

Article

Climate Change Risk Perceptions of Audiences in the Climate Change Blogosphere

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Abstract: The Climate Change Risk Perception Model (CCRPM, Van der Linden, 2015) has been used to characterize public risk perceptions; however, little is known about the model's explanatory power in other (online) contexts. In this study, we extend the model and investigate the risk perceptions of a unique audience: The polarized climate change blogosphere. In total, our model explained 84% of the variance in risk perceptions by integrating socio-demographic characteristics, cognitive factors, experiential processes, socio-cultural influences, and an additional dimension: Trust in scientists and blogs. Although trust and the scientific consensus are useful additions to the model, affect remains the most important predictor of climate change risk perceptions. Surprisingly, the relative importance of social norms and value orientations is minimal. Implications for risk and science communication are discussed.

Keywords: climate change; risk perception; blogs; CCRPM

1. Introduction

Over the years, climate change blogs have become a popular outlet in which climate science, politics, policy, and other topics are discussed [1]. Especially since the 'climategate' episode, which significantly influenced public trust and opinion [2], blogs played a prominent role in the global climate discussion, influencing scientific, political, and media discourse [3–6]. There is a community of "climate skeptical bloggers" that rejects the scientific consensus on climate change [7]. Some of these bloggers are part of a greater network of scientists, conservative think tanks, and private corporations that intentionally spread misinformation on climate change to delay action [8–10]. This network uses blogs as one of their main communication outlets [1]. Next to that, there are various communities of bloggers that support the scientific consensus on climate change ("climate mainstream bloggers") [7], for example climate scientists that blog to correct misinformation on climate change [11]. Previous studies showed that persistent polarization around climate change manifests itself in online communities and topics [7], hyperlinking [12,13], bloggers' operationalization of journalistic norms [11], discursive constructions of reality [14,15], and interaction strategies in comment threads [16] of the climate change blogosphere. Importantly, to date, little research has focused on audiences in the climate change blogosphere.

Climate change blog visitors form a unique media audience in comparison to other audiences, since climate skepticism is widespread in the climate change blogosphere. Lewandowsky, Oberauer, et al. [3] (p. 213) note that visitors of climate change blogs are "a self-selected audience that is by definition highly engaged in the increasingly polarized climate debate". A user thread analysis of the Air Vent blog, in which readers commented about their various background and how they became interested in climate science, reveals that climate change blogs were important in forming climate skepticism [17].

In a recent experiment, Lewandowsky et al. [1] find that climate blogs that either do or do not support the scientific consensus can partially shape public opinion on the issue. Although research on climate skepticism and the rejection of climate science makes clear that blogs can exert significant effects on public opinion, to the best of our knowledge, no other studies have systematically assessed audiences' climate change risk perceptions and the socio-psychological factors that explain these perceptions. Such research is crucial though, as Lewandowsky, Oberauer, et al. [3] (p. 629) note: *"This group of people has a demonstrable impact on society and understanding their motivations and reasoning is therefore of importance"*.

Hence, the current research will examine the climate change risk perceptions of audiences in the English-language climate mainstream blogosphere. Breakwell [18] (p. 858) defines a risk representation as *"the product of a process in which a hazard is recognized, its characteristics identified, and the probability of its negative impacts occurring are estimated"*. Climate change poses a "unique" risk [18], as the causes are invisible and the impacts are temporal and often geographically distant [19]. Because the notion of "risk" is socially constructed [20,21], blogs can act as a powerful conduit, shaping public risk perception through both posts and subsequent discussion [1].

To investigate risk perceptions in the climate mainstream blogosphere, the current research will adopt and advance the Climate Change Risk Perception Model (CCRPM) of Van der Linden [22]. The goals of the current research are twofold. First, we will test the CCRPM in a novel context by investigating the socio-psychological factors that predict the climate change risk perceptions of blog audiences. Second, we aim to improve the explanatory power of the model by adding trust and knowledge about the scientific consensus as new predictor variables.

2. Theoretical Framework

To date, the CCRPM of Van der Linden [21,22] has been one of the most successful climate change risk perception models, predicting 68% of the variance in climate change risk perceptions. Although the CCRPM was initially validated on a representative national sample of the UK population [22], Xie et al. [23] replicated the CCRPM amongst a representative sample of the Australian general public, which accounted again for 68% in variance.

For the first time, a variation of the CCRPM will be applied to a media audience instead of the general public. Therefore, we expect to find slightly different results, as skepticism is more prevalent in the climate change blogosphere than amongst the general public [1,7,24,25]. Moreover, this audience is highly engaged with climate change in comparison to the general public [3]. As such, the current research will provide novel insights into whether the CCRPM produces largely consistent results across different target populations.

