinaus berichtete sie von zahlreichen Längsschnittstudien, die belegen, wie vergleichsweise ineffektiv Maßnahmen auf individueller Ebene sind. Zusätzlich stellte sie Forschungsergebnisse vor, die klar zeigen, dass das Einhalten der 1,5 Grad Ziele von Paris durch festgefahrene Finanzstrukturen in der Wirtschaft fast unmöglich zu erreichen sind. [...]"

Québec Times
"Unchangeable Climate Change"
By David Beisley
23.03.2022
(übersetzt)

F. Choice Scenarios to Assess Level of Construal

Im Folgenden sollen Sie sich zwischen zwei Option entscheiden. Wichtig ist, dass es dabei kein richtig oder falsch gibt.

Stellen Sie sich jetzt bitte vor, dass Sie sich in Ihrem eigenen Haushalt für ein System zur Mülltrennung entscheiden sollen. Ihnen stehen zwei Systeme zur Verfügung.
Option A ist für die Wiederverwertung des Mülls sehr effektiv, dafür müssen Sie den Müll in sehr viele verschiedene Behälter trennen.
Option B ist für die Wiederverwertbarkeit des Mülls mehr oder weniger effektiv, dafür muss der Müll nur in zwei Behälter getrennt werden.

Welches System zur Mülltrennung würden Sie bevorzugen?

Bei Ihrem nächste Kaffeehaus-Besuch stehen Sie vor der Wahl:
Option A: Sie nutzen einen wiederverwendbaren Kaffee-Becher mit sehr guter Öko-Bilanz, dafür müssen sie aber 2 Euro Pfand zahlen und den Becher in demselben Kaffeehaus zurückgeben.
Option B: Sie nutzen einen Einweg-Becher mit schlechter Öko-Bilanz, der Sie dafür nichts extra kostet und überall einfach entsorgt werden kann.

Welchen Kaffee-Becher würden Sie präferieren?