Perception of Climate Change and Mitigation Measures: Acceptability of Climate Change Mitigation Pathways

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Abstract

Considering the unprecedented threat that global warming poses, the Intergovernmental Panel on Climate Change (IPCC) presents four pathways proposed to help mitigate climate change. The public acceptability of these pathways could facilitate their implementation. Within the framework of the protection motivation theory, this thesis investigated the relationship of climate change risk perception and perceived effectiveness of the pathways to fulfil their goal of limiting climate change to 1.5°C with the acceptability of two out of the four IPCC pathways (P2 and P4). Results of our pre-registered survey ($N = 224$, collected via convenience sampling) support a positive association between climate change risk perception and the acceptability of P2 and a negative association between this variable and the acceptability of P4. Climate change risk perception was also positively related to the probability to prefer P2 over P4. Furthermore, a positive association between the perceived effectiveness of the pathways and the acceptability of P2 as well as P4 was found. Compared to climate change risk perception, perceived effectiveness could explain more variance in the acceptability of both pathways. Implications and limitations are discussed at the end of the paper.

Keywords: climate change, IPCC, acceptability, protection motivation theory

Perception of Climate Change and Mitigation Measures: Acceptability of Climate Change Mitigation Pathways

According to the IPCC special report on global warming of 1.5°C (2018), the consequences of human-induced climate change will be and are already severe. To curb some of the impacts, global warming should be kept within 1.5°C over pre-industrial levels (IPCC, 2018). A significant reduction of anthropogenic CO2 emission is necessary to achieve this, as the amount of greenhouse gas released into the environment over the following decades will determine whether global warming will exceed 1.5°C (IPCC, 2018). Therefore, it is of utmost importance to implement means reducing these emissions as much as possible.

Although changes on the individual level are crucial, the necessary decrease in CO2 emissions on a global scale calls for multi-level system transformations. Considering this, the IPCC (2018) presents four pathways aiming at mitigating climate change, thereby limiting global warming to 1.5°C. They incorporate transitions in the energy and economy sector and propose changes in energy production and consumption patterns. Hence, the pathways are connected to implications for lifestyle, industry, and policy options (IPCC, 2018). However, putting the changes into action can be accompanied by obstacles. Strong negative reactions of the public towards a policy can prevent its implementation (Ejelöv & Nilsson, 2020; Gärtling & Loukopoulos, 2007). Similarly, social opposition towards energy technologies may impede their employment (Huijts et al., 2012; Seetharaman et al., 2019). Since acceptability – the attitude (Huijts et al., 2012) towards proposed transitions – can impact the decision concerning their implementation quite substantially, gaining an understanding of factors influencing people's preferences for, and acceptability of, different climate change mitigation measures is of great significance. This study will examine factors proposed to influence the acceptability of two IPCC pathways.

The IPCC 1.5°C Mitigation Pathways

While the primary aim of the presented pathways is to limit global warming to 1.5°C, changes proposed to realize this goal differ between pathway two (P2) and pathway four (P4) (IPCC, 2018). In contrast to P2, P4 is considered a high overshoot pathway, meaning that the global mean temperature in P4 would surpass 1.6°C but would be brought back down to 1.5°C at a later point during the 21st century. This difference has significant implications for the changes the pathways propose (IPCC, 2018).

P2 is a sustainability-oriented, no- or limited overshoot pathway aiming at the immediate and constant reduction of CO2 emissions (IPCC, 2018). To achieve this, P2 promotes the widespread employment of renewable energy technologies (e.g., solar and wind energy) while it devalues the use of carbon dioxide removal techniques and fossil fuel energy use. Furthermore, the pathway presumes a decrease in energy demands and more environmentally-friendly consumption patterns (e.g., in the food sector) (IPCC, 2018).

In P4, CO2 emission is assumed to be primarily reduced in the latter part of the century through the implementation of carbon dioxide removal technologies (e.g., bioenergy with carbon capture and storage (BECCS)) (IPCC, 2018). In this way, P4 allows for lifestyles requiring high amounts of energy and fossil fuel use without consideration for behavioural changes. Although P4 proposes a heightened use of renewable energy, P2 plans a sharper and faster increase. Additionally, P4 plans an increase in fossil fuel energy, specifically oil (IPCC, 2018).

To enable a smooth implementation of the changes proposed, the pathways are accompanied by policy options (IPCC, 2018). Generally, P2 calls for a more rapid reduction of energy demand, which is why policies within P2 comprise a broader and more far-reaching set of changes (IPCC, 2018).

Focus of the Present Study

This study examines factors suggested to influence the acceptability of the two pathways. Factors include altruistic, egoistic, and biospheric values, costs and benefits, knowledge about climate change, distributional fairness, perceived risk of climate change, and the perceived effectiveness of a given pathway to reach its aim. This thesis will focus on risk perception and effectiveness. More specifically, it will investigate the role climate change risk perception (CCRP) and perceived effectiveness play in people's preferences for, and acceptability of, the IPCC mitigation pathways P2 and P4, within the framework of the protection motivation theory (PMT).

Literature Review

The Protection Motivation Theory

The PMT proposes that two variables, threat and coping appraisal, are relevant in predicting engagement in protective behaviour (Floyd et al., 2000). First, one assesses the perceived probability of encountering a threat (i.e., threat vulnerability) and the perceived effects that this exposure could have (i.e., threat severity) (Bamberg et al., 2017). These two factors form the threat appraisal component. Secondly, the perceived ability of the proposed response to prevent the threat (i.e., response efficacy) and one's perceived capacity to engage in the proposed behaviour (i.e., self-efficacy) are judged, forming the coping appraisal component (Floyd et al., 2000). Based on these judgements, a decision of whether to engage in the protective action is made (Floyd et al., 2000). Research applying the PMT in an environmental context found that threat and coping appraisal were associated with environmentally-friendly behaviour and behavioural intentions (e.g., Bockarjova & Steg, 2014; Rainear & Christensen, 2017).

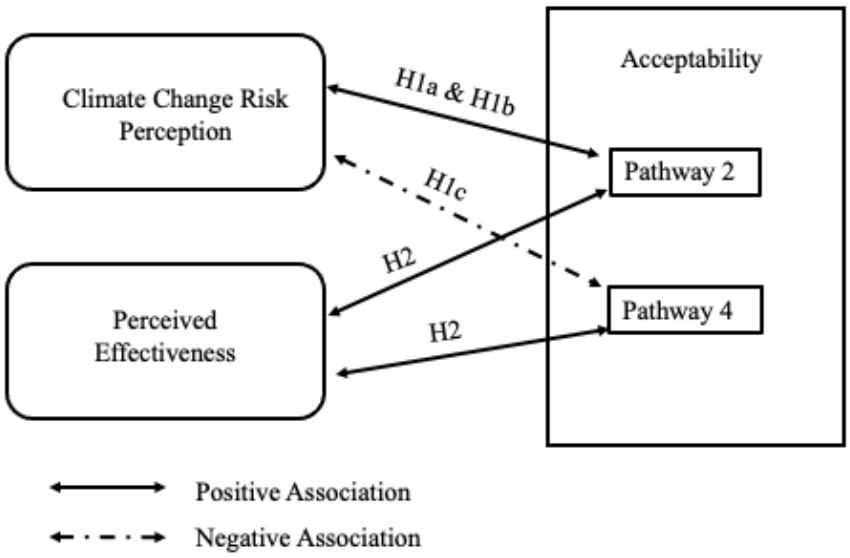
In this study, the PMT lends itself as a theoretical framework that embeds CCRP and perceived effectiveness of the pathways. Since this thesis concentrates on the threat of climate change, threat appraisal (i.e., CCRP) is conceptualized as how likely one thinks it is that they

will be exposed to (consequences of) climate change (i.e., threat vulnerability) and how serious one perceives the consequences of climate change to be (i.e., threat severity). Apart from threat appraisal, the PMT also includes coping appraisal. Within the PMT framework, previous research typically examined specific behaviours (e.g., electric car use, Bockarjova & Steg, 2014). For example, in a study predicting electric car use and support for policies promoting this, participants rated self-efficacy concerning behaviours relating to electric car use (e.g., feeling prepared to charge the car) and response efficacy based on the usefulness of switching to electric cars (Bockarjova & Steg, 2014). Considering the broad transitions that the pathways propose, measuring response- and self-efficacy of all specific actions that the pathways involve would not be feasible. Therefore, the PMT framework is adapted to include perceived effectiveness – "an individual's beliefs concerning whether a policy instrument is capable of achieving a given goal" (Huber et al., 2019, p.656) – in this study. Perceived effectiveness is conceptualized in terms of whether one believes that a given pathway can achieve a given goal (i.e., mitigate consequences of climate change by limiting global warming to 1.5°C (IPCC, 2018)). This enables the examination of the overall perceived effectiveness of a given pathway, instead of the effectiveness of specific behaviours.

In the following, the relationships of CCRP and of perceived effectiveness with acceptability are examined. The presented evidence serves as a guide for the hypotheses depicted in Figure 1.

Figure 1

Overview of Hypotheses



Climate Change Risk Perception

Interindividual differences divide people according to the extent to which they feel threatened by global warming (van der Linden, 2015). These variations are related to differences in the support for three components of the IPCC pathways, namely policies, energy and behavioural transitions (e.g., Goldberg et al., 2020; Spence et al., 2010; Hunter & Röös, 2016). Since the two pathways differ in regards to changes planned for these components (IPCC, 2018), interindividual differences in CCRP are assumed to be related to varying acceptability of P2 and P4. In the following, evidence for the relationship between CCRP and the three components is examined. For each element, it is concluded whether existing evidence supports a negative or positive relationship between CCRP and the acceptability of P2 and P4, respectively.

First, literature on policy support is considered. Here, research reports that being concerned about climate change and its consequences played an important role in predicting support for policies related to climate change (e.g., Drews & van den Bergh, 2015; Goldberg et al., 2020). Thereby, perceived risk of the negative consequences of climate change could account for more variance in support for climate change policies than objective risks (Zahran et al., 2006). Regarding different types of climate change policies, climate change concern

was positively related to the support for less and more stringent policies alike (Rhodes et al., 2017). These ranged from carbon taxes, advocating the use of more sustainable energy, to providing benefits for pro-environmental choices made by households or businesses (Rhodes et al., 2017). Lastly, in a recent meta-analysis, CCRP was positively related to the acceptability of policies involving taxation and those regulating production and emissions (Bergquist et al., 2022). Together, the presented findings point to a positive relationship between CCRP and various climate change mitigation policies. Since both pathways intend to mitigate climate change (IPCC, 2018), the presented evidence suggests that higher CCRP is associated with higher acceptability of P2 as well as P4.

