Differences in the Experience of Eco-Anxiety Between the Dutch and German Population

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Abstract

Background: The growing threat to societies and nature worldwide posed by climate change results in the experience of eco-related emotions, such as eco-anxiety. Due to insufficient research on these emotions, this study explored the relationship between eco-anxiety and different variables. The main aim was comparing levels of eco-anxiety between the Dutch and German populations. Additionally, the relationship between eco-anxiety and two risk factors for flooding, namely living near bodies of water and below sea level, were investigated. Lastly, the study explored the influence of living below sea level on the relationship between nationality and eco-anxiety. **Methods:** This cross-sectional, quantitative study applied the EAQ-22 to measure and compare eco-anxiety scores between different populations. The sample of 232 participants was recruited online through convenience sampling. To test the hypotheses, both t-tests and a linear regression analysis were conducted. **Results:** The findings indicate that there are indeed higher levels of eco-anxiety amongst German participants than in Dutch participants population ($p < .001$). However, there was no significant difference found in scores of eco-anxiety between people living close and further away from bodies of water ($p = .744$), as well as for people living above and below sea level, ($p = .129$). Lastly, there was no significant effect of the moderator variable altitude on the relationship between nationality and eco-anxiety ($p=.111$). **Conclusion:** German participants experienced significantly higher levels of eco-anxiety than Dutch participants. Furthermore, neither living close to bodies of water, nor living below sea level significantly affected the experience of eco-anxiety. The differences in the experience of eco-anxiety on a national level might be explained by varying preventative measures and climate policies applied by the Dutch and German government.

Contents

Introduction

In recent years, climate change has become one of the most prevalent threats to our society. Climate change refers to "the long-term changes in the Earth's climate that are warming the atmosphere, ocean and land" (United Nations, 2023). Due to this change, people worldwide increasingly experience catastrophic weather phenomena such as storms, heatwaves, or floods (World Health Organisation [WHO], 2023). Further, ecosystems around the globe are brought into an imbalance, thus impacting diversity and the health of many species (United Nations, 2023). While such shifts in weather can have natural causes (United Nations, 2023), many aspects of climate change are a result of human activities (Intergovernmental Panel on Climate Change [IPCC], 2023). These are, for instance, lavish lifestyles, increasingly unsustainable consumption behaviours and growing energy use (IPCC, 2023). Therefore, human made climate change and its consequences pose ongoing challenges for societies around the globe.

Although climate change constitutes a global problem, its impact and consequences show considerable variability across countries and regions. Today, the most common natural disaster around the world are floods (Einar, 2024; Yari et al., 2020). Moreover, due to rising sea levels and more extreme rainfall, the number of floods is expected to grow even more in the future (Wang et al., 2015). However, the vulnerability of becoming a victim of flooding is mostly related to geographical conditions (Yusmah et al., 2020). Particularly living in a low-lying area such as below sea level, and near a river are considered risk factors, as these areas are more likely to overflow after for instance heavy rainfall (Yusmah et al., 2020). However, flood prone areas for instance around rivers are oftentimes seen as economically attractive and therefore experience growth in their population (Aerts et al., 2018). This growth can lead to an increased risk of victimisation, as floods occurring in urban and highly populated areas are most critical in terms of the damage they cause (Sakieh, 2017). Consequently, the impact

of climate change and particularly flooding manifests differently depending on the region and geography of a country.

Due to their geographic vulnerability, a country particularly at risk of flooding are the Netherlands. Currently, over half of their population lives in areas with an increased risk of becoming victim to flooding (Klijn et al., 2011; Wright et al., 2021). Moreover, the highest risk for potential damage is posed by rising sea levels or storms, which can cause failures of coastal defences such as dikes or dams (Botzen et al., 2009). Due to this vulnerability, the Netherlands have increased funding available for safety precautions particularly related to flooding (Van Eerd et al., 2014). Furthermore, adjustments to climate issues in general were developed and implemented earlier in the Netherlands than in many other countries such as Germany (Van Eerd et al., 2014). While the Netherlands started adapting to climate change in the early 2000s (Mees & Surian, 2023), Germany only started their strategy for climate change adaptation end of 2008 (Climate Adaptation Platform, 2023). Consequently, the Dutch are considered a leading country in regard to climate change adaptation (Pettenger, 2016) and flood control prevention worldwide (Buchholz, 2020). Lastly, the flood risk management strategy applied by the Netherlands were found to be sufficient to cope with rising sea levels and overflowing rivers for many decades to come (Klijn et al.,2011). Thus, by proving to be effective, the precautions and adaptations taken by the Dutch government help in coping with the challenges experienced in times of the climate crisis. Furthermore, to some extent, these effective measures prevent potential harm caused by climate change for the Dutch citizens, thereby resulting in a sense of safety.

Germany seems to face similar challenges caused by climate change and the corresponding natural disasters as the Netherlands. Furthermore, although implementing strategies later than the Netherlands, Germany is also considered a leading country regarding climate change mitigation strategies (King, 2022). However, unlike the Netherlands,

Germany does not seem to be as prepared and able to cope with these challenges in practice. One possible explanation for this could be the fact, that until recently most measures against climate change remained on a voluntary basis (Climate Adaptation Platform, 2023). Only recently, in 2023, a federal law has been passed that puts responsibility on preventative measures for climate change (Climate Adaptation Platform, 2023). Hence, the results and impact of this new law still have to be evaluated in the future.