Van der Linden [22] conducted a literature review to get an overview of the psychological factors that drive and shape climate change risk perceptions. Past research shows that factors that predict climate change risk perceptions can mostly be categorized into socio-demographic, cognitive, experiential, and socio-cultural dimensions [26]. Accordingly, the CCRPM model combines and integrates cognitive factors, experiential processing mechanisms, and socio-cultural influences, while controlling for key socio-demographic characteristics. In the following section, these four dimensions of the original CCRPM will be outlined. Importantly, Van der Linden [22] (p. 122) wrote: *"While the aim of the current study was to examine key social-psychological determinants, the list is certainly not exhaustive, as other important factors have also been noted to influence risk perception, including trust in scientists"*. Accordingly, the CCRPM+ will be proposed as a new model that incorporates knowledge about the scientific consensus and trust in scientists and blogs to specifically examine risk perceptions in the blogosphere.

2.1. Dimensions of the Climate Change Risk Perception Model

In the original CCRPM, key *socio-demographic characteristics* include gender, age, education, income, religiosity, and political party affiliation. In the final model of Van der Linden [22], only gender and

political party affiliation appeared to be significant predictors of variances in climate change risk perceptions, accounting for 2.2% of the explained variance. Consistent with these results, being female and holding liberal political views are generally both associated with higher climate change risk perceptions, e.g., see [27,28].

The *cognitive* dimension comprises knowledge about the causes, impacts, and responses to address climate change. In the final model of Van der Linden [22], all these factors contributed to 9.3% of the explained variance in climate change risk perceptions. In line with these results, studies generally show that if 'accurate' knowledge about climate change is assessed, this factor is a positive and significant predictor of climate change risk perceptions, e.g., see [29,30].

The *experiential processing* dimension consists of affect and personal experiences with extreme weather events. The factor affect here draws on a variety of affective-laden adjectives (unpleasant, unfavorable, and negative) to establish 'holistic' affect. In the final model of Van der Linden [22], both factors were strong predictors of variances in risk perceptions, accounting for 22.1% of the explained variance, also see [23]. Other research on experiential processing generally revealed similar results, in which negative affective evaluations of climate change, e.g., see [28,31], and experiences with extreme weather events, e.g., see [32,33], are influential predictors of high climate change risk perceptions.

Lastly, the dimension that comprises *socio-cultural influences* includes social norms and value orientations. Van der Linden [22] (p. 116) distinguished between descriptive social norms and prescriptive social norms, whereas the first refers to "the extent to which referent others are taking action to help reduce the risk of climate change" and the latter to "the extent to which an individual feels socially pressured to view climate change as a risk that requires action". Moreover, following prior research, Van der Linden [22] (p. 116) also distinguished between: "(1) egoistic values (i.e., maximizing individual outcomes), (2) socio-altruistic values (i.e., caring about others), and (3) biospheric values (i.e., caring for non-human nature and the biosphere itself)" [34,35]. In the final model of Van der Linden [22], descriptive and prescriptive social norms and biospheric values were significant predictors and contributed to the majority of 34.4% of the explained variance in climate change risk perceptions. These results are consistent with other research on the influence of social norms, e.g., see [36,37], and value orientations, e.g., see [38,39], on climate change risk perceptions.

2.2. CCRPM+

Given the high relevance of trust in scientists and the scientific consensus for the blogosphere [1], in the current research, we aim to increase the explanatory power further by adding trust in sources of information about climate change and knowledge about the scientific consensus. We dub this new theoretical model the CCRPM+ (see Figure 1).

The role of *trust* in risk assessments has been recognized by many studies that discuss extreme distrust of the public in individuals, industries, and institutions responsible for risk management [40]. In the context of climate change, scientists are generally the most trusted source of information about climate change [2,41,42]. Importantly, trust in scientists is associated with greater concerns about the issue, while distrust in scientists is associated with little concern [2,43], but there are exceptions, e.g., see [44]. Trust is often conditional on political ideology such that Liberals are more likely than Conservatives to trust scientists as a source of information about climate change [45]. Moreover, trust in media as a source of information about climate change is also an important predictor of risk perceptions, where different groups of audiences trust different media [41,46]. Previous research has shown that trust in scientists mediated the effect of news media on public perceptions [47]. Van der Linden [22] himself noted that trust in scientists was potentially an interesting addition to the original model. Accordingly, the current research will investigate respondents' trust in (a) scientists; (b) climate skeptical blogs; and (c) climate mainstream blogs as a source of information about climate change. Because trust does not fit any of the existing dimensions of the CCRPM, it will be added as a new dimension.