Apart from policies, different energy sources and technologies play a role of varying magnitude in the two pathways. Research showed that people concerned about climate change thought more positively of renewable energy systems (e.g., wind or solar systems) but evaluated fossil fuel energy systems (e.g., oil) more negatively (Spence et al., 2010). Moreover, higher risk perception of climate change was also associated with a higher readiness to spend money for energy generated by low-emission energy technologies (Mayer & Smith, 2018). Concerning the relationship between CCRP and support for carbon dioxide removal (CDR) techniques, the two variables seem to be positively related (Pidgeon et al., 2012). However, a study comparing the acceptance of different climate change mitigation scenarios found that regarding climate change as a serious problem and acknowledging its relevance to oneself (i.e., problem perception) was significantly and positively associated with acceptance of the mitigation scenario (including energy and lifestyle transitions, therefore resembling P2), but not with the BECCS scenario (reliance on technology instead of behavioural change, therefore resembling P4) (Klaus et al., 2020). Importantly, perceived risk correlated positively with problem perception of climate change in the BECCS, but negatively with problem perception in the mitigation scenario (Klaus et al., 2020). Therefore, higher

CCRP might be associated with higher awareness of the risks associated with BECCS and thus with a less positive evaluation in comparison to mitigation options (Klaus et al., 2020). Since the BECCS scenario resembles P4 and the mitigation scenario resembles P2 more closely, this evidence points to a positive association between CCRP and acceptability of P2 and a negative relationship between CCRP and the acceptability of P4. These suggestions are further supported by the other evidence reported above. That is, since P4 includes an increase in fossil fuel energy and BECCS use, while P2 more strongly promotes renewable energy use (IPCC, 2018), CCRP should be positively associated with the acceptability of P2, but negatively with acceptability of P4.

The two pathways also significantly differ in the degree of proposed behavioural changes. Concerning specific pro-environmental behaviours, higher CCRP was related to stronger intentions to consume less meat (Hunter & Röös, 2016). Furthermore, perceiving climate change to be a significant issue positively predicted a broad range of more sustainable consumption behaviours (Wicker & Becken, 2013). These included decreasing energy usage by insulating one's house, purchasing food produced near one's home, as well as opting for more sustainable transport options (Wicker & Becken, 2013). Moreover, research showed that people high in CCRP were more likely to perform pro-environmental behaviours (e.g., energy conservation) because they perceived fewer psychological obstacles towards these actions (Lacroix & Gifford, 2017). On another note, besides being more willing to align one's behaviour with sustainable actions, research also found that people who perceive that climate change poses a significant risk are also less likely to not change their behaviour in response to global warming (Wang et al., 2021). To conclude, as in contrast to P4, P2 includes sustainable consumption, reduced energy demand and behavioural changes (IPCC, 2018), the evidence points to a positive relationship of CCRP with the acceptability of P2 and a negative relationship with P4.

Taking all findings together, there is evidence for significant overlap between the variables that CCRP positively relates to and the transitions proposed in P2. Contrastingly, although there is some evidence pointing towards a positive relationship between CCRP and the acceptability of P4, evidence for a negative relationship outweighs the remaining evidence. Accordingly, the following hypotheses (see Figure 1) are forwarded:

H1a: There is a positive relationship between climate change risk perception and the probability to choose P2 over P4.

H1b: There is a positive relationship between climate change risk perception and the acceptability of P2.

H1c: There is a negative relationship between climate change risk perception and the acceptability of P4.

Perceived Effectiveness

This study also investigates how the perceived effectiveness of the pathways regarding their ability to limit global warming to 1.5°C, therefore mitigating (consequences of) climate change, influences acceptability. By definition, perceived effectiveness is specific to a given policy aim (Huber et al., 2019). A review in the environmental domain reports evidence for a positive relationship between perceiving that a policy can achieve its' goal and its' acceptability (Ejelöv & Nilsson, 2020). In the context of policies that promote sustainable ways of transportation, higher perceived effectiveness of the investigated policies predicted increased support (Huber et al., 2019). Similarly, Eriksson et al. (2008) provide evidence for increased acceptability of an environmental policy, given that people perceive that it can effectively ameliorate the environmental issue it is concerned with. Furthermore, in a recent meta-analysis, perceived effectiveness was reported to be the second most important predictor of the acceptability of various policies targeting climate change mitigation and behavioural change (Bergquist et al., 2022).

In regards to the evidence, it is expected that perceiving that a given pathway can accomplish its goal - keeping global warming within 1.5°C by the end of the century, thereby limiting the consequences of climate change (IPCC, 2018) - positively relates to its acceptability. In line with this, the following hypothesis (see Figure 1) is investigated:

H2: There is a positive association between perceived effectiveness and the acceptability of P2 as well as P4.

Outlook on the Study

This study investigates the association between CCRP and acceptability as well as between perceived effectiveness and acceptability of the two IPCC pathways. Additionally, CCRP will be studied as a predictor of choice between the pathways. In an exploratory part, the strength of the two variables in predicting acceptability is compared. Considering the significant standing of the IPCC (*The Intergovernmental Panel on Climate Change*, n.d.), the pathways present potential real-life solutions to mitigate global warming. As their implementation partly hinges on public acceptability, an advanced understanding of factors influencing the acceptability of the pathways could have important implications.

Method

Ethics Statement

Ethical approval for this study was given by the Ethical Committee Psychology (ECP) connected to the University of Groningen, the Netherlands.

Participants

In total, 291 participants participated in the study. In this thesis, the sample consisted of 224 (77%) participants, as 67 (23%) were removed due to missing values. Out of the considered sample, 111 (49.6%) participants were recruited via snowball sampling (e.g., via social media, asking friends and family and leaflets on notice boards), whereas 113 (50.4%) participated via SONA – the first-year psychology student participant pool of the RUG.

Within the sample, participants' age ranged from 18 years to 68 years (M = 24.1, SD = 9.3). Concerning the gender distribution, 136 (60.7%) participants identified as female, 82 (36.61%) as male, five as other (0.02%), and one (0.0045%) participant preferred not to indicate their gender. While participants recruited through snowballing participated voluntarily and without incentives, SONA participants received 0.5 SONA credits for the voluntary completion of the study.

Design

As a cross-sectional design, the study was conducted as an online survey in English via Qualtrics (Qualtrics, Provo, UT). Independent variables (IVs) measured were CCRP; perceived effectiveness; objective knowledge; costs and benefits; perceived distributional fairness; biospheric, egoistic, and altruistic values. Data on the following dependent variables (DVs) was collected: acceptability of each pathway and the preference for a pathway. Simplified descriptions of the two pathways were also included in the survey (Figure A1, Appendix A). Within the questionnaire, P2 was referred to as pathway A and P4 as pathway B.

Materials

Although the survey comprised several scales to measure all the variables included in the study, for simplicity reasons, only scales relevant to the hypotheses investigated in this thesis are described (Figures A2 to A5, Appendix A). The order in which the items on the IV scales were presented was randomized to prevent order effects. Each scale was analysed using the statistical software R (R Core Team, 2022), including the *ltm* package (Rizopoulos, 2006). Means and standard deviations of all variables can be found in Table B1, Appendix B.

Acceptability of the Pathways

To measure *acceptability*, a seven-point scale was used. Participants indicated to what extent they think that a given pathway is *not at all acceptable* (1) - *very acceptable* (7), *very*

bad (1) – *very good* (7), *not at all necessary* (1) – *very necessary* (7). In that way, pathway A and B were rated with three items each. This scale was adapted from Perlaviciute et al. (2021) and its high reliability was indicated by Cronbach's α for P2 = 0.87 and Cronbach's α for P4 = 0.85.

Choice Between the Pathways

The choice between the two pathways was measured using a single item. Participants indicated which pathway they would prefer; choosing either pathway A or B.

Climate Change Risk Perception

Since CCRP was conceptualised in terms of the PMT, measurements were adopted from Rainear & Christensen (2017). Three items measuring threat vulnerability and three measuring threat severity were merged into one scale to measure CCRP. On a seven-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (7), participants indicated to what extent they agree with items such as "Climate change will have negative consequences" (threat severity) or "Climate change can negatively affect me" (threat vulnerability). Internal reliability was high (Cronbach's $\alpha = 0.84$)

Perceived Effectiveness

A seven-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (7) was used to measure perceived effectiveness. The scale comprised four items, three of which were adapted from Wan et al. (2014) and modified to fit the conceptualisation of perceived effectiveness adopted in this thesis. The item "By following this pathway, global warming would be limited to 1.5°C by the end of the 21st century" was a new item, added for completeness. The extent of agreement with the items was measured twice, once for each pathway. (Cronbach's α for P2 = 0.79, Cronbach's α for P4 = 0.87).

Procedure

The study was preregistered in the Open Science Framework before the survey was published (link: https://osf.io/r3km5/?view_only=c77cf7b0351548a0b9ea70b09e72c867). After preregistration, data was collected within the time frame of three and a half weeks (from April 26th to May 20th 2022). Prior to participation in the survey, participants were informed about the purpose and content of the study. Additionally, they received informed consent information stating that participation is voluntary, discontinuation of the study is possible at any time and that all data is handled confidentially, i.e., in accordance with the Netherlands code of conduct for research integrity.

First, data pertaining to gender and age of the participants was collected. Then, participants continued with the rest of the survey, which can be divided into two parts. In the first part, participants were asked to fill out scales measuring matters generally connected to climate change. These included CCRP, objective knowledge of climate change and all three personal value scales, respectively. In the second part, scales pertained directly to the evaluation of the pathways. In between these two sections, participants read a simplified description of the pathways. To increase the quality of the answers on the scales subsequently employed, sufficient engagement with the information was ensured by including four questions testing specific knowledge about the descriptions (Figure A6, Appendix A). Continuation of the survey was only possible after correctly answering these comprehension questions. Next, the pathways were evaluated by employing the scales measuring perceived effectiveness, risks and benefits, and fairness. Thereby, the scales were presented in such a way that participants first evaluated pathway A and then pathway B on a given variable and then moved on to the next variable. The option to go back and forth between questions and a summary of the pathways' content on each page provided the possibility to refresh one's mind about the information given about the pathways. Lastly, participants rated the acceptability

and chose between the two pathways. Then, participants were thanked for their participation and dismissed.

Data Analysis

Regression analyses were used to examine the hypotheses. By employing logistic regression, the association between CCRP and the preference for P2 over P4 was explored (H1a). Furthermore, two multiple linear regression analyses were conducted. One linear regression examined the relationship between CCRP and perceived effectiveness of P2 with the acceptability of P2 (H1b and H2 for P2). The other one explored the association between CCRP and perceived effectiveness of P4 with the acceptability of P4 (H1c and H2 for P4). In the exploratory analysis, backward selection was performed on the two linear regression analyses. Thereby, the semi partial correlation squared indicated which of the two independent variables could explain more variance in the acceptability of each pathway. The models were selected based on the AIC, an indicator of model fit (i.e., how well the predictors could account for the data) (Cavanaugh & Neath, 2019).