Moreover, a consequence of climate change that particularly had a considerable impact in Germany in the past 25 years are extreme precipitation and floods. For instance, massive flooding in 2002 (Botzen et al., 2009) and in 2013 (Kreibich et al., 2015) hit the German population. Moreover, in 2021, part of the Rhine area in Germany suffered from detrimental consequences of flooding, causing more than 180 deaths and billions in damage (Bundeszentrale für politische Bildung, 2024; Fekete & Sandholz, 2021). The non-efficient response to the most recent catastrophe showed many gaps and reasons for concern regarding the coping and adaptation strategies for climate change applied by the German Government at that time (Fekete & Sandholz, 2021). This has led to an increased mistrust in warning- and prevention systems (Fekete & Sandholz, 2021). Furthermore, this mistrust is in line with the finding of a study by Bodor et al. (2020), who found that the German population overall shows higher levels of concern regarding the impact of climate change than the Dutch population. Therefore, there are considerable differences in how Dutch and German populations experience the consequences of climate change.

Impact of climate change on health

The consequences of global warming have often been associated with both physical and mental illness. For instance, the IPCC (2023) reports an increase in deaths due to extreme heat, as well as a spreading of vector-borne diseases due to climate change**.** A rise in psychopathologies such as anxiety, post-traumatic stress disorder (PTSD) and depression has

also been linked to climate change (Hrabok et al., 2020). These mental health issues can be triggered either directly, through exposure to extreme events, or indirectly, due to for instance displacement or insufficient food supplies (Cianconi et al., 2020). Thus, global warming can negatively influence an individual's physical- or mental health, and thereby elicit adverse emotional states.

A specific type of mental health affectation directly related to global warming is called eco-anxiety. According to Ágoston et al. (2022, p 1), eco-anxiety refers to "a special type of stress and worry, which is related to the ecological crisis." Eco-anxiety is sometimes triggered by direct exposure to climate-change related events. However, it is mostly a result of the concerns about the detrimental impact climate change might potentially have on one's future (Pihkala 2018). This finding could explain the very common case in which children and young people experience concerns caused by climate change (Agoston et al., 2022).

There are different symptoms related to the experience of eco-anxiety. They manifest in the form of panic attacks, insomnia, or obsessive thinking (Usher et al., 2019). Further, the emotions related to the existential questions around climate change can trigger certain defence- and coping mechanisms in individuals (Pihkala, 2018). Oftentimes, these defensive responses are paired with more negative reactions, such as anger, guilt, or fear (Baudon & Jachens, 2021; Brophy et al., 2022). Consequently, the experience of climate-related anxiety can negatively influence a person's overall well-being and quality of life.

Although in recent years the interest and body of scientific literature related to climate change induced emotions such as eco-anxiety has grown, there is still uncertainty around what the term involves. For instance, there seems to be no consensus on whether the experience of eco-anxiety should be considered psychopathological and maladaptive, or whether it is a potential driver of climate-friendly actions (Ágoston et al., 2022). Furthermore, Pihkala (2018) states that many people experience a combination of anxieties

related to both climate-change as well as unrelated issues, thus making it difficult to separate them. Therefore, measuring and interpreting the precise impact of eco-anxiety on an individual's well-being is complex.

In order to gain more insights into the impact of climate change on the mental health of individuals, Ágoston et al. (2022) developed the Eco-Anxiety Questionnaire (EAQ-22), intended to measure symptoms related to eco anxiety and their relationship to one's mental health. Following this, recent studies by Doyle (2024) and Gökoglan (2024) started exploring eco-anxiety in the Dutch and German population by translating the EAQ-22 to German and Dutch. However, their papers focused on exploring other demographic variables such as gender and age. Consequently, there is insufficient research on the differences in the experience of eco-anxiety between the Dutch and German population.

Current study

The current study connects to previous research done on the effect of climate change on mental well-being in the Dutch and German population by Doyle (2024) and Gükoglan (2024), by applying their recently translated versions of the EAQ-22. The main aim of this project is comparing levels of eco-anxiety experienced by the Dutch and German population, to see whether these different policies and vulnerabilities lead to differences in the expression of eco-anxiety. Due to feeling protected and safe by the effective climate change adaptations by the Dutch government and the generally higher levels of worries in relation to climate change by German citizens, it is expected that the Dutch participants experience lower overall eco-anxiety levels than the German ones.

Furthermore, a particularly common form of natural catastrophe that has increasingly gained attention in recent years in both the Netherlands and Germany is flooding. Due to rising sea levels and more extreme precipitation caused by climate change, the risk of flooding is expected to grow even further in the future. Thus, an additional focus of this

research lies on differences in the expression of eco-anxiety in people living in areas especially prone to flooding, namely people living close to bodies of water and/or below sea level. Consequently, eco-anxiety scores of participants living close to large bodies of water such as rivers or lakes will be compared with the scores of people living further away. Additionally, scores of eco-anxiety experienced by individuals living below sea level will be compared to individuals living above sea. Due to the increased risk posed by these two factors, higher scores of eco-anxiety are expected in populations living close to water, as well as living below sea level.

Although it is expected that Dutch participants will show lower scores on the eco-anxiety scale compared to German participants, a higher portion of Dutch than German citizens are faced with the heightened risk of victimisation due to living below sea level. Therefore, it will be investigated whether living below sea level has an impact on the relationship between nationality and eco-anxiety.

Consequently, this study aims at investigating the following research question: *Are there differences in the levels of eco-anxiety between the Dutch and German population?*

To answer this research question, the following hypotheses are formulated:

Hypothesis 1: There are significantly higher scores of eco-anxiety in the German population compared to the Dutch population.