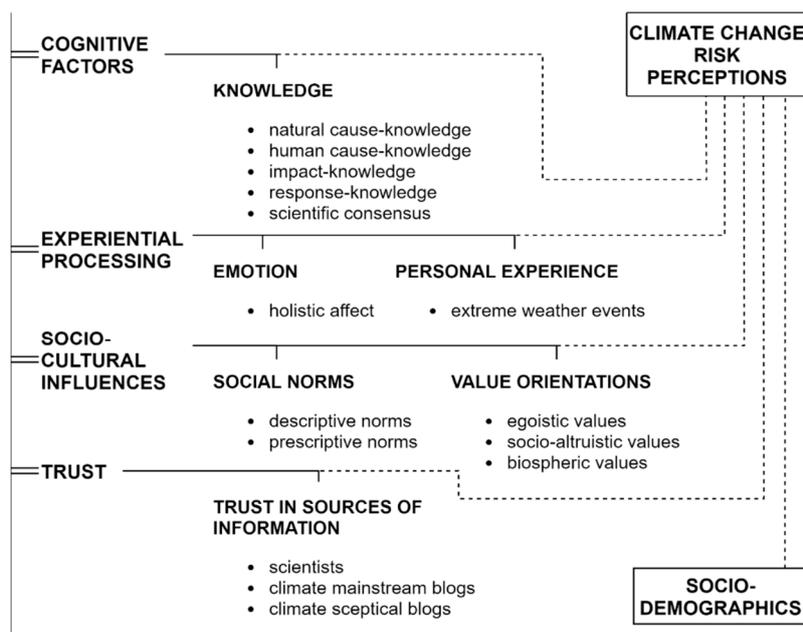


Figure 1. Climate Change Risk Perception Model (CCRPm+).

Additionally, research has generally found that the cognitive dimension of the original model contributes least to risk perception (~9% in Van der Linden [22] and ~4% in Xie et al. [23] for the original dimension). Most studies show a 97% agreement amongst climate scientists that climate change is human-caused [48–50]. Previous research has shown that respondents' *knowledge about this scientific consensus* is an important “gateway” to concern about climate change [22,51–53]. Therefore, the current research will also test respondents' knowledge about the scientific consensus on climate change, by adding it to the cognitive dimension in an attempt not to underestimate the influence of different kinds of knowledge on public risk perception.

3. Materials and Methods

3.1. Research Design

The current research is a cross-sectional study ($N = 674$), in which data were obtained through a survey questionnaire that was disseminated amongst audience members in the English-language climate mainstream blogosphere.

3.2. Materials and Procedure

The project proposal was reviewed and approved of by the Social Sciences Ethics Committee of Wageningen University and Research (WUR) and preregistered on As Predicted (<https://aspredicted.org/xe7xj.pdf>). The survey was pilot tested at the Communication, Philosophy, and Technology section of WUR. The input was used to refine the language and restructure the order of items of the survey. Subsequently, 66 bloggers of English-language climate change blogs were invited to publish the survey on their blog. All of the 29 approached climate skeptical bloggers either did not reply or informed us that they did not want to participate (climate skeptical bloggers that did not want to participate provided different reasons for that; for example, because they did not trust the researchers or did not endorse the survey). Ultimately, the survey was posted on 12 climate mainstream blogs, e.g., *Real Climate*, *...And Then There's Physics*, and *Hot Whopper*. These climate mainstream blogs consist of climate science and climate activist blogs (see Supplement 1 for a more elaborate description of the blogs).

The survey was launched on the first blog on 8 October 2019, and shortly after this date the 11 other blogs each published the survey. Participation was on a voluntary basis and anonymous. Respondents also had the opportunity to leave their contact details to get a chance of winning a gift card or get a sneak peak of the results. To prevent that the sample would not include any climate skeptical blog audience members, in the event that none of the climate skeptical blogs would post the survey, we preregistered that we would employ a quota sampling strategy. Quota sampling was used to determine whether data collection would continue after one month; the goal was to collect at least 100 responses of audience members that answered 'yes' to the question whether they "visit blogs that reject evidence for human-caused climate change" (Y/N) and at least 100 responses of audience members that answered 'yes' to whether they "visit blogs that support evidence for human-caused climate change" On 8 November 2019, data collection ended. A total of 832 audience members participated in the survey.

3.3. Measures

This paper used the same measures as Van der Linden [22], while making several adjustments. Questions were tailored to an international audience instead of the UK general public. In addition, the knowledge scale was updated by obtaining input of an IPCC scientist, e.g., by making a distinction between knowledge about the natural and human causes of climate change. Moreover, new measures were added that tested respondents trust in scientists and climate change blogs and their knowledge about the scientific consensus. Please see Supplement 2 for an elaborate description of all measures.

3.3.1. Risk Perception

Following Van der Linden [22], a holistic risk perception index was created. A total of 8 items evaluated respondents' risk perceptions across affective, cognitive, and temporal-spatial dimensions on a 7-point Likert scale. For example, respondents were asked "How serious of a threat do you think that climate change is to the natural environment?" A highly reliable score was obtained ($M = 5.73$, $SD = 1.40$, $\alpha = 0.95$).