Assumption Checks

As all participants were allowed to only take the survey once, the data fulfilled the independence of observation assumption for all regression models. Furthermore, no evidence indicated violations of the linearity assumption for the logistic regression model (Figure C1, Appendix C). Concerning the linear regression for H1c and H2 (for P4), no evidence for violations of the linearity, homoscedasticity and normality assumptions was found (Figure C3, Appendix C). However, while no evidence for violations of the linearity assumption of the regression for H1b and H2 (for P2) was found, there was evidence for violations of the homoscedasticity and normality assumptions (Figure C2, Appendix C). In contrast to decisions made in the preregistration, variables were not transformed to maintain straightforward interpretability of the results. Instead, as a robustness check, results of a rank-

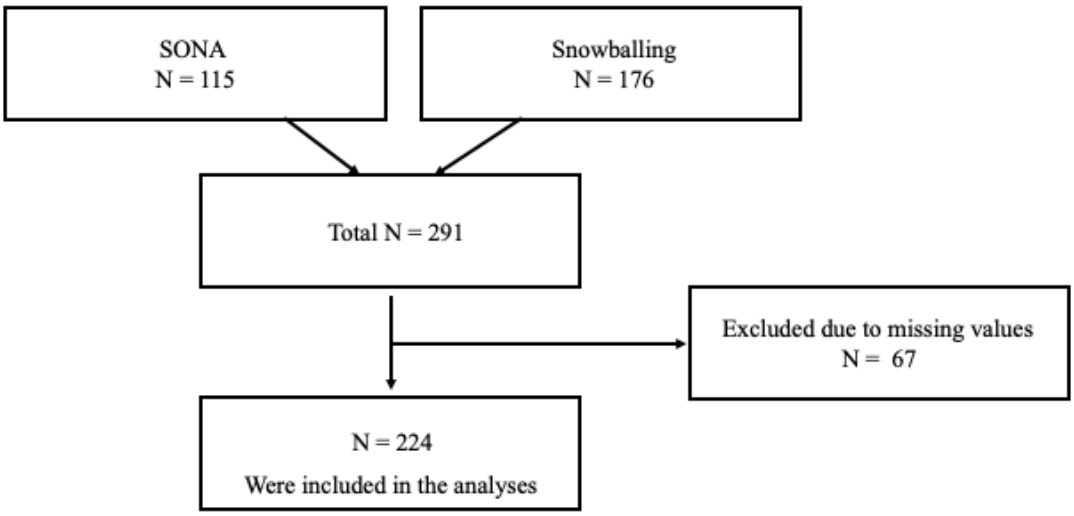
based regression[1] were compared with the results of the multiple linear regression (Table E1, Appendix E). Lastly, for all three regressions, outliers were analysed using Cook's Distance[2].

Data Preparation

Participants who did not fill in the scales needed for the analyses conducted in this thesis were removed prior to running the analyses (i.e., missing values were deleted case-wise). Upon examination of the raw data, it can be speculated that premature quitting might have been due to the length of the survey. Many participants left the survey approximately halfway through. They might have skipped the scales in the latter part to save time (*Mdn* response time = 944 seconds). Applying the missing value criterion, 67 (23%) participants were removed from the data set. Therefore, a total of 224 (77%) participants were included in the statistical analyses (see Figure 2).

Figure 2

Participant Exclusion Process



[1] Results of the rank-based regression were in line with effects obtained from the linear regression. Since rank regression does not assume normality or homoscedasticity (Kloke & McKean, 2012), these results indicate that findings of the linear regression could provide valuable information, instead of reflecting a distorted picture of the true findings.

[2] Following the 4/n rule, 16, 17 and 14 outliers with a Cook's Distance larger than 0.018 (4/224) were identified for the regression for H1a, H1b and H1c, respectively. However, none of these responses was removed, as they could provide valuable information.

Results

The statistical analyses were conducted using R (R Core Team, 2022) including, the *tidyverse* package (Wickham et al., 2019) and the *olsrr* package (Hebbali, 2020).

Descriptive Statistics

Distributions of the IVs and DVs are depicted in Figures D1 and D2 (Appendix D). The relevant correlations are visualized in Figure D3, Appendix D. Positive correlations between CCRP and acceptability of P2 and between perceived effectiveness of P2 and the acceptability of P2 were found. A negative correlation between CCRP and the acceptability of P4 and a positive correlation between perceived effectiveness of P4 and its acceptability could be observed (Table D4, Appendix D). No great overlap between the predictors was found, as correlations between them were all below or at 0.3 (Table D4, Appendix D) and VIF values centred around one. Regarding the preference for a pathway, out of the participants included in the analysis, 187 (83.5%) chose P2, while 37 (16.5%) indicated a preference for P4.

Preference for Pathway 2 (H1a)

The logistic regression analysis revealed a positive relationship between CCRP and the probability to choose P2 (Table 1). The odds ratio indicated that for every one-unit increase in CCRP, the likelihood to choose P2 over P4 increased by almost three times [*Exp(b)* = 2.91, 95% CI (1.91, 4.63)].

Table 1

Logistic Regression Results

Predictor	*b*	*SE*	*z value*	*p*	*Exp(b)*	*Exp(b) 95% CI [LL, UL]*
(Intercept)	-4.51	1.27	-3.54	<.001***	0.01	[0.0, 0.12]
CCRP	1.07	0.22	4.75	<.001***	2.91	[1.91, 4.63]

Note. Exp(b) represents the odds ratio. *LL* and *UL* indicate the lower and upper limits of the 95% confidence interval, respectively.

*** $p < .001$.

Acceptability of Pathway 2 (H1b and H2)

The relationships of CCRP and of perceived effectiveness with acceptability of P2 were investigated using multiple regression. The whole model could explain a considerable amount of variance in the DV ($R^2 = 0.5$, $F(2, 221) = 110.3$, $p<.01$). The analysis revealed a positive association between CCRP and acceptability of P2 ($b = 0.45$, $CI = [0.32, 0.57]$, $p<.01$) (H1b). Similarly, perceived effectiveness of P2 was positively related to the acceptability of P2 ($b = 0.61$, $CI = [0.49, 0.72]$, $p<.01$) (H2) (Table 2).

Table 2

Multiple Regression Results with Acceptability of Pathway 2 as the Criterion

Predictor	*b*	*b* 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	*r*	Fit
(Intercept)	-0.17	[-1.00, 0.66]				
CCRP	0.45**	[0.32, 0.57]	.11	[.05, .17]	.49**	
Perceived Effective-ness P2	0.61**	[0.49, 0.72]	.26	[.17, .34]	.62**	
						R^2 = .50** 95% CI[.41,.57]

Note. LL and *UL* indicate the lower and upper limits of the 95% confidence interval, respectively.

** $p < .01$.

Acceptability of Pathway 4 (H1c and H2)

A second multiple regression model examined the relationship between the two predictors and the acceptability of P4. Overall, the model could account for a considerable amount of variance ($R^2 = 0.48$, $F(2, 221) = 103$, $p<.01$). CCRP negatively predicted the acceptability of P4 ($b = - 0.19$, $CI = [-0.35, -0.03]$, $p<.019$) (H1c) and perceived effectiveness

of P4 was positively related to the acceptability of P4 (b = 0.68, CI = [0.57, 0.78], $p<.01$) (H2) (Table 3).

Table 3

Multiple Regression Results with Acceptability of Pathway 4 as the Criterion

Predictor	b	b 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	r	Fit
(Intercept)	2.32**	[1.22, 3.43]				
CCRP	-0.19*	[-0.35, -0.03]	.01	[-.01, .03]	-.32**	
Perceived Effective-ness P4	0.68**	[0.57, 0.78]	.38	[.29, .48]	.69**	
						R^2 = .482** 95% CI[.39,.55]

Note. LL and *UL* indicate the lower and upper limits of the 95% confidence interval, respectively.

** $p < .01$.

Exploratory Analysis

For each of the two multiple regression models described above, backward selection was performed. Both predictors (i.e., CCRP and perceived effectiveness) remained in the model predicting the acceptability of P2. Similarly, neither predictor in the regression modelling the acceptability of P4 was eliminated. Compared to eliminating CCRP, a larger increase in the AIC could be observed when perceived effectiveness was removed. This held true for both models. As gains in the AIC indicate decreases in model fit (Cavanaugh & Neath, 2019), the results suggest that although CCRP could be an important IV, perceived effectiveness might be the better predictor of acceptability of both pathways. This is also reflected in the comparison of the two predictors based on their respective semi partial correlations squared. The perceived effectiveness of P2 and P4 could uniquely account for

more variance in the acceptability of P2 (sr^2 = 0.26) and P4 (sr^2 = 0.38) than CCRP (sr^2 = 0.11, sr^2 = 0.01; for P2 and P4, respectively).

Discussion

The present study aimed at investigating factors proposed to influence the acceptability of the IPCC 1.5°C mitigation pathways. Within the theoretical framework of the PMT, this thesis focused on two predictors of acceptability in particular: CCRP and perceived effectiveness. Generally, the findings offer support for all proposed hypotheses. However, it is important to keep in mind that results pertaining to H1b and H2 (for P2) need to be interpreted with caution due to assumption violations. Now, findings concerning each predictor are reviewed.