Hypothesis 2: Participants living close to a body of water show significantly higher scores of eco-anxiety.

Hypothesis 3: Participants living below sea level show significantly higher scores of eco-anxiety

Hypothesis 4: The level of eco-anxiety depends on the nationality and is moderated by living below sea level.

Methods

Design

To ensure the report's comprehensiveness while providing a complete overview, the study incorporates the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist, specifically designed for cross-sectional studies, as detailed in Appendix A. Moreover, a cross-sectional online survey was conducted to investigate the level of eco-anxiety among different populations. The survey explores the impact of the independent variables nationality, living below sea level, and living close to a body of water on the dependent variable, eco-anxiety.

Participants

The current study applied eligibility criteria. Firstly, participants must either be Dutch or German. Next, they must currently live in Germany or the Netherlands and speak one of the languages to take part in this research. Next, participants must be at least 18 years old. Lastly, individuals currently in treatment for a mental disorder and/or who experienced suicidal ideation in the past 2 years are not eligible.

Sampling procedure

Participants were sampled through snowball sampling and convenience sampling. Multiple advertisements were created for the online questionnaire in both German and Dutch (See Appendix B). These advertisements were then posted on various social media platforms to recruit participants. The researchers distributed the survey through platforms such as WhatsApp, Instagram stories, and Reddit forums of cities, such as Rotterdam, Amsterdam, and Groningen. Furthermore, family and friends were asked to forward the advertisement. Furthermore, participants were recruited through the platform SONA, which rewards students at the University of Twente with credits for their participation. The questionnaire remained accessible for a duration of six weeks, from March 22th to May 5th in 2024.

Procedure

The entire data collection was conducted through Qualtrics, a platform for online surveys and data collection. Additionally, Qualtrics provides advanced security features, including advanced data encryption, ensuring the protection of respondents' data and confidentiality throughout the entire data collection process. At the beginning of the questionnaire, participants received a written introduction including information regarding the procedure of the study, the objectives, and the use of their data. Additionally, they were informed of the inclusion and exclusion criteria of the study. Lastly, participants were provided with the contact details of the researchers, in case they had any questions or remarks regarding their participation or the questionnaire.

Next, participants were presented with the informed consent sheet. Here, it was clearly stated that their participation in the research was entirely voluntary and that they had the right to withdraw from the study at any time without providing a reason and without any consequences. Further, they were informed that no personal data that could potentially identify the participant, such as their IP address, name, or address, would be collected.

Once participants gave their consent, their demographic data was collected. Here, participants were asked to provide their age, gender, their level of education and their nationality. Furthermore, they were asked whether they live close to a body of water such as a river, whether they live below sea level, whether they have been a victim of a flood previously, and lastly, whether they live in a rural or urban area.

Subsequently, participants were introduced to the newly translated versions of questionnaires measuring emotional experiences related to climate change, namely EAQ-22, Eco-Guilt Questionnaire (EGuiQ-11), Eco-Grief Questionnaire (EGriQ-6), and the Pro-Environmental Behavioural Scale (PEBS). Following the eco-questionnaires, they were asked to answer already well-established and validated questionnaire for comparison, namely the

GAD-7, Guilt and Shame Questionnaire (GSQ-8), and the Kessler Psychological Distress Scale (K-10). As the data collection was conducted in a research group investigating a multitude of variables, several scales were included in the questionnaire. However, as only the EAQ-22 was subject of investigation of this study, the rest of the scales will not be further described in the remainder of the paper.

At the end of the questionnaire, participants were asked once more for their informed consent and whether their data could be used for subsequent analyses. This second informed consent was introduced to ensure that participants fully understood the information they were providing. Furthermore, after the participants finished the surveys, they were asked whether they wanted to be contacted later for research purposes to evaluate once again after 3 and 6 months how they were feeling. For this, they were required to provide an email to contact them. In the follow-up study, the same questionnaires will be applied to them again. Following their participation, their data was subject to different data analysis processes, aimed at answering the researchers' research questions and hypotheses.

Materials

Eco-Anxiety Questionnaire (EAQ-22)

The Eco-Anxiety Questionnaire is a 4-point Likert scale ranging from "strongly disagree" to "strongly agree" and was developed by Ágoston et al., (2022). This questionnaire consists of 22 items and was translated into German and Dutch by Doyle (2024) and Gökoglan (2024) as well as implemented in 2024. It measures the level of Eco-Anxiety in an individual and consists of two factors, namely ecological worry, and the negative consequences of Eco-Anxiety. Both factors show high internal consistency with a Cronbach's Alpha of .91 for ecological worry and .86 for negative consequences of Eco-Anxiety.

Data Analysis

Firstly, to calculate the appropriate sample size for the current study, the G*Power software was used. Here, an a priori power analysis with two tails and a power level of = .95 was performed. The minimal sample size necessary for a linear regression calculating the difference between two independent means was n = 105 per group, thus a total sample of n = 210 (see Appendix C).

Next, for applying the data analysis, the software RStudio (RStudio2024.04.0+735) has been used. First, the dataset was imported in CSV file format and the working directory was set. The second step involved the installation and loading of the required packages, including “tidyverse”, “dplyr”, “ggplot2”, “lmtest”, “interactions”, “sjPlot”, “MASS”, and “e1071”. Subsequently, all missing data has been excluded (for instance participants not finishing the survey). Additionally, participants clicking the “other” option for the nationality question were excluded, as the analyses focused only on Dutch and German participants. The next step included deleting all data that may identify the participator such as the start and end date, status, duration in seconds, recorded date, response ID, and preview distribution channel. Lastly, columns displaying NA for instance the email address or first and last name of the participant were excluded as well.

At first, the raw scores were presented for all key variables. Subsequently, variables displayed in character format were converted to numeric values. For example, the EAQ-22 variable 'strongly agree' was assigned a numeric factor of 4, while 'strongly disagree' was assigned a numeric factor of 1.

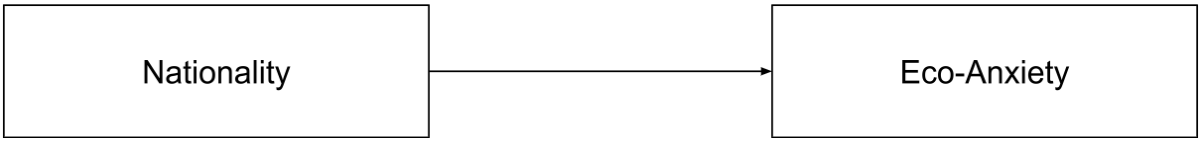
After preparing the dataset for further analysis, the descriptive statistics were computed. The Mean score and Standard Deviation were calculated for age and the EAQ-22. Furthermore, the correlation between these two scales was analysed. Other demographic data, namely gender, nationality, and education level were then analysed and evaluated. In addition

to that, in line with the aim of the study, certain conditions under which participants live were analysed, for instance how many of the participants live close to a body of water. The resulting new variables were then checked for normality, linearity, independence, and homoscedasticity.

H1: To investigate the first hypothesis, a linear regression analysis was used to investigate whether there is an association between nationality and eco-anxiety. The dichotomous variable "Nationality" was set as the independent variable, whereas eco-anxiety was determined as the dependent variable (see Figure 1).

Figure 1

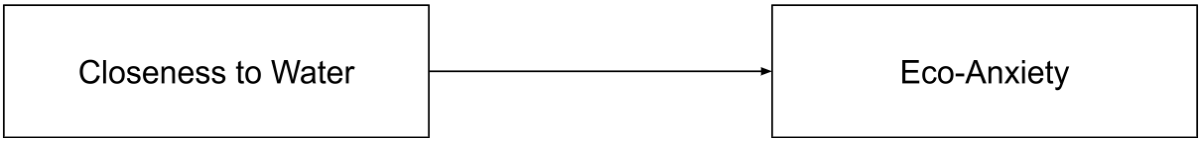
Graph Depicting the Hypothesised Relationship Between Nationality and Eco Anxiety



H2: To investigate the second hypothesis, a linear regression analysis was used to investigate whether there is an association between living close to water and the experience of eco-anxiety. Living close to water was set as the independent variable, whereas eco-anxiety was determined as the dependent variable (see Figure 2).

Figure 2

Graph Depicting the Hypothesised Relationship Between Closeness to Water and Eco-Anxiety

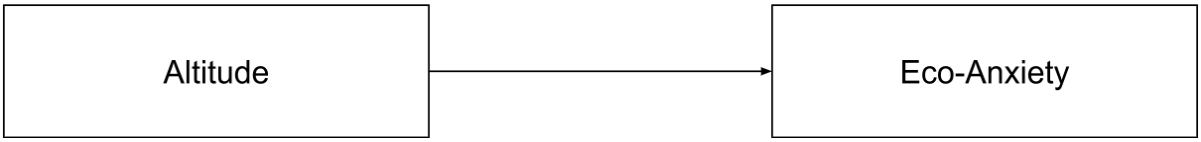


H3: To investigate the third hypothesis, a linear regression analysis was made to investigate whether there is a relationship between living below sea level and eco-anxiety.

Here, the variable “Altitude” was set as the predictor and the level of eco-anxiety as the outcome variable (see Figure 3).

Figure 3

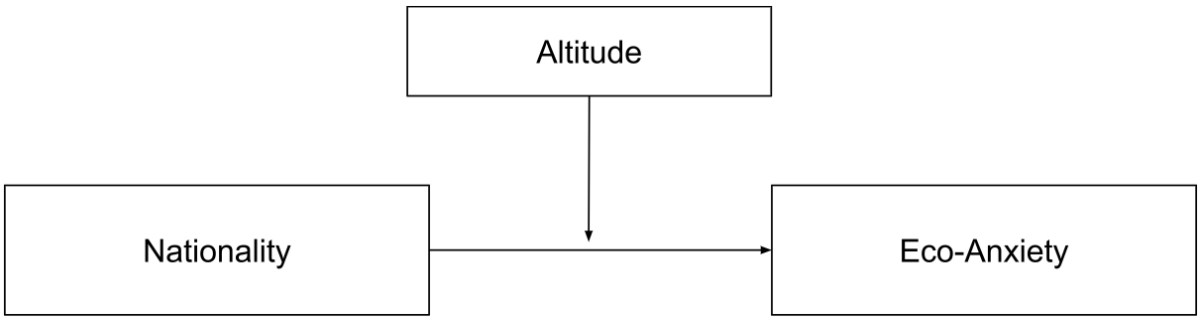
Graph Depicting the Hypothesised Relationship Between Altitude and Eco-Anxiety



H4: The fourth hypothesis includes a moderating variable. Therefore, a moderated linear regression analysis was used to investigate whether the altitude a person lives at moderates the relationship between nationality and eco-anxiety. Thus, nationality was the independent variable, altitude the moderator, and the level of eco-anxiety the dependent variable (see Figure 4)

Figure 4

Graph Depicting the Hypothesised Relationship Between Eco-Anxiety and Nationality, Including the Moderating Variable Altitude



Results

Demographics

After finishing the data collection, the sample consisted of 343 participants. Following the exclusion of participants who indicated having another nationality than German or Dutch (n=21), participants who only partly completed the questionnaire (n=84), participants not conforming with the first (n=3) or second informed consent (n=3), a total of

232 participants were left for further data analysis (see Figure 5). For a thorough description of the sociodemographic characteristics of the sample, see Table 1.