3.3.2. Knowledge about Climate Change

Four scales with in total 50 randomly ordered items were created about natural causes, human causes, impact, and responses to test respondents' knowledge about climate change. For example, the natural cause-knowledge scale asked respondents to what extent each item (i.e., volcanic eruptions) contributes to natural influences on climate change (i.e., major, minor, or no contribution). In total, 37 of the statements were "correct", which means that there is a strong scientific consensus in the literature on these statements. Importantly, prior to each scale, respondents answered a question about their beliefs in climate change. Depending on this answer, skip logic was applied in order to avoid that respondents would get tired of reviewing statements that were, according to them, based on false assumptions about climate change (these 20 responses with missing data were removed from the dataset). The statements were reviewed by two climate scientists [22] and updated by another climate scientist for accuracy. Responses were dichotomized as either right (1) or wrong (0) and for each respondent a mean score per scale was calculated. Reliable scores were obtained for the impact scale ($M = 0.86$, $SD = 0.18$, $\alpha = 0.77$), and response scale ($M = 0.85$, $SD = 0.16$, $\alpha = 0.68$). The natural cause scale ($M = 0.85$, $SD = 0.19$, $\alpha = 0.40$) and human cause scale ($M = 0.86$, $SD = 0.12$, $\alpha = 0.45$) were less reliable. The natural cause scale was not validated previously and therefore omitted from the analysis. However, since the human cause scale has been validated in earlier research [22,23], it was retained in the current research for comparative purposes.

In addition, following Van der Linden [22], a single-item measure asked respondents to indicate, to the best of their knowledge, “what percentage of climate scientists have concluded that human-caused climate change is happening (0–100%)”. Again, responses were dichotomized as either correct (1) or wrong (0). Based on IPCC’s very likely probability indication, a scientific consensus of 90% or higher was considered as correct [54] ($M = 93.68$, $SD = 13.69$).

3.3.3. Holistic Affect

Three 7-point bi-polar adjective items were used to evaluate holistic affect, e.g., “I believe that climate change is something very positive” (strongly disagree–strongly agree). A reliable score was obtained ($M = 6.55$, $SD = 0.82$, $\alpha = 0.94$).

3.3.4. Personal Experience with Extreme Weather Events

Respondents were asked in a single-item measure how often they have personally experienced any type of extreme weather event in their local area (e.g., floods, severe heat waves, droughts, freak storms, etc.) while residing in their country of residence (never, once, twice, more than three). Responses were dichotomized into 0 = no experience ($N = 127$) and 1 = experience ($N = 547$).

3.3.5. Broad Value Orientations

De Groot and Steg’s [55] standardized value scales were used to measure respondents’ broad value orientations. The egoistic, socio-altruistic, and biospheric value scales comprised four randomly ordered items each. Respondents rated the importance of 12 values as guiding principles in their lives on a 9-point Likert scale, ranging from –1 opposed to my values, 0 not important, to 7 extremely important. A reliable score was obtained for altruistic ($M = 7.19$, $SD = 1.36$, $\alpha = 0.82$) and biospheric ($M = 7.22$, $SD = 1.50$, $\alpha = 0.90$) values. The egoistic scale was less reliable ($M = 3.58$, $SD = 1.06$, $\alpha = 0.57$); however, it was still included in the analysis as this scale has been included in previous research [22,23].

3.3.6. Social Norms

Descriptive norm: On a 7-point Likert-scale, respondents answered three items about how likely they think it is that important referent others are taking personal action to help tackle climate change. A reliable score was obtained ($M = 4.01$, $SD = 1.46$, $\alpha = 0.87$).

Prescriptive norm: Similarly, on a 7-point Likert scale, respondents answered four items about the extent to which they feel socially pressured to personally help reduce the risk of climate change. A reliable score was obtained ($M = 5.05$, $SD = 1.24$, $\alpha = 0.79$).

3.3.7. Socio-Demographic Factors

Respondents’ gender (1 = female), age, country of residence, income, education, and political views were surveyed. We measured respondents’ political views with a 7-point slider, as follows: “Here is a 7-point scale on which the political views that people might hold are arranged from extremely liberal (left) to extremely conservative (right). Where would you place yourself on this scale?” Political views were recoded into binary responses (Left-wing: $0 > 3.5 = 1$, Right-wing: $3.5 \geq 7 = 0$).

3.3.8. Trust in Sources of Information about Climate Change

The single-item measure of Hmielowski et al. [47] was used to assess trust in scientists. Respondents were asked “how much they trust scientists as a source of information about climate change”, on a 7-point Likert scale ($M = 6.38$, $SD = 1.16$). Two other items on a 7-point Likert scale asked respondents “how much they trust blogs that *support* evidence for human-caused climate change as a source of information” and “how much they trust blogs that *reject* evidence for climate human-caused climate change” (climate mainstream: $M = 5.70$, $SD = 1.31$, climate skeptic: $M = 6.30$, $SD = 1.19$, $r = 0.57$).

3.4. Statistical Analysis

The responses with missing data (mostly drop-outs, 19%) for the predictor variables in the multiple regression were removed from the dataset (we preregistered that we have “no formal a priori exclusion criteria”; thus, this decision was made after the data was collected), resulting in a final dataset of $N = 674$ responses. For all scales (excluding the single item measures), the mean score and Cronbach alpha was calculated. Trust in climate skeptical blogs and a prescriptive norm item were reverse-scored, so that higher scores indicated higher levels of risk perceptions.

First, descriptive statistics are reported, in order to understand the dataset. Second, a bivariate, two-tailed Pearson correlation test of the CCRPM+ variables was conducted to examine whether these variables were correlated in the expected direction. Subsequently, on the basis of a theory-based approach [21,22], a hierarchical multiple regression analysis was conducted to assess to what extent cognitive, experiential, socio-cultural, and the new trust dimension can explain and predict climate change risk perceptions of blogosphere audience members. Lastly, following Van der Linden [22] and Xie et al. [23], Pratt’s [56] measure was used to calculate the relative importance among the predictor variables. The calculation measure comprises the sum of each variable’s standardized regression coefficient (β_j) multiplied by its zero-order correlation with the dependent variable (r_j), the sum of which equals the standardized explained variance of a regression model (R^2).

$$\sum_j (\beta_j \times r_j) = R^2 \quad (1)$$

The relative importance scores were manually calculated and all the other analyses were conducted with IBM SPSS Statistics (version 25).

4. Results

4.1. Overview of Socio-Demographic Characteristics

Table 1 provides an overview of the socio-demographic characteristics of the research sample. The majority of respondents are male (89.6%). More than half of the respondents are 55 or older (65.3%). Respondents came from 40 different countries, but the United States was the most frequently reported country of residence (44.7%). More than half of the respondents obtained a master’s or doctoral degree (59.1%). Lastly, most respondents hold left-leaning political views (85.8%).

Table 1. Overview of socio-demographic characteristics sample.

Socio-Demographic Characteristics	Valid Percent
Gender	
Female	10.4%
Male	89.6%
Age	
24 or younger	2.2%
25–34	5.9%
35–44	8.8%
45–54	17.8%
55–65	32.8%
66 or older	32.5%
Country of residence	
United States	44.7%
United Kingdom	12.3%
Australia	9.2%
Canada	7.4%
The Netherlands	4.5%
Other	21.9%
Highest Level of Education	
No qualification	1.3%
High school degree or equivalent	5.6%
Vocational degree or equivalent	5.5%
Bachelor’s degree or equivalent	27.6%
Master’s degree or equivalent	32.2%
Doctoral degree	26.9%
Prefer not to answer	0.9%
Political Views	
Left-wing	85.8%
Right-wing	14.2%

4.2. Descriptive Statistics of Variables CCRPM+

Table 2 provides an overview of the intercorrelations, means, and standard deviations of the CCRPM+ variables. All of the predictor variables are significantly and positively correlated with risk perceptions, ranging from ($r = 0.32$ to $r = 0.86$)—except egoistic values ($r = 0.05$, $p > 0.05$) and human causes-knowledge ($r = 0.01$, $p > 0.05$), which are both not significant. Affect ($r = 0.86$) is the strongest correlate of risk perceptions.

Table 2. Descriptive statistics and intercorrelations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Biospheric values	(0.90)														
2. Egoistic values	0.09 *	(0.57)													
3. Altruistic values	0.71 **	0.09 *	(0.82)												
4. Human cause	−0.121 **	−0.10 **	−0.06	(0.45)											
5. Impact	0.26 **	0.03	0.25 **	0.28 **	(0.77)										
6. Response	0.18 **	0.01	0.19 **	0.37 **	0.72 **	(0.68)									
7. Scientific consensus	0.24 **	0.05	0.23 **	0.17 **	0.68 **	0.57 **	(1.0)								
8. Descriptive norm	0.19 **	0.16 **	0.22 **	0.04	0.26 **	0.26 **	0.18 **	(0.87)							
9. Prescriptive norm	0.32 **	0.14 **	0.31 **	0.04	0.35 **	0.32 **	0.31 **	0.66 **	(0.79)						
10. Affect	0.46 **	0.04	0.42 **	0.04	0.66 **	0.50 **	0.56 **	0.24 **	0.39 **	(0.94)					
11. Personal experience	0.22 **	0.01	0.16 **	−0.07	0.29 **	0.23 **	0.24 **	0.21 **	0.25 **	0.33 **	(1.0)				
12. Trust scientists	0.31 **	0.07	0.27 **	0.14 **	0.62 **	0.53 **	0.57 **	0.25 **	0.34 **	0.63 **	0.31 **	(1.0)			
13. Trust climate mainstream blogs	0.36 **	0.08 *	0.31 **	0.08 *	0.60 **	0.50 **	0.49 **	0.26 **	0.36 **	0.65 **	0.27 **	0.65 **	(1.0)		
14. Distrust climate skeptical blogs	0.36 **	0.04	0.31 **	0.08 *	0.61 **	0.51 **	0.64 **	0.23 **	0.33 **	0.69 **	0.31 **	0.63 **	0.57 **	(1.0)	
15. Risk perceptions	0.50 **	0.05	0.45 **	0.01	0.69 **	0.56 **	0.62 **	0.32 **	0.43 **	0.86 **	0.43 **	0.69 **	0.71 **	0.72 **	(0.95)
Mean	7.22	3.58	7.19	0.86	0.86	0.85	93.68	4.01	5.05	6.55	0.81	6.38	5.70	6.30	5.73
SD	1.50	1.06	1.36	0.12	0.18	0.16	13.69	1.46	1.24	0.82	0.39	1.16	1.31	1.19	1.40

Note: Scale reliabilities (Cronbach's alpha) are presented along the diagonal. * $p < 0.05$, ** $p < 0.01$.

4.3. Multiple Regression CCRPM+

Model 1 is the baseline model comprising significant socio-demographic predictor variables. Gender ($\beta = 0.08, p < 0.05$) and political views ($\beta = 0.47, p < 0.01$) are both positive significant predictors and income ($\beta = -0.11, p < 0.01$) is a negative significant predictor. These predictors explain a total of 25% of the variance in risk perceptions (see Table 3 and Supplement 3). Thus, being female, having a low income, and holding liberal political views is associated with high climate change risk perceptions.

Table 3. CCRPM+ results.

Independent Variables	Socio-Demographics Model 1 (β)	Cognitive Factors Model 2 (β)	Experiential Processes Model 3 (β)	Socio-Cultural Influences Model 4 (β)	Trust Model 5 (β)
Gender	0.08 *	0.11 **	0.07 **	0.06 **	0.06 **
Income	-0.11 **	-0.08 **	-0.04 *	-0.04 *	-0.04 **
Political views	0.47 **	0.16 **	0.06 **	0.04	0.02
Human causes		-0.19 **	-0.08 **	-0.06 **	-0.06 **
Impact		0.44 **	0.11 **	0.11 **	0.07 *
Responses		0.14 **	0.10 **	0.09 **	0.06 **
Scientific consensus		0.20 **	0.10 **	0.10 **	0.06 **
Affect			0.61 **	0.56 **	0.45 **
Personal experience			0.13 **	0.11 **	0.10 **
Biospheric values				0.10 **	0.07 **
Egoistic values				0.01	-0.01
Altruistic values				0.01	0.02
Descriptive norm				0.06 **	0.05 *
Prescriptive norm				0.01	-0.01
Trust in scientists					0.08 **
Trust in climate mainstream blogs					0.14 **
Distrust in climate skeptical blogs					0.09 **
N	674	674	674	674	674
adj. R^2	0.25	0.60	0.81	0.82	0.84
Δ adj.		0.35	0.21	0.01	0.02
F_{change}	76.41	146.05	367.06	9.86	30.01

Note: Dependent variable is risk perceptions (index). Entries are standardized beta coefficients. * $p < 0.05$, ** $p < 0.01$.

Model 2 investigated the explanatory power of the cognitive dimension, while controlling for socio-demographic characteristics. Knowledge about the impacts of climate change ($\beta = 0.44, p < 0.01$), responses to address climate change ($\beta = 0.14, p < 0.01$), and the scientific consensus ($\beta = 0.20, p < 0.01$) were all positive and significant predictors. Knowledge about the human causes of climate change was a negative significant predictor ($\beta = -0.19, p < 0.01$). Overall, model 2 explained an additional 35% of the variance in risk perceptions. Thus, having knowledge about the impacts of climate change, responses to address climate change, and perceived scientific consensus are all associated with high risk perceptions, while, surprisingly, having knowledge about the human causes of climate change is associated with lower risk perceptions.

Model 3 tested to what degree experiential processes explain variations in climate change risk perceptions, while controlling for cognitive and socio-demographic factors. Negative affect ($\beta = 0.61, p < 0.01$) and personal experiences with extreme weather events ($\beta = 0.13, p < 0.01$) were both significant predictors. Together, these factors explain an additional 21% of the variance in risk perceptions of audience members. In other words, negative evaluative feelings towards climate change and personal experiences with extreme weather events are both positively associated with risk perceptions.

Model 4 explored the explanatory power of socio-cultural influences on risk perception, while controlling for experiential, cognitive, and socio-demographic characteristics. Biospheric values ($\beta = 0.10, p < 0.01$) and descriptive social norms ($\beta = 0.06, p < 0.01$) were the only significant predictors, explaining 1% additional variance in risk perceptions.

Lastly, model 5 investigated the explanatory power of the new dimension of trust, while controlling for the other dimensions. Trust in scientists ($\beta = 0.08, p < 0.01$) and mainstream blogs ($\beta = 0.14, p < 0.01$) and distrust in climate skeptical blogs ($\beta = 0.09, p < 0.01$) were significant predictors of climate change risk perceptions, explaining a further 2% of the variance. Thus, trust in scientists and climate mainstream blogs and distrust in climate skeptical blogs as a source of information are associated with higher risk perceptions.

In summary, (a) being female; (b) having lower income; (c) more liberal political views; (d) more knowledge about the impacts, (e) the responses, and (f) the scientific consensus on climate change; (g) stronger negative affective evaluations of climate change; (h) more personal experiences with extreme weather events; (i) stronger biospheric values; (j) higher perceptions of being surrounded by people who believe it is important that you take personal action to tackle climate change; (j) more trust in scientists; (k) climate mainstream blogs as a source of information; and lastly (l) less trust in climate skeptical blogs as a source of information were all independently associated with increased risk perceptions of climate change. The final model explains 84% of the variances in climate change risk perceptions of audience members in the climate mainstream blogosphere.