First, the results support the predictions made in the three hypotheses advanced for CCRP. As expected, the results indicate that the more participants perceived that climate change poses a risk, the more accepting they were of P2 (H1b) and the more likely they were to prefer P2 over P4 (H1a). Furthermore, the more participants perceived climate change to be a serious threat, the less accepting they were of P4 (H1c). Broadly speaking, these results could indicate that participants high in CCRP generally oppose climate change mitigation measures involving temporal overshoot of 1.5°C (like P4 (IPCC, 2018)), while favouring measures avoiding overshoot (like P2 (IPCC, 2018)). However, it is also important to consider the findings in light of the three components of the pathways (i.e., policy support, energy systems, behavioural changes). First, the results suggest that behavioural changes (part of P2 (IPCC, 2018)) seem to be increasingly acceptable the higher the level of CCRP. Similarly, not changing one's behaviour (part of P4 (IPCC, 2018)) seems to be less acceptable the more one perceives that climate change poses a risk. This is in line with the literature on behavioural change (Wang et al., 2021; Wicker & Becken, 2013). Furthermore, energy sources planned to be frequently used in P2 (e.g., renewable energy (IPCC, 2018)) seem to be

more supported by people who perceive that climate change poses a risk, whereas energy transitions proposed in P4 (e.g., use of oil (IPCC, 2018)) seem to be less accepted the higher CCRP. These findings are also mainly reflected by the literature in the energy domain (e.g., Spence et al., 2010). Lastly, increasing levels of CCRP seem to be related to higher acceptability of climate change mitigation policies proposed by P2 but not by P4. This is in contrast to evidence reported in the literature, which generally suggests a positive link between CCRP and the support of mitigation policies (e.g., Rhodes et al., 2017). Three possible explanations for the contradicting findings of this study can be considered. For one, the description of the pathways included in the survey provided little information about policy implications (Figure A1, Appendix A). Hence, other components (e.g., behaviour) to which CCRP negatively relates in case of P4 (e.g., Wang et al., 2021), might have had a stronger impact on perceptions of acceptability. This reasoning is supported by other research in the acceptability domain, which addressed framing of proposed transitions as a factor influencing research findings (Pidgeon et al., 2012). Additionally, policy options derived from the pathways would include the energy and behavioural components that each pathway proposes (IPCC, 2018). Since the literature reports negative relationships between CCRP and these two components for P4 (e.g., Spence et al., 2010; Wang et al., 2021), policy options for P4 might be less supported by participants with high CCRP. However, as this study focuses on the pathways as a whole, it is difficult to draw conclusions about the impact of CCRP on the three components individually. Therefore, results remain specific to the acceptability of the pathways as a whole. To further disentangle the link between CCRP and the acceptability of the pathways, future research could investigate the link between CCRP and the individual components specifically.

With regards to perceived effectiveness, the findings support the forwarded hypothesis. More specifically, the more participants perceived that P2 was able to fulfil its

aim of limiting global warming to 1.5°, the higher the acceptability of P2 (H2 for P2). Similarly, the more participants perceived that P4 was effective in fulfilling this goal, the more accepting they were of P4 (H2 for P4). These results are in line with the literature, which generally found a positive association between the acceptability of a given climate change mitigation measure and its perceived effectiveness (e.g., Eriksson et al., 2008). Importantly, since previous research has mainly investigated perceived effectiveness of climate change policies (e.g., Huber et al., 2019), perceived usefulness (e.g., Kardooni et al., 2016) or benefits of specific energy sources (e.g., Visschers & Siegrist, 2014), this study makes a unique contribution to the existing literature by studying perceived effectiveness of the IPCC pathways.

This thesis also aimed at comparing the relative explanatory power of the two predictors. Together, they could account for a substantial amount of variance in the acceptability of P2 as well as P4. Furthermore, the results suggest that both variables play a central role in explaining the acceptability of the two pathways, as both helped to account for the data of the dependent variable. However, perceived effectiveness seems to be a more important predictor than CCRP. Two differences are important to consider in this regard. First, for both pathways, perceived effectiveness could better account for the data than CCRP. Additionally, perceived effectiveness was able to uniquely account for more variance in the acceptability of P2 and P4 than CCRP. Importantly, the difference in the unique variance accounted for was more pronounced for P4 than P2. That is, compared to perceived effectiveness of P4, CCRP could uniquely explain a very small part of the variance in the acceptability of P4. A possible explanation for the discrepancy between uniquely explained variance by the two predictors could be their degree of specificity (van der Linden, 2017). According to the Domain-Context-Behavior (DCB) Model, predictors possessing a similar degree of specificity as the DV are better able to predict the outcome than predictors with a

different degree (van der Linden, 2017). In this study, CCRP pertains to broader attitudes about climate change, whereas acceptability is specific to the mitigation pathways. Contrastingly, perceived effectiveness directly relates to the pathways, similar to acceptability. Possibly then, perceived effectiveness accounted for more variance than CCRP because its degree of specificity matched that of acceptability.

Theoretical Implications

The research in this thesis was embedded in the theoretical framework of the PMT. Thereby, the theory was modified in three ways. First, instead of coping appraisal, perceived effectiveness was included, enabling the examination of the pathways' overall perceived effectiveness in reducing the impact of climate change. As all the changes proposed within the pathways (i.e., behavioural changes, energy transitions, policies; see IPCC, 2018) could be implemented together at the same time, including perceived effectiveness - as a measure to examine the overall effectiveness of all the changes together - might be a valuable modification of the PMT for research investigating the acceptability of the pathways. Nonetheless, investigating coping appraisal for specific elements (e.g., behavioural changes) within the pathways could be important. For example, previous research applying the PMT in the policy acceptability context found coping appraisal to be related to the acceptability of specific pro-environmental policies (e.g., Bockarjova & Steg, 2014). Examining coping appraisal for specific elements within the pathways could therefore provide valuable insights. Contrastingly, it might not prove useful to include perceived effectiveness and coping appraisal together in research applying the PMT to exclusively investigate acceptability of specific behaviours. Comparing their respective definitions, perceived effectiveness (Huber et al., 2019) and coping appraisal (especially response efficacy) (Floyd et al., 2000) seem to be quite similar constructs. When investigating the acceptability of the pathways, it might be useful to examine both, as perceived effectiveness serves as a broad measure of effectiveness

and coping appraisal relates to individual behaviours within the pathways. However, adding either predictor as an addition when only investigating individual behaviours might not make a relevant contribution to the variance explained, due to their overlap. Future research might explore this reasoning further. As a second modification of the PMT framework, CCRP was conceptualized as threat appraisal. The results of this study support the notion that this conceptualization might be useful for investigating acceptability generally, and of the pathways specifically. Lastly, in contrast to previous studies investigating the PMT in an environmental context, which for example investigated pro-environmental behaviour (e.g., Bockarjova & Steg, 2014), the outcome variable of this study was acceptability (i.e., an attitude). To my knowledge, few studies have investigated acceptability within the PMT framework yet (such as e.g., Bockarjova & Steg, 2014). The notion that this study could therefore make a valuable contribution to this body of literature is supported by the present findings.

On the whole, this study found support for the predictions made within the PMT framework, along with the modifications implemented. Accordingly, the PMT, including the modifications, might provide a useful framework for research investigating acceptability, also of the IPCC pathways specifically. Future research needs to determine whether this conclusion holds true in the long run.

Practical Implications

This study could have important practical implications for decision-makers and their communicators which might facilitate a translation of the transitions proposed in the pathways into reality. Generally, participants endorsed a preference for P2. The findings suggest that this might be connected to the fact that most of the participants perceived the threat of climate change to be high. Additionally, the high acceptability of P2 seems to also be linked to the perception that P2 can mitigate consequences of climate change. Should the external

circumstances (e.g., time, money, political decisions) allow for the implementation of P2, the results of this study indicate that a certain baseline acceptability for this pathway might be present, at least in a group of people similar to this study's sample. Since this might be due to heightened awareness of the risk of climate change and/or perceptions of the effectiveness of P2, decision-makers might be well advised to raise perceptions of risk and effectiveness in those with a low baseline level on both variables.

If the circumstances call for the implementation of P4, the results suggest that decision-makers should direct their attention to the perceived effectiveness of the pathway and away from CCRP. Participants in this study generally accepted P4 less than P2 and therefore, plans for P4's implementation might be faced with stronger resistance. As the study suggests, this might be related to high levels of CCRP. To increase acceptability and enable a smooth implementation of P4, decision-makers could promote perceptions of effectiveness of P4.

While considering these implications, it is important to keep in mind that due to the correlational nature of the study, no causal claims can be made. Despite this, the findings still seem highly practically relevant. The high amount of variance explained by the predictors indicates that real-life differences in CCRP and perceived effectiveness potentially relate to the acceptability of a pathway in a practically meaningful way. Future research could adopt an experimental design to test whether the implications stated here hold true in a laboratory context. Research in a practical context is also called for.

Limitations

Before drawing final conclusions, limitations of the present research and their respective implications are discussed. First, by focusing on the pathways as a whole, instead of the three components they combine (i.e., policies, energy and behavioural change; see IPCC, 2018), findings in this study only pertain to the acceptability of the pathways as a

whole and do not serve to disentangle whether the predictors are differently associated with the acceptability of individual components. Future research could investigate the components of the pathways separately to reveal the underlying mechanisms of the results found. Nonetheless, to my knowledge, this study is unique in examining the IPCC pathways and could therefore make a valuable contribution to research in the acceptability domain.

Secondly, the correlational nature of the study restrains the interpretation of the results to relational statements. To draw causal conclusions and control for possible confounding factors, future research could systematically manipulate the predictors in an experiment. With regards to the practical significance that the results might have, follow-up experimental research might be especially valuable.

Thirdly, the sampling technique employed might constrain the generalizability of the presented results to a wider population. Instead of true random sampling, a convenience sample was collected. Via snowballing, the researchers distributed the survey to their family and friends, as well as to people who were assumed to be interested in climate change. Moreover, most participants recruited via SONA were first-year psychology students. Therefore, young and educated people, and those generally interested in the subject, are likely to be overrepresented in the sample. This might have biased the results in the direction of increased concern for the topic, which could be especially true for the variable CCRP (van der Linden, 2017). This might have been amplified further by demand characteristics. Friends and family of the researchers might be aware that climate change is an important issue to the researchers, making them prone to respond in line with what they thought the researchers wanted to hear. Therefore, future research could determine whether the results found also generalize to a wider population.

Another factor which might have impacted the results is language differences. Since the majority of the researchers are German, it can be assumed that many participants sampled

via snowballing were German native speakers who do not use English in their daily lives. Misunderstandings resulting from translation or limited proficiency in the English language could therefore have affected the findings. Differences in English proficiency might also be reflected in the amount of time needed to complete the survey, which presents another possible influence on the results.

Fifths, pre-testing the scale measuring perceived effectiveness, which was comprised of one new and three adapted items could have improved the quality of the survey (Boateng et al., 2018). Pre-testing items would have been advantageous to discover and correct for potential misinterpretations, thereby also decreasing cognitive resources needed to fill out the scale (Boateng et al., 2018). Considering that some participants required quite some time to fill in the survey, pre-testing would have therefore presented the opportunity to facilitate its completion. For future research intending to use the scale, this study could provide a base from which the scale could be improved.

It is also important to consider the operationalization of the predictors. Regarding perceived effectiveness, two out of four items included the phrase "limit global warming to 1.5°C by the end of the 21st century". In the survey, descriptions of the pathways directly mention whether the pathways can fulfil the 1.5°C goal (Figure A1, Appendix A). Although it also becomes clear that both pathways aim at fulfilling it, including the description of overshoot of P4 might have influenced the perception of whether P4 is as likely to return to 1.5°C as P2. Consequently, operationalizing the two items in that way might have biased the responses in favour of P2. Future research could investigate this issue by making the descriptions more neutral or by omitting the phrase. Concerning CCRP, measuring global CCRP (i.e., risks for others) might help to gain additional insights (van der Linden, 2017). This study focused on personal CCRP (i.e., risks for oneself), but research in the PMT framework showed that including global CCRP significantly aided in explaining pro-

environmental intentions (Hunter & Röös, 2016). Research is needed to determine whether this also holds true in the acceptability context.