Figure 5

Flowchart of Participant Exclusion

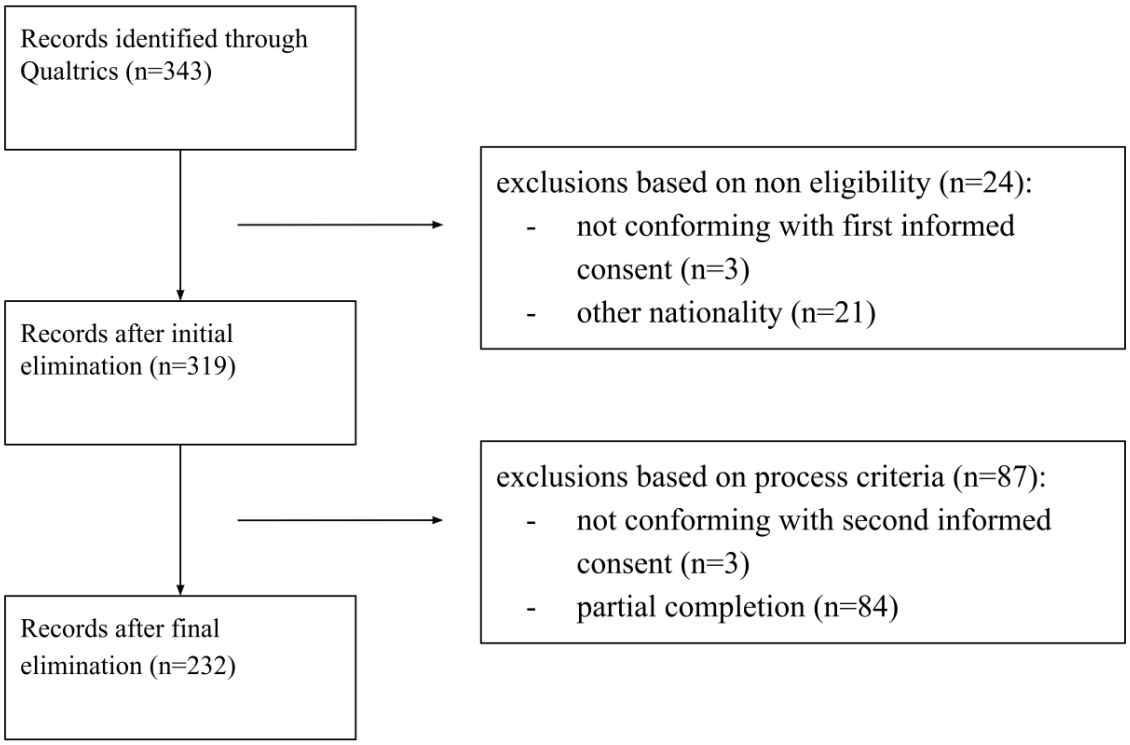


Table 1

Sociodemographic Characteristics of Participants

Sample Characteristic	n(%)
Gender	
Male	84 (36.2)
Female	146 (62.9)
Non-binary/Other	2 (0.9)
Nationality	
Dutch	112 (48.3)
German	120 (51.7)

Educational Level		
	Apprenticeship	19 (8.2)
	Bachelor's Degree	70 (30.2)
	Master's Degree	29 (12.5)
	Secondary Education	63 (27.2)
	University of Applied Sciences	36 (15.5)
	PhD/Doctorate	5 (2.2)
	Other	10 (4.3)
Location		
	Urban	175 (75.4)
	Rural	57 (24.6)
	Close to Water	149 (64.2)
	Further from Water	83 (35.8)
	Above Sea Level	183 (78.9)
	Below Sea Level	49 (21.1)
	Victim of Flooding	5 (2.2)

Note. $N = 232$. Participants were on average 31.58 years old ($SD = 14.23$), with an age range from 18 to 75.

Linear Assumption testing

First, the assumption of normality was tested. Here, the Kolmogorov-Smirnov test of normality was conducted. Firstly, for the EAQ-22, the plot of the data showed a normal distribution (see Appendix D). Further, the Kolmogorov-Smirnov test showed that the data of the EAQ-22 was normally distributed ($D = 0.05$, $p = .509$). Next, regarding homoscedasticity, the plots indicated an equal variance for all proposed models (See Appendix E, F, and G)

Moreover, the results of the Breusch-Pagan test indicated that there is no violation of homoscedasticity, as all models of interest showed equal variance (Nationality: $\chi^2 = 1.36$, $p = .243$; Closeness to water: $\chi^2 = 1.08$, $p = .299$; Sea level: $\chi^2 = 0.21$, $p = .646$). Due to the dichotomous nature of the independent variables, the assumption of linearity did not need to be tested, as the assumption always holds true for binary predictors (Nahhas, 2024). Lastly, due to the study design, there is no clustering or dependencies in the data. Therefore, the assumption of independence is not violated.

Descriptive Statistics

The EAQ-22 had a $M = 2.41$ with a $SD = 0.56$, indicating a moderate level of eco-anxiety among the entire sample. The scores ranged from 1 to 3.64.