4.4. The Relative Importance of CCRPM+ Predictor Variables

Table 4 shows the relative importance for each of the single variables as well as the five dimensions of CCRPM+. The results show that in the final regression model *experiential processes* (43%) and *trust* (21.94%) account for the majority of explained variance (64.94%). Moreover, *cognitive factors* (11.85%) and *socio-cultural influences* (5.10%) contribute significantly less and *socio-demographics'* contribution is nearly insignificant (1.31%). *Affect* (38.70%) is the single strongest predictor variable of climate change risk perceptions. Another interesting observation is that *knowledge about the human causes of climate change* (−0.06%) does not significantly contribute to the relative explained variance, whereas *knowledge about the impacts, responses, and scientific consensus* together account for 11.79% of the explained variance.

Table 4. Relative importance of CCRPM+ predictor variables.

Independent Variables	Partitioning of Explained Variance
<i>Socio-Demographics</i>	
Gender	0.66%
Income	0.56%
<i>Total Variance Explained</i>	1.22%
<i>Cognitive Factors</i>	
Human causes–knowledge	−0.06%
Impacts–knowledge	4.83%
Responses–knowledge	3.36%
Scientific consensus–knowledge	3.72%
<i>Total Variance Explained</i>	11.85%
<i>Experiential Processes</i>	
Affect	38.70%
Personal experience	4.30%
<i>Total Variance Explained</i>	43.00%
<i>Socio-Cultural Influences</i>	
Biospheric values	3.50%
Descriptive norm	1.60%
<i>Total Variance Explained</i>	5.10%
<i>Trust</i>	
Trust in scientists	5.52%
Trust in climate mainstream blogs	9.94%
Distrust in climate skeptical blogs	6.48%
<i>Total Variance Explained</i>	21.94%
Overall Variance Explained	83.11%

5. Discussion

The goals of this paper were twofold: (a) Investigating the socio-psychological factors that predict the climate change risk perceptions of mainstream blog audiences by replicating the CCRPM; and (b) improving the explanatory power of the model by adding trust and knowledge about the scientific consensus as new predictor variables.

5.1. Evaluation of CCRPM+

Whereas the CCRPM predicted 68% of the variance in climate change risk perceptions for the UK [22] and the Australian public [23], the CCRPM+ explained 84% of the variance for international audiences in the climate mainstream blogosphere. The relative contribution of predictors to climate change risk perceptions in the CCRPM are largely congruent with our findings for the CCRPM+, however there were some remarkable differences with the British and Australian general public.

First of all, gender and income were the only significant socio-demographic predictors in the final model. Thus, when audience members are female and have a lower income, they especially tend to view climate change as a greater risk. Van der Linden [22] found that political views were a significant and consistent predictor of risk perception, which is congruent with our findings though in our model, ideology lost its significance after controlling for socio-cultural influences. Overall, the relative contribution of socio-demographic factors to risk perceptions was nearly zero, which is consistent with other research. e.g., 3% in [23] and the general expectation that the influence of socio-demographic variables is diminished when introducing theory-based psychological dimensions [21].

Second, knowledge about impacts, responses, and the scientific consensus were all significant and positive predictor variables. Therefore, adding the latter as new predictor variable is a useful advancement of the CCRPM. Thus, when audience members have knowledge about the impacts, responses, and the scientific consensus on climate change, they tend to view climate change as a higher risk. Surprisingly, knowledge about the human causes of climate change is significantly and negatively related to risk perceptions. Yet, we caution against interpreting this finding for two main reasons; (a) human causation did not reveal a significant zero-order correlation with risk perception likely due to (b) the very low reliability of the scale in this study. Overall, it appears that the relative importance of cognitive factors to explain risk perceptions was more substantial for mainstream blogosphere audience members than for the British and Australian general public.

Third, experiential processes were the strongest contributor to the total variance in risk perceptions. Affect was the greatest predictor of climate change risk perceptions overall and personal experiences with extreme weather events was also a significant and positive predictor. These findings are largely congruent with the findings of Van der Linden [22] and Xie et al. [23]. While the importance of affect in shaping risk perceptions was diminished in earlier research [57], more recent research largely endorses the idea that emotions and affect play a crucial role in forming climate change risk perceptions [22,23,31,58–64]. Therefore, since once again the importance of emotions and affect in understanding risk perceptions of climate change is underscored, the need for future research focusing on how emotions can—and should—be addressed in climate change communications is paramount.

Fourth, the relative importance of socio-cultural influences on risk perceptions as a whole is minimal compared to the contribution of other dimensions. This finding goes somewhat against current academic scholarship, which stresses the importance of recognizing the role of social norms and human values in how climate change risk perceptions are formed, e.g., [37,39,65], but may speak to the unique composition of factors that predict the risk perceptions of blog audiences. Although the relative importance was minimal, biospheric values and descriptive norms were both significantly and positively related to climate change risk perceptions. Thus, audience members that hold biospheric values and perceive that others are taking action to help reduce the risk of climate change tend to view climate change as a greater risk. In contrast to Van der Linden [22] and Xie et al. [23], prescriptive norms was not a significant predictor of risk perceptions. Thus, although perceived consensus seems to be important in shaping perceptions of blog visitors [1], the extent to which audience members

feel directly socially pressured to view climate change as a risk that requires action does not affect their risk perceptions. This finding suggests that audiences in the climate mainstream blogosphere are perhaps more inclined to view themselves as independent thinkers and therefore defer to other heuristics, such as trust in science.

In fact, the new dimension of trust is a useful addition to the model, as it accounted for a quarter of the total explained variance in risk perceptions. Trust in scientists was a positive and significant predictor of risk perceptions. Importantly and perhaps unsurprisingly, the predictive power of trust in climate mainstream blogs and distrust in climate skeptical blogs was even greater. Thus, this finding adds to the notion that the degree to which individuals trust certain media as a source of information about climate change is critical for understanding how climate change risk perceptions are formed [43].

Overall, these results largely replicated earlier studies using the CCRPM. However, it is important to note that some of our findings deviated from previous research, like the minimal relative importance of socio-cultural influences. We suggest that these counterintuitive results show that the assigned weight of predictor variables influencing climate change risk perceptions may be dependent on each unique target population. In this case, since climate change blog audiences are highly engaged and climate skepticism is more prevalent in the blogosphere [3], one can speculate about whether mainstream audience members view themselves as more independent thinkers with a greater interest in climate science than members of the general public. We recommend to replicate the CCRPM+ in the context of climate skeptical blogs and in other (non-English) contexts and cultures.

5.2. Implications for Practice and Future Research

The current research has important implications for risk communication via blogs. Van der Linden [22] recommends to craft risk messages that appeal to affective and experiential processing mechanisms and socio-cultural influences, besides providing people with increased knowledge about the causes, impacts, and responses about climate change. We largely endorse this recommendation, but we have a few suggestions for crafting risk messages that are intended for climate change blog audiences.

First of all, we suggest to continue educating audiences about the causes, impacts, and responses of climate change, including the scientific consensus given that, besides the present study, a large literature highlights the benefits of doing so [52,53,66]. Second, we suggest that although the perception of social consensus on blogs is important [1], crafting messages in which audience members feel directly socially pressured to view climate change as a risk may not be effective or even elicit psychological reactance.

For example, previous research showed that some climate change bloggers are already sensitive to selecting and composing blog content that aims to evoke certain emotions, in addition to a focus on objective and scientific content [11]. However, scientist bloggers might feel restrained to craft content that appeals to audience members' emotions and prefer to stick to content that feeds knowledge to the audiences. However, according to Engdahl and Lidskog [67] (p. 714), this strategy is not effective for building trust. Instead, they discuss that trust is created when individuals feel "*emotionally involved, take part, have a say, and in some sense are able to recognize themselves in the recipient of their trust*". Therefore, we encourage bloggers to write blogs that appeal to audiences' emotions, given that both audiences' affect and trust in climate change blogs is an influential predictor of their climate change risk perceptions.

The current research also has important implications for risk communication in general. Our research provides evidence for the fact that each target audience has its own unique characteristics. Therefore, we suggest that risk communicators aim to understand the socio-psychological factors that shape their audience's risk perceptions so that a risk message can be crafted that is tailored to the characteristics of this specific audience. Moreover, we recommend to test communications to evaluate their effectiveness [68].

Of course, this research has limitations that need to be considered. First and foremost, the survey was not published on any climate skeptic blogs. Second, the sample was self-selected. Thus,

we recognize that the sample is not representative of the entire climate change blog audience population, but instead representative of the climate mainstream blogosphere. However, the sample did include audience members with low risk perceptions. Therefore, the composition of the sample allowed us to evaluate what socio-psychological factors explain the variance in climate change risk perceptions of blog audiences. Third, the data are self-reported, which makes the research prone to social desirability and memory biases. However, if respondents coordinated their responses to insert noise into the data [3], such results would likely have surfaced in the analysis. Fourth, the reliability scores of the natural and human cause–knowledge scales were low. Therefore, we recommend to restructure the items that were used in the present research and develop scales that are reliable in different contexts. Lastly, the data are cross-sectional, which means that the associations reported here cannot be used to infer causality.

6. Conclusions

We advanced the CCRPM to investigate the climate change risk perceptions of audiences in the climate mainstream blogosphere. Our model explained 84% of the variance in risk perceptions. The most important predictor variable is affect. Overall, this research shed light on the views of the highly engaged audiences of polarized climate change blogs.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2071-1050/12/19/7990/s1>, Supplement 1: Climate Change Blogs that Published the Survey, Supplement 2: Survey Items, Supplement 3: Overview Coefficients of Multiple Regression CCRPM+.

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