Lastly, it is of great significance to acknowledge the context within which the study was conducted. Two important external events are crucial to consider in this regard. The war between Russia and Ukraine substantially affects the energy sector (Tollefson, 2022). Combined with direct effects on one's own purse, e.g. through an upsurge in petrol prices (*Benzin teuer wie nie,* 2022), knowledge about the war could have affected how participants viewed the pathways and consequently how they answered the survey items. Next to the war, experts recently estimated that it is likely that global warming will exceed 1.5°C within the next five years (*Klimabericht von UN-Experten*, 2022). This news, which was released during the period of data collection for the study (*Klimabericht von UN-Experten*, 2022), could have impacted participants' responses by creating a sense of urgency and desire for fast and drastic change to avoid surpassing the 1.5°C goal. As P2 proposes quicker change (IPCC, 2018), the news could have increased the acceptability of P2. More research is needed to determine the impact of these contextual influences further.

Conclusion

To conclude, climate change risk perception and perceived effectiveness might play a significant role in the public acceptability of the two IPCC pathways. Considering that the pathways might be implemented in real life, as means to mitigate climate change, this study makes a valuable unique contribution to research in the acceptability context. Especially in regards to the practical significance of the findings, it could lay a base from which the acceptability of the pathways could be examined further. However, future research accounting for the limitations of the present study is called for. Exploring the generalizability, replicability, and causality of the findings is of great significance.

References

Bamberg, S., Masson, T., Brewitt, K., & Nemetschek, N. (2017). Threat, coping and flood prevention – A meta-analysis. *Journal of Environmental Psychology*, *54*, 116–126. https://doi.org/10.1016/j.jenvp.2017.08.001

Bergquist, M., Nilsson, A., Harring, N., & Jagers, S. C. (2022). Meta-analyses of fifteen determinants of public opinion about climate change taxes and laws. *Nature Climate Change*, *12*(3), 235–240. https://doi.org/10.1038/s41558-022-01297-6

Benzin teuer wie nie: Spritpreise steigen sprunghaft. tagesschau.de. (2022, May 30). Retrieved May 30, 2022, from https://www.tagesschau.de/wirtschaft/verbraucher/benzinpreise-105.html

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer. *Frontiers in Public Health*, *6*. https://doi.org/10.3389/fpubh.2018.00149

Bockarjova, M., & Steg, L. (2014). Can Protection Motivation Theory predict pro-environmental behavior? Explaining the adoption of electric vehicles in the Netherlands. *Global Environmental Change*, *28*, 276–288. https://doi.org/10.1016/j.gloenvcha.2014.06.010

Cavanaugh, J. E., & Neath, A. A. (2019). The Akaike information criterion: Background, derivation, properties, application, interpretation, and refinements. *WIREs Computational Statistics*, *11*(3). https://doi.org/10.1002/wics.1460

Drews, S., & van den Bergh, J. C. (2015). What explains public support for climate policies? A review of empirical and experimental studies. *Climate Policy*, *16*(7), 855–876. https://doi.org/10.1080/14693062.2015.1058240

Ejelöv, E., & Nilsson, A. (2020). Individual Factors Influencing Acceptability for Environmental Policies: A Review and Research Agenda. *Sustainability*, *12*(6), 2404. https://doi.org/10.3390/su12062404

Eriksson, L., Garvill, J., & Nordlund, A. M. (2008). Acceptability of single and combined transport policy measures: The importance of environmental and policy specific beliefs. *Transportation Research Part A: Policy and Practice*, *42*(8), 1117–1128. https://doi.org/10.1016/j.tra.2008.03.006

Floyd, D. L., Prentice-Dunn, S., & Rogers, R. W. (2000). A Meta-Analysis of Research on Protection Motivation Theory. *Journal of Applied Social Psychology*, *30*(2), 407–429. https://doi.org/10.1111/j.1559-1816.2000.tb02323.x

Gärtling, T., Loukopoulos, P., 2007. Effectiveness, public acceptance, and political feasibility of coercive measures for reducing car traffic. In: Gärtling, T., Steg, L., (Eds.), *Threats to the quality of urban life from car traffic: Problems, causes, and solutions.* (pp. 313-324). Elsevier.

Goldberg, M. H., Gustafson, A., Ballew, M. T., Rosenthal, S. A., & Leiserowitz, A. (2020). Identifying the most important predictors of support for climate policy in the United States. *Behavioural Public Policy*, *5*(4), 480–502. https://doi.org/10.1017/bpp.2020.39

Hebbali, A. (2020). _olsrr: Tools for Building OLS Regression Models_. R package version 0.5.3, https://CRAN.R-project.org/package=olsrr.

Huber, R. A., Wicki, M. L., & Bernauer, T. (2019). Public support for environmental policy depends on beliefs concerning effectiveness, intrusiveness, and fairness. *Environmental Politics*, *29*(4), 649–673. https://doi.org/10.1080/09644016.2019.1629171

Huijts, N., Molin, E., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renewable and*

Sustainable Energy Reviews, *16*(1), 525–531. https://doi.org/10.1016/j.rser.2011.08.018

Hunter, E., & Röös, E. (2016). Fear of climate change consequences and predictors of intentions to alter meat consumption. *Food Policy*, *62*, 151–160. https://doi.org/10.1016/j.foodpol.2016.06.004

IPCC, 2018: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

Kardooni, R., Yusoff, S. B., & Kari, F. B. (2016). Renewable energy technology acceptance in Peninsular Malaysia. *Energy Policy*, *88*, 1–10. https://doi.org/10.1016/j.enpol.2015.10.005

Klaus, G., Ernst, A., & Oswald, L. (2020). Psychological factors influencing laypersons' acceptance of climate engineering, climate change mitigation and business as usual scenarios. *Technology in Society*, *60*, 101222. https://doi.org/10.1016/j.techsoc.2019.101222

Klimabericht von UN-Experten: 1,5-Grad-Schwelle könnte bis 2026 überschritten werden. (2022, May 10). tagesschau.de. Retrieved May 19, 2022, from https://www.tagesschau.de/ausland/europa/erderwaermung-klimabericht-wmo-101.html

Kloke, J., & McKean, J. (2012). Rfit: Rank-based Estimation for Linear Models. *The R Journal*, *4*(2), 57. https://doi.org/10.32614/rj-2012-014

Lacroix, K., & Gifford, R. (2017). Psychological Barriers to Energy Conservation Behavior: The Role of Worldviews and Climate Change Risk Perception. *Environment and Behavior*, *50*(7), 749–780. https://doi.org/10.1177/0013916517715296

Mayer, A., & Smith, E. K. (2018). Unstoppable climate change? The influence of fatalistic beliefs about climate change on behavioural change and willingness to pay cross-nationally. *Climate Policy*, *19*(4), 511–523. https://doi.org/10.1080/14693062.2018.1532872

Perlaviciute, G., Görsch, R., Timmerman, M., Steg, L., & Vrieling, L. (2021). Values in the backyard: the relationship between people's values and their evaluations of a real, nearby energy project. *Environmental Research Communications*, *3*(10), 105004. https://doi.org/10.1088/2515-7620/ac25d0

Pidgeon, N., Corner, A., Parkhill, K., Spence, A., Butler, C., & Poortinga, W. (2012). Exploring early public responses to geoengineering. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *370*(1974), 4176–4196. https://doi.org/10.1098/rsta.2012.0099

Qualtrics. (2005). *Qualtrics International Inc.* (May, 2022). Qualtrics. https://www.qualtrics.com

Rainear, A. M., & Christensen, J. L. (2017). Protection Motivation Theory as an Explanatory Framework for Proenvironmental Behavioral Intentions. *Communication Research Reports*, *34*(3), 239–248. https://doi.org/10.1080/08824096.2017.1286472

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Rhodes, E., Axsen, J., & Jaccard, M. (2017). Exploring Citizen Support for Different Types of Climate Policy. *Ecological Economics*, *137*, 56–69. https://doi.org/10.1016/j.ecolecon.2017.02.027

Rizopoulos, D., (2006). ltm: An R package for Latent Variable Modelling and Item Response Theory Analyses, *Journal of Statistical Software*, 17 (5), 1-25. URL https://doi.org/10.18637/jss.v017.i05

Seetharaman, Moorthy, K., Patwa, N., Saravanan, & Gupta, Y. (2019). Breaking barriers in deployment of renewable energy. *Heliyon*, *5*(1), e01166. https://doi.org/10.1016/j.heliyon.2019.e01166

Spence, A., Poortinga, W., Pidgeon, N., & Lorenzoni, I. (2010). Public Perceptions of Energy Choices: The Influence of Beliefs about Climate Change and the Environment. *Energy & Environment*, *21*(5), 385–407. https://doi.org/10.1260/0958-305x.21.5.385

The Intergovernmental Panel on Climate Change. IPCC. (n.d.). Retrieved June 15, 2022, from https://www.ipcc.ch/

Tollefson, J. (2022). What the war in Ukraine means for energy, climate and food. *Nature*, *604*(7905), 232–233. https://doi.org/10.1038/d41586-022-00969-9

van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*, *41*, 112–124. https://doi.org/10.1016/j.jenvp.2014.11.012

van der Linden, S. (2017). Determinants and Measurement of Climate Change Risk Perception, Worry, and Concern. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2953631

Visschers, V. H., & Siegrist, M. (2014). Find the differences and the similarities: Relating perceived benefits, perceived costs and protected values to acceptance of five energy

technologies. *Journal of Environmental Psychology*, *40*, 117–130. https://doi.org/10.1016/j.jenvp.2014.05.007

Wan, C., Shen, G. Q., & Yu, A. (2014). The moderating effect of perceived policy effectiveness on recycling intention. *Journal of Environmental Psychology*, *37*, 55–60. https://doi.org/10.1016/j.jenvp.2013.11.006

Wang, C., Geng, L., & Rodríguez-Casallas, J. D. (2021). How and when higher climate change risk perception promotes less climate change inaction. *Journal of Cleaner Production*, *321*, 128952. https://doi.org/10.1016/j.jclepro.2021.128952

Wicker, P., & Becken, S. (2013). Conscientious vs. ambivalent consumers: Do concerns about energy availability and climate change influence consumer behaviour? *Ecological Economics*, *88*, 41–48. https://doi.org/10.1016/j.ecolecon.2013.01.005

Wickham, H., Averick, M., Bryan, J., Chang, W., D'Agostino McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T. L., Miller, E., Milton Bache, S., Müller, K., Ooms, J., Robinson, D., Seidel, D. P., Spinu, V., … Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, 4(43), 1686, https://doi.org/10.21105/joss.01686

Zahran, S., Brody, S. D., Grover, H., & Vedlitz, A. (2006). Climate Change Vulnerability and Policy Support. *Society & Natural Resources*, *19*(9), 771–789. https://doi.org/10.1080/08941920600835528

Appendix A

Figure A1

Pathway Descriptions

Pathway Descriptions
*explanations for terms in **bold** are included in the brackets.*

We are interested in people's stand toward changes suggested by the **IPCC** *(Multidisciplinary group of United Nations experts who prepare reports about the current knowledge on climate change)* to limit the **effects expected from global warming** *(e.g. increase in heat waves, droughts, heavy rainfalls, extreme weather events, water and food shortages)*. To avoid an increase beyond **1.5° C,** the IPCC has suggested multiple pathways *(A global average temperature increase of 1.5°C above pre-industrial levels has been selected as a "tipping point" beyond which the effects of climate change are much harder to reverse or mitigate)*.

Implementation of these pathways requires changes to *industry* and *everyday behaviour on a global level*. They will affect our *lifestyles* and *economy*.
The two pathways we are focusing on differentiate in two main aspects: the **overshoot** they allow for, and the way they aim to reach a stable temperature *(Rising above 1.5°C, then being brought back down. This may bring changes that we would not be able to reverse, even if we can reverse the warming itself)*.

Pathway A aims to limit the overshoot of 1.5°C to a maximum of 1.6°C, keeping the effect of climate change as low as possible.
Pathway B does not aim to limit the overshoot of 1.5°C, allowing it to go beyond 1.6°C, risking higher effects of climate change.

To limit the effects, both pathways aim to return to 1.5°C by the end of the 21st century.

Pathway A expects rapid transitions to future energy production systems and implementation of industry and lifestyle policies. Pathway B expects slower transitions, resulting in overshoot, which is then reversed using **carbon capture** *(A future technology proposed to remove CO2 from the atmosphere and store it in the ground)*. There would be no need to change from the current CO2-emission-intensive lifestyle.

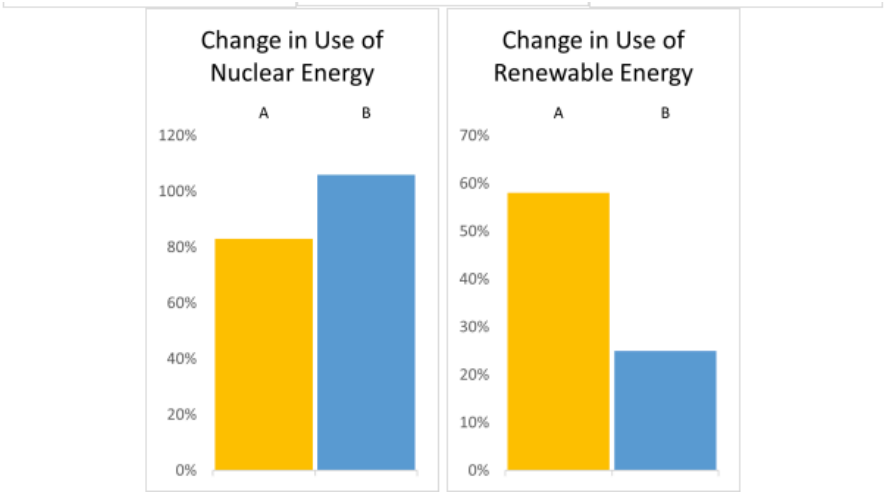
Details of the proposed energy transitions can be seen below:

Pathway A reduces energy demand by 5% by 2030

- Eating local and seasonal foods
- Reducing meat and dairy consumption
- Reducing waste in water, food and transportation industries
- Using resources more efficiently (insulation etc.)
- **Low emission innovations** *(Electric vehicles, heat pumps, district heating and cooling, future cars give off less emissions)*
- Energy-saving behaviour (walking, cycling, mass transit, lower heating)
- Organisational change (replacing business travel by video calls)
- Flood protective behaviour Heat protective behaviour (green roofs)
- Efficient water use (rationing)

Pathway B increases energy demand by 39% by 2030

- Increased economic growth and globalisation
- Increased meat and dairy consumption
- Increased demand for fuel
- Increased worldwide shipping
- **Electrification** *(replacing technologies that use fossil fuels, e.g., coal, oil, and natural gas, with technologies that run on electricity)*
- Building desalination plants to convert seawater into freshwater



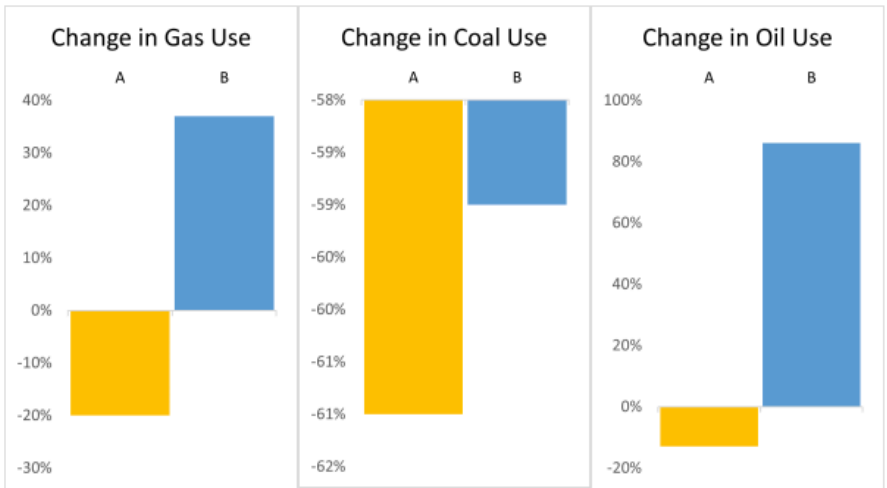
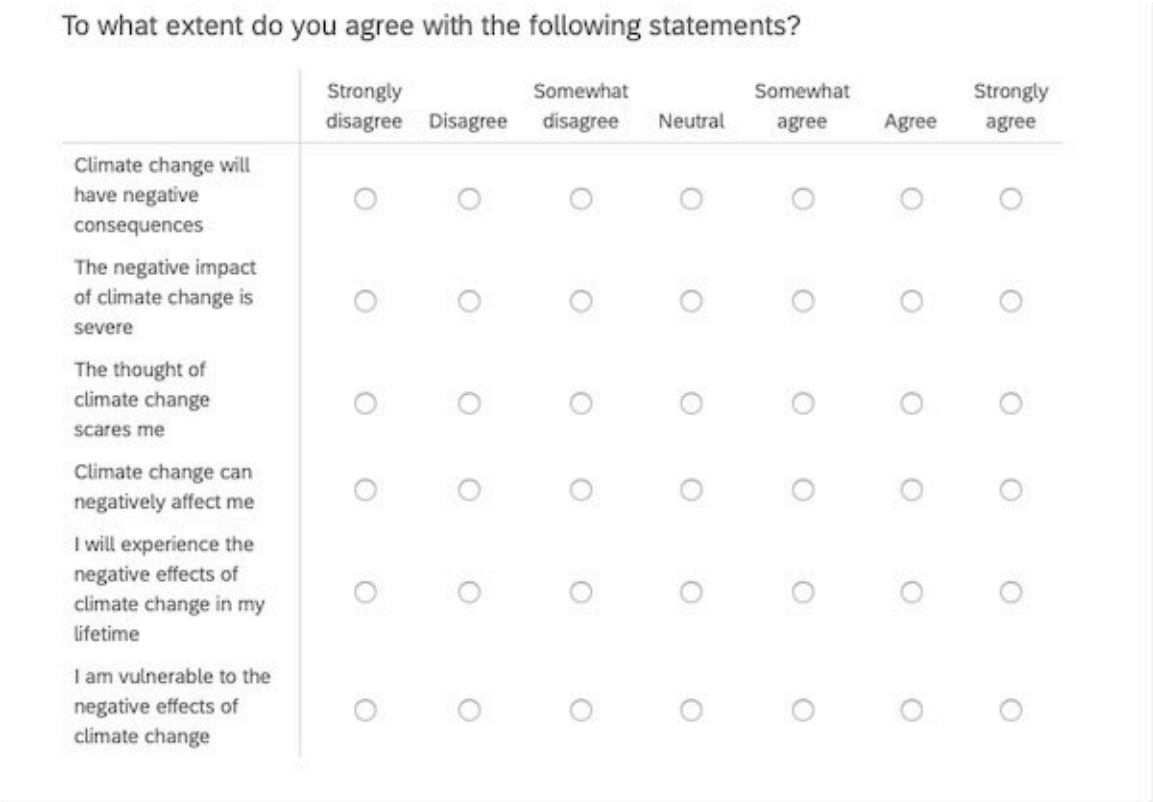


Figure A2

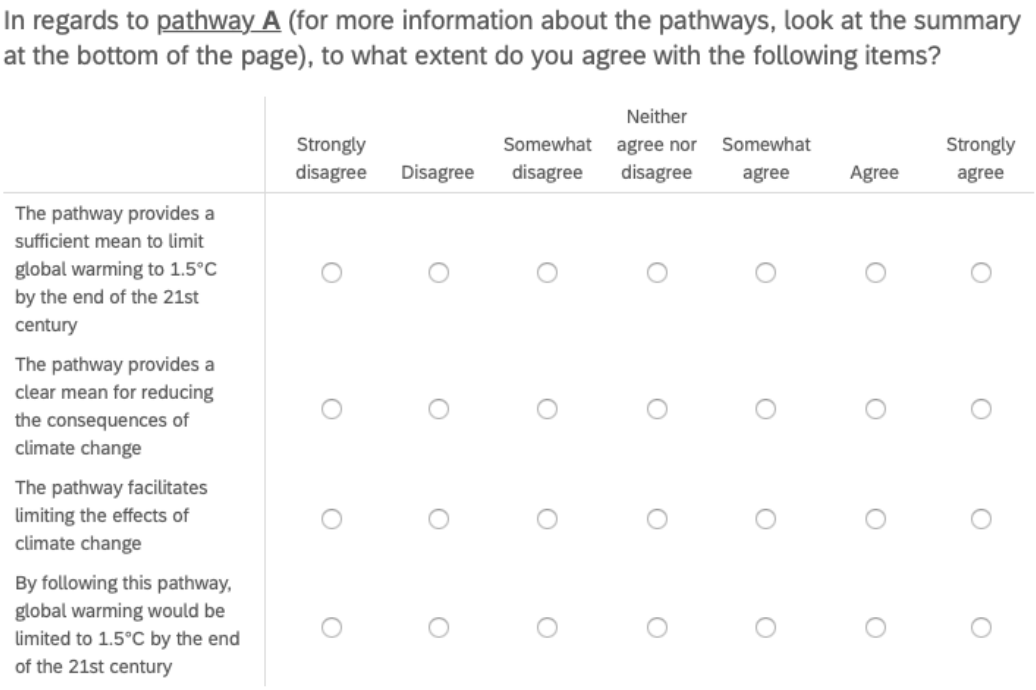
Climate Change Risk Perception Scale


To what extent do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
Climate change will have negative consequences	○	○	○	○	○	○	○
The negative impact of climate change is severe	○	○	○	○	○	○	○
The thought of climate change scares me	○	○	○	○	○	○	○
Climate change can negatively affect me	○	○	○	○	○	○	○
I will experience the negative effects of climate change in my lifetime	○	○	○	○	○	○	○
I am vulnerable to the negative effects of climate change	○	○	○	○	○	○	○

Figure A3

Perceived Effectiveness Scale


In regards to pathway **A** (for more information about the pathways, look at the summary at the bottom of the page), to what extent do you agree with the following items?

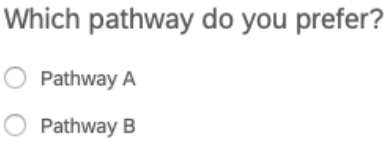
	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The pathway provides a sufficient mean to limit global warming to 1.5°C by the end of the 21st century	○	○	○	○	○	○	○
The pathway provides a clear mean for reducing the consequences of climate change	○	○	○	○	○	○	○
The pathway facilitates limiting the effects of climate change	○	○	○	○	○	○	○
By following this pathway, global warming would be limited to 1.5°C by the end of the 21st century	○	○	○	○	○	○	○

Figure A4

Acceptability Scale

Figure A5

Choice Item



Appendix B

Table B1

Means and Standard Deviations of all Relevant Continuous In- and Dependent Variables

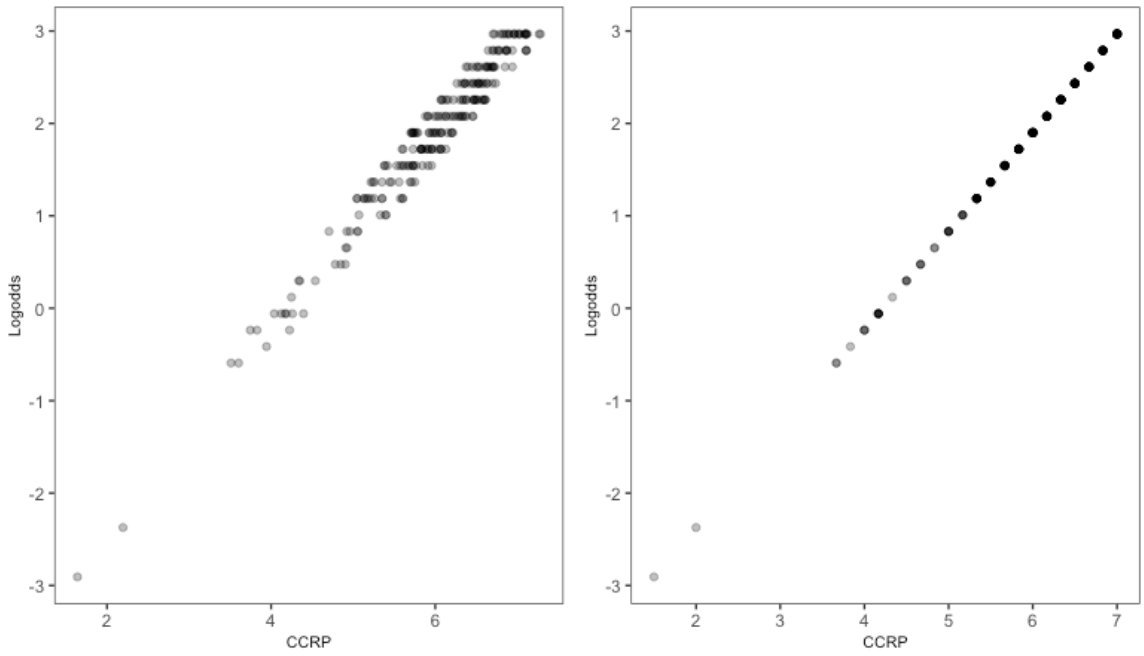
Descriptives	Variables				
	CCRP	Perceived Effectiveness P2	Perceived Effectiveness P4	Acceptability P2	Acceptability P4
Mean	6.0	5.4	3.1	5.8	3.2
Standard Deviation	0.9	1.0	1.3	1.1	1.4

Note. Responses for CCRP and perceived effectiveness were recorded on a 7-point Likert scale ranging from 1 = *strongly disagree* to 7 = *strongly agree.* Responses for acceptability were recorded on a 7-point Likert scale with three items ranging from *not at all acceptable* (1) - *very acceptable* (7), *very bad* (1) – *very good* (7), *not at all necessary* (1) – *very necessary* (7).

Appendix C

Figure C1

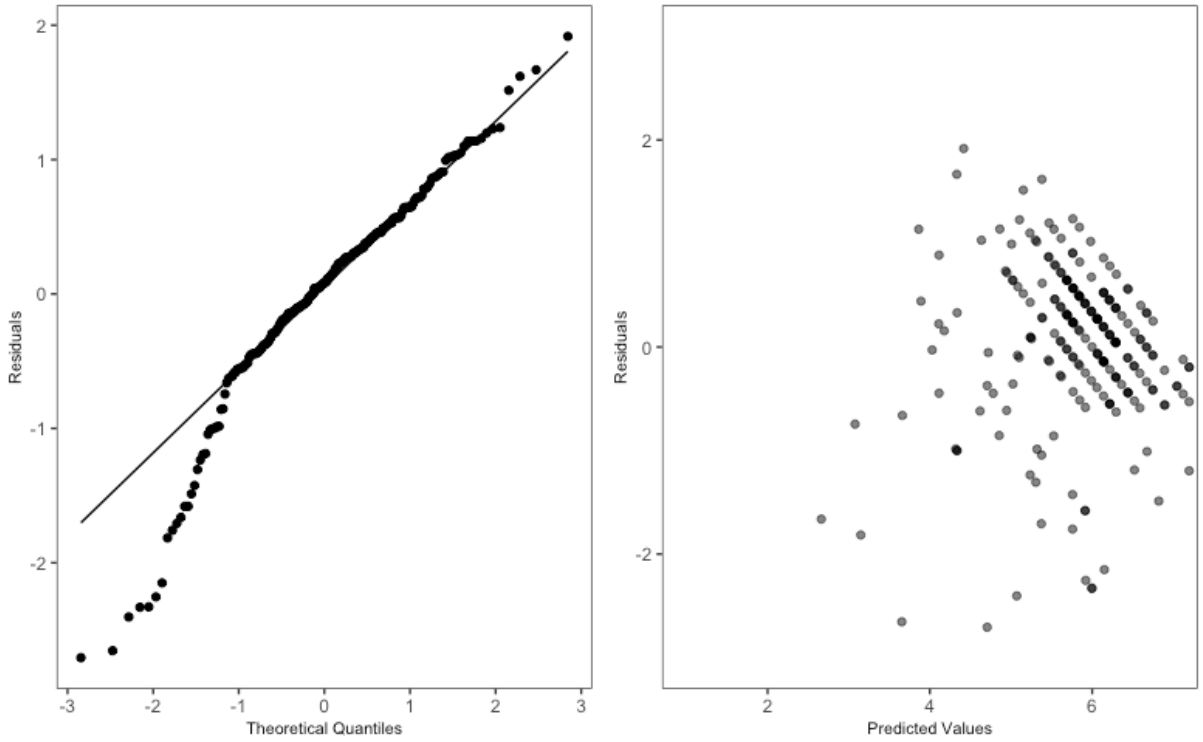
Linearity Assumption Check Between CCRP and the Log Odds for the Logistic Regression (H1a)



Note. The log odds are plotted against the values of the predictor (CCRP). The points in the plots on the left side have been artificially spread to illustrate that multiple points lie on top of each other. The plot on the right side depicts the original plot.

Figure C2

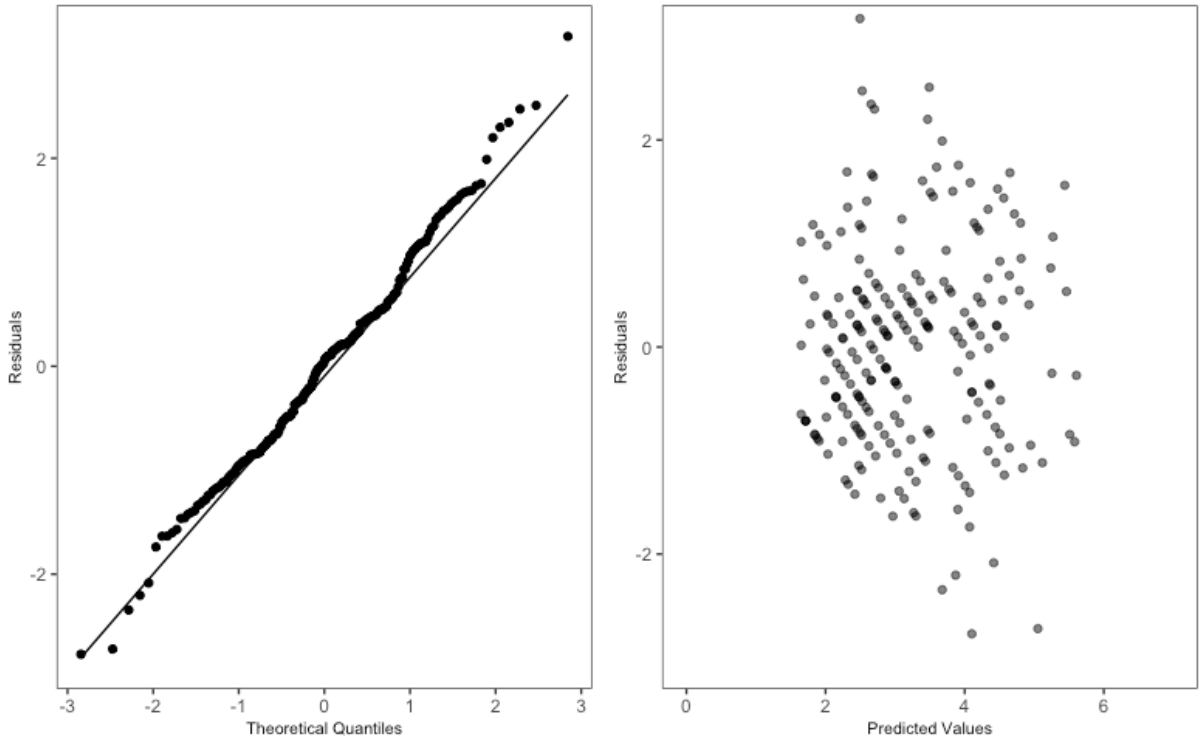
Residual Plots for the Assumption Checks of H1b & H2 (for P2)



Note. Normality Assumption (left) and Homoscedasticity & Linearity Assumptions (right). In the left plot, residuals are plotted against the theoretical quantiles. In the right plot, the residuals are plotted against the predicted values of the predictors.

Figure C3

Residual Plots for the Assumption Checks of H1c & H2 (for P4)

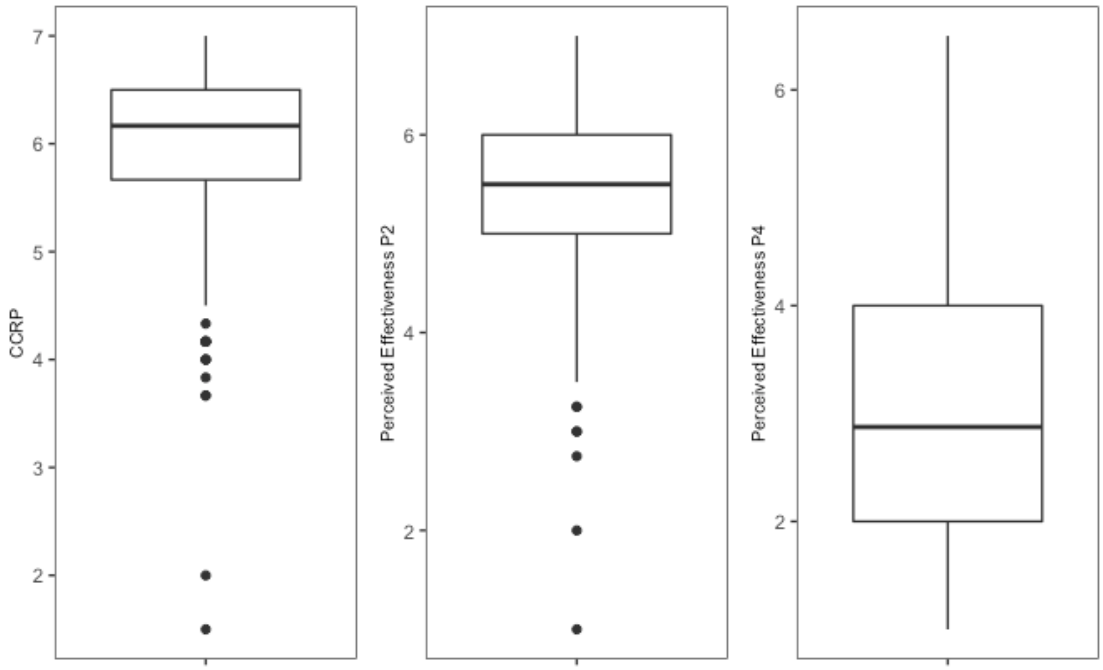


Note. Normality Assumption (left) and Homoscedasticity & Linearity Assumptions (right). In the left plot, residuals are plotted against the theoretical quantiles. In the right plot, the residuals are plotted against the predicted values of the predictors.

Appendix D

Figure D1

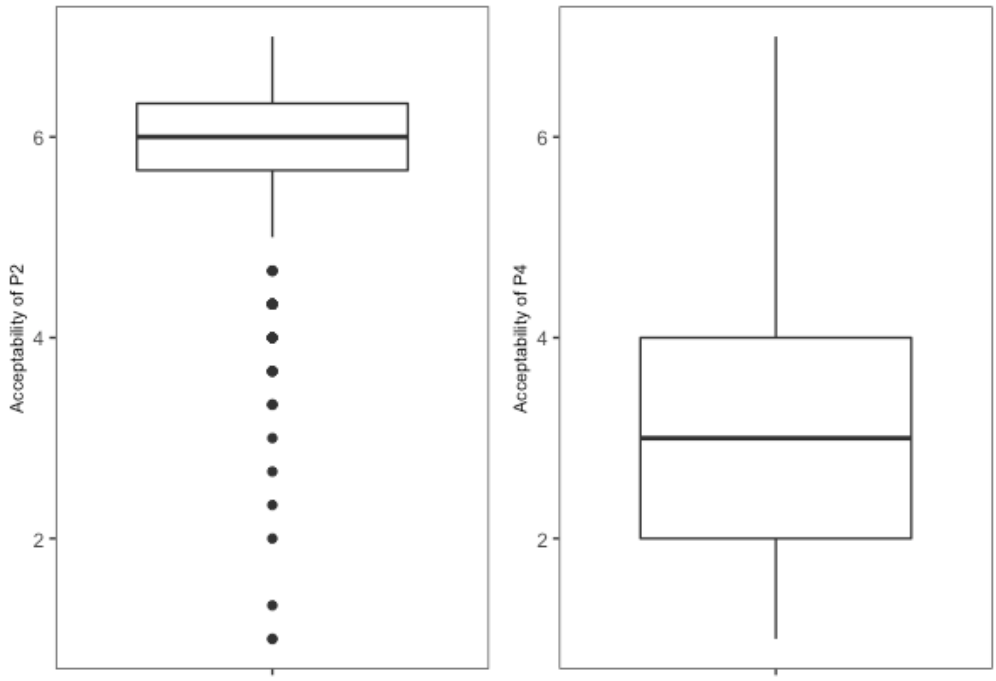
Distribution of the Data for the Independent Variables



Note. A ceiling effect could be observed for CCRP (left). Responses for the perceived effectiveness of P2 were left-skewed (middle) and responses for the perceived effectiveness of P4 were right-skewed (right).

Figure D2

Distribution of the Data for the Dependent Variables



Note. Responses for the acceptability of P2 were left-skewed (left). The distribution of responses for the acceptability of P4 was right-skewed (right).

Figure D3

Associations Between the Independent and Dependent Variables

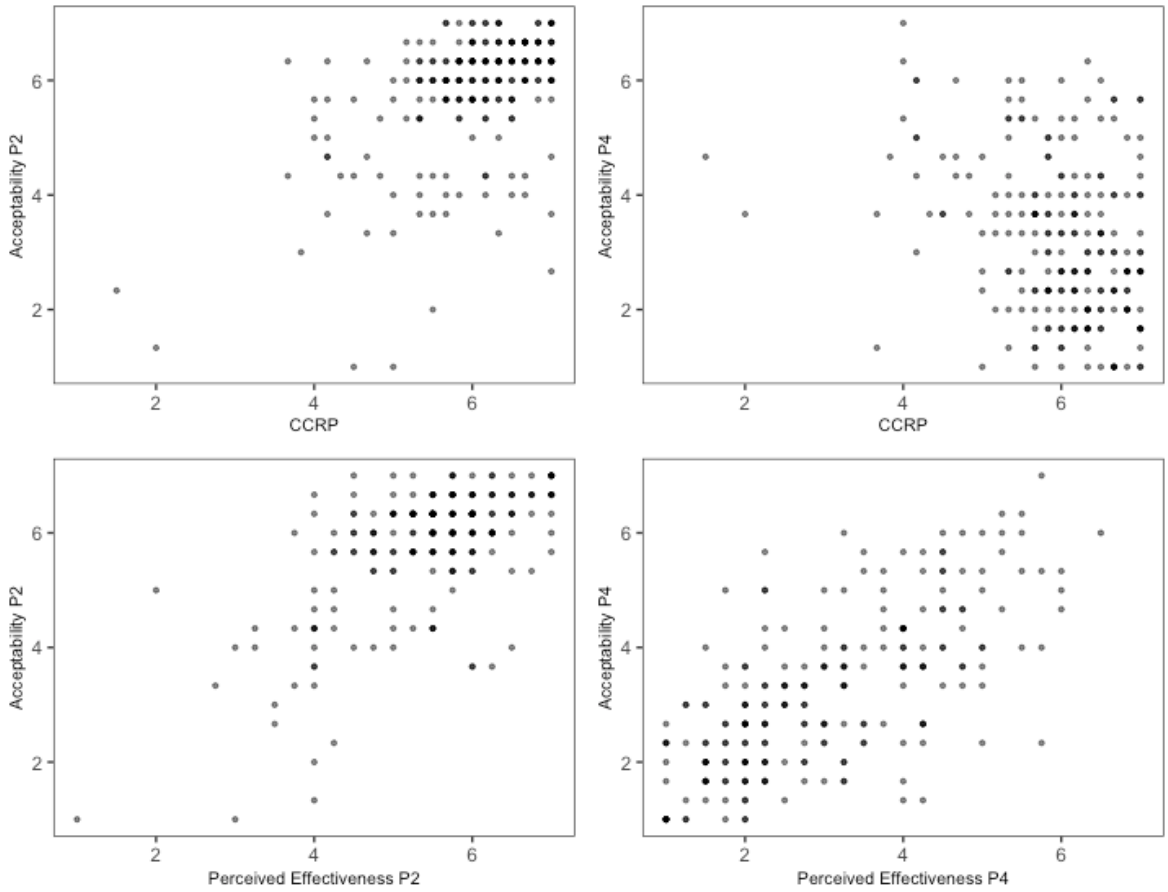


Table D4

Correlations with Confidence Intervals for All Relevant In- and Dependent Variables

Variable	1	2	3	4
1. CCRP	-			
2. Perceived Effective-ness P2	.28** [.15, .39]	-		
3. Perceived Effective-ness P4	-.30** [-.42, -.18]	-.13 [-.26, .00]	-	
4. Acceptability P2	.49** [.39, .59]	.62** [.54, .70]	-.28** [-.39, -.15]	-
5. Acceptability P4	-.32**	-.08	.69**	-.29**

	[-.43, -.19]	[-.21, .05]	[.61, .75]	[-.41, -.17]

Note. Values in square brackets indicate the 95% confidence interval for each correlation.

** $p < .01$.

Appendix E

Table E1

Rank-based Regression Results with Acceptability of Pathway 2 as the Criterion

Predictor	*b*	*SE*	Fit
(Intercept)	0.60	0.32	
CCRP	0.40**	0.05	
Perceived Effective-ness P2	0.53**	0.04	
			R^2 = 0.44**

Note. ** $p < .01$.