When looking at the distribution of participants living below sea level per nationality, it becomes evident that a majority of the sample living below sea level are Dutch participants (See Table 2). However, this is not the case for the variable of living close to water. Here, participants from both nationalities are almost equally distributed.

Table 2

Number of Participants for Variables "Altitude" and "Closeness to Water" per Nationality

Nationality	**Amount of People per Variable**			
	Close to Water	Further from Water	Below Sea Level	Above Sea Level
German	81	39	6	114
Dutch	68	44	43	69

Hypothesis Testing

To investigate the research question "*Are there differences in the levels of eco-anxiety between the Dutch and German population?*" the following analysis were conducted:

Hypothesis 1

The t-test comparing eco anxiety scores between German and Dutch participants demonstrated a statistically significant higher score in the German versus the Dutch population ($t(230) = 4.887$, $p < .001$). Therefore, the hypothesis that there are significantly higher scores of eco-anxiety in the German population compared to the Dutch population can be retained. The mean score on the EAQ-22 per nationality can be found in Table 3.

Table 3

Scores of the EAQ-22 per Nationality

Nationality	EAQ-22	
	Mean	***SD***
German	2.56	0.51
Dutch	2.23	0.56

Note. SD = Standard Deviation. EAQ-22 = Eco-Anxiety Questionnaire 22

Hypothesis 2

The t-test comparing eco anxiety scores between participants living close and further away from water demonstrated no significant difference in the scores of eco-anxiety ($t(230) = -0.327$, $p = .744$). Both populations had medium high average scores of eco-anxiety. Therefore, the hypothesis that participants living close to a body of water show significantly higher scores of eco-anxiety can be rejected. The scores of the EAQ-22 for people living close compared to further from water can be found in Table 4.

Table 4

Scores of the EAQ-22 for People Living Close and Further from Water

Location	EAQ-22	
	Mean	***SD***
Close to Water	2.42	0.58

Further from Water	2.40	0.53

Note. SD = Standard Deviation. EAQ-22 = Eco-Anxiety Questionnaire 22

Hypothesis 3

The t-test investigating the relationship between eco anxiety and living below sea level demonstrated no statistically significant difference in the two populations ($t(230) = 1.524$, $p = .129$). Consequently, the hypothesis that participants living below sea level show significantly higher scores of eco-anxiety can be rejected. The mean scores of the EAQ-22 for people living above and below sea level can be found in Table 5. Furthermore, see Table 6 for a table showing the multiple regression analysis with all three predictors.

Table 5

Scores of the EAQ-22 for People Living Above and Below Sea Level

Location	EAQ-22	
	Mean	***SD***
Below Sea Level	2.30	0.58
Above Sea Level	2.44	0.55

Note. SD = Standard Deviation. EAQ-22 = Eco-Anxiety Questionnaire 22

Table 6

Multiple Regression Showing the Predictors of Eco-Anxiety

Variable	**Estimate**	**SE**	**t-value**	**95% CI**		**p-value**
				LL	**UL**	
(Intercept)	2.22	0.07	31.14	2.08	2.36	< .001
Nationality	0.36	0.08	4.56	0.20	0.51	< .001
Altitude	0.05	0.09	0.47	-0.15	0.24	.642
Closeness to Water	-0.01	0.08	-0.15	-0.16	0.14	.883

Note. SE=Standard Error, CI=Confidence Interval, LL=Lower Level, UL=Upper Level

Hypothesis 4

In the linear regression analysis, the moderating effect of living below sea level on the relationship between nationality and eco-anxiety was investigated. While the main effect of nationality (β = -1.099, 95% CI [-2.03, -0.17] p = .020) was significant, the main effect of living below sea level (β = -0.758, 95% CI [-1.66, 0.14] p = .098) was insignificant. Furthermore, the interaction between nationality and living below sea level was insignificant (β = 0.393, 95% CI [-0.09, 0.88] p = .111). Therefore, the hypothesis that the level of eco-anxiety depends on the nationality and is moderated by living below sea level can be rejected. See Table 7 for the results of the linear regression analysis. The conceptual model of the moderation analysis including the coefficients can be found in Figure 6.

Table 7

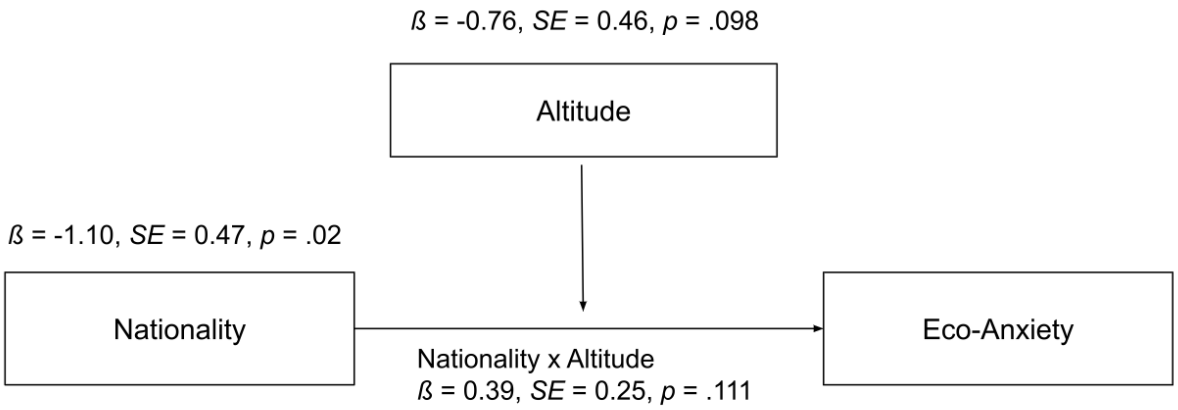
Result of Linear Regression Analysis

Effect	**Estimate**	**SE**	**95% CI**		**p-value**
			LL	**UL**	
(Intercept)	4.39	0.89	2.63	6.15	< .001
Nationality	-1.10	0.47	-2.02	-0.17	.02
Altitude	-0.76	0.46	-1.66	0.14	.098
Nationality x Altitude	0.39	0.25	-0.09	0.88	.111

Note. SE=Standard Error, CI= Confidence Interval, LL=Lower Level, UL=Upper Level

Figure 6

Conceptual Model of Moderation Analysis Including Coefficients



Note. SE = Standard Error

Discussion

This study aimed to address the research gap regarding the impact of climate change on mental well-being, while particularly focusing on eco-anxiety. By using recently translated versions of the EAQ-22 this research gained new insights into the relationship between the experience of eco-anxiety and the German and Dutch populations. Furthermore, this study focused on potential differences in the expression of eco-anxiety among populations living in flood-prone areas, particularly those near bodies of water or below sea level. Four hypotheses were formulated to investigate these relationships, including a moderation effect of living below sea level on the nationality-eco-anxiety relationship.

Confirming the first hypothesis, German participants showed on average significantly higher levels of eco-anxiety than Dutch participants. A possible explanation for this finding might be the proactive measures taken by the Dutch government for combatting the consequences of climate change (Pettenger, 2016). Related to this finding, studies found, that overall, Dutch citizens show higher trust in their government than German citizens (CBS, 2019; Edelman, 2024). Furthermore, a study by Bodor et al. (2020) revealed, that German participants generally showed higher concerns towards climate change than the Dutch ones. Therefore, the lower scores of eco-anxiety in the Dutch population might partly stem from these differences in levels of trust and concerns.

Next, when comparing people living closer to a body of water with people living further away, the results show that they did not significantly differ in their experience of eco-anxiety. Therefore, the hypothesis that people living close to bodies of water such as rivers show higher levels of eco anxiety could be rejected. A possible explanation for this finding could be that many individuals are simply unaware of firstly living below sea level, and secondly the potential risk they are exposed to due to the location they live in. A study by Aerts et al. (2018) investigated factors that influence this risk perception, including insufficient risk awareness and the tendency to underestimate the probability due to a lack of recent victimisation. In addition, there seems to be a mismatch in flood risk perception between experts, who view the risks more realistically, and broader society (Lechowksa, 2018). Thus, resulting from this underestimated risk perception, participants might not have drawn a connection from their living location to a risk of flooding. However, adequate risk perception in relation to flooding is of utmost importance, as it heavily influences the attitudes and behaviours, and thus the effectiveness of reactions in case of potential victimisation (Lechowska, 2018). Thus, fostering more realistic risk perceptions in society are crucial to prepare individuals better for future floods.

Furthermore, the influence of living below sea level on the experience of eco-anxiety was studied. The results indicate that people living below sea level did not experience more eco-anxiety than people living above sea level. Thus, the third hypothesis stating that people living below sea level show significantly higher levels of eco-anxiety could be rejected. A country particularly affected by their low altitude are the Netherlands, as 55% of their country are prone to flooding (Klijn et al., 2011). Furthermore, Dutch participants constituted the majority of the people living below sea level in the current sample (88%), compared to the German sample (12%). Due to this vulnerability, the Dutch government puts much emphasis on adapting to the consequences of climate change and rising sea levels (Van Eerd

et al., 2014). A thorough analysis by Klijn et al. (2011) found the flood risk management strategy applied by the Netherlands to be adaptive and sufficient to cope with rising sea levels and overflowing rivers for many decades to come. These advanced water management strategies, combined with the moderate trust of the Dutch population into their government, could potentially explain the insignificant relationship between living below sea level and climate change.

Additionally, these effective measures taken to protect populations living below sea level in the Netherlands might therefore also explain the non-significant moderation effect tested in hypothesis 4. Here, living below sea level did not change the relationship between nationality and eco-anxiety as predicted, as German participants still scored higher in eco-anxiety than Dutch participants. Consequently, although Dutch individuals living below sea level are theoretically exposed to an increased risk of becoming flood victims, they nonetheless feel protected by the flood prevention systems in place, thereby still showing lower overall levels of eco-anxiety than the German sample.

Limitations

The following limitations should be considered when interpreting the results of this study. Firstly, the utilisation of a self-report measure could pose a potential limitation of this study, as self-report measures can cause different types of biases, which can affect the accuracy of the data (Paulus & Vazire, 2007). A common bias stemming from self-report measures is social desirability, which leads individuals to seek consistency in their answers and to portray an agreeable picture of themselves (Paulhus and Vazire, 2007). However, researchers can reduce social desirability and identify potential biases by carefully preparing the data gathering method and applying methods to validate the data obtained (Fadnes et al., 2009). Therefore, due to the anonymous and online nature of the data gathering method applied by this study, social desirability presumably only played a minor role in this research.

Nonetheless, a slight influence of social desirability on participants' responses cannot be completely ruled out.

An additional limitation results from the small sample size of people living below sea level. Although attempts were made to recruit people from areas particularly affected by their low altitude, by posting for example in reddit forums, only 49 out of the 232 participants (21.1% of the sample) stated that they lived below sea level. Due to this uneven distribution, the results might be biased, and the level of eco-anxiety by this population could potentially be misrepresented.

One further limitation is related to the conceptualisation of two of the variables investigated by this research, namely whether participants live close to a body of water and whether they live below sea level. There was no agreement in the literature on what constitutes closeness or a particularly risky proximity to a body of water. However, according to (Onen, 2016), not clearly conceptualising variables can negatively impact results of a research. Thus, as this question was potentially posed in a vague manner, it might have resulted in an ambiguous understanding by participants. Furthermore, some participants might not have been aware of the altitude they live in, thus they possibly did not know whether they live above or below sea level. Thereby, the data related to these two questions could potentially be compromised. In order to avoid these biases, future research could conceptualise these questions more clearly. Furthermore, including the regions people live in could further deepen the insights related to the variables of living close to water and below sea level.

Lastly, there might be some sampling biases present in this study. As this study applied convenience sampling methods, participants were not randomly sampled from the population. Unlike probability sampling, in which every member of a group has the same chance of being recruited, convenience sampling does not allow to draw inferences or

generalisations about the entire population, as this probability is not given (Stratton, 2021). Therefore, although the results and conclusions of the present study cannot be generalised, they can be used as a starting point for more exhaustive research projects in the future. Consequently, future research could gain more generalisable insights by replicating this study with a random sample from both the Dutch and German population.

Although this study provides new insights into the impact of climate change on mental health, due to the previously identified limitations the findings should be interpreted with caution. Thus, these limitations constitute areas of improvement for future research.

Strengths

The current study has several strengths that are worth mentioning. Firstly, this study offers insights into the different experiences caused by climate change among the German and Dutch population. Although a study by Zeier & Wessa (2024) explored climate-related emotions such as eco-anxiety in a German sample in their study, this study is among the initial studies comparing the impact of climate change on the mental health between the German and Dutch populations. Here, particularly using the newly translated versions of the EAQ-22 by Doyle (2024) and Gökoglan (2024) was a strength, as it made researching eco-anxiety in these two populations possible. Therefore, this study can offer new insights into the experience of eco-related emotions of German and Dutch citizens.

Furthermore, this study collected a diverse sample regarding demographic variables. Here, the sample consists of participants from different age groups ranging from 18 to 75, different educational backgrounds and different geographical and topographical conditions. Therefore, although this study did not apply random sampling methods, due to the diversity of age and educational background, the results are still applicable in a somewhat broader context. Consequently, this study adds a valuable contribution to the growing body of research exploring mental health affectations caused by climate change.

Suggestions for Future Research

The first suggestion for future research projects evolves around the main finding of this study, namely the difference in levels of eco-anxiety experienced by Dutch and German participants. In previous research, there is oftentimes a distinction made between state and trait anxiety. On the one hand, state anxiety is related to a certain stimulus or situation, on the other, trait anxiety describes more long-term tendencies of threat appraisal towards certain threats (Pacheco-Unguetti et al.,2010). Thus, individuals high in trait anxiety, generally show higher baseline levels of arousal, thereby also acting as a factor increasing vulnerability towards comorbidity (Knowles & Olatunji, 2020). Consequently, future research could investigate a potential fluctuation and variation of eco-anxiety over time, by for instance inducing momentary eco-anxiety. This could be done by using prompts such as news articles or videos related to climate change. Gaining more insights into how eco-anxiety scores of individuals vary over time, and what type of input triggers a rise in eco-anxiety, as well as decreases it, could further deepen the knowledge on the impact of climate concerns on mental well-being.

Furthermore, exploring the driving factors for the difference in the level of eco-anxiety in the Dutch and German population could gain important insights into this relationship. Exploring reasons for why Dutch participants are less prone to experiencing eco-anxiety could be particularly important for developing coping strategies that can be applied by the German population. Additionally, future research could go more into depth on the influence certain variables have on the experience of eco-related emotions. For instance, according to a study by Cianconi et al. (2023), young individuals are particularly vulnerable to the impacts of climate change. Therefore, age could potentially act as a moderator for the relationship between nationality and eco-anxiety.

Lastly, this study also focussed on the relationship between eco-anxiety and other predictors, namely living close to water, and living below sea level. In future research projects, these variables could be measured more accurately and in depth, by conceptualising them more precisely. This in turn might counteract the ambiguity related to these factors present in this study. Furthermore, by specifically aiming at a bigger sample of people living below sea level, the comparison could be made more generalisable.

Conclusion

This study explored the relationship between climate change and eco-anxiety among Dutch and German people living in areas more or less prone to floods. By applying recently translated Dutch and German versions of the EAQ-22, this paper examined the differences in the experience of eco-anxiety in the German and Dutch population. The main finding of the study is that German participants experience significantly higher levels of eco-anxiety than Dutch participants, which potentially stems from efficient prevention methods by and higher trust in the Dutch government. Next, people living close to bodies of water or living below sea level did not significantly experience more eco-anxiety, which is potentially explained by tendencies to underestimate the heightened risk they are exposed to. These findings suggest that national policies and public trust could crucial roles in defining the experience of eco-anxiety.

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Appendices

Appendix A

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item no	Recommendation	Page no
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**2**
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	**2**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**5-9**
Objectives	3	State specific objectives, including any prespecified hypotheses	**10**
Methods			
Study design	4	Present key elements of study design early in the paper	**11**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**11-13**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of case ascertainment	**11**

		and control selection. Give the rationale for the choice of cases and controls	
		(*b*) For matched studies, give matching criteria and the number of controls per case	-
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**11**
Data sources / measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**14-16**
Bias	9	Describe any efforts to address potential sources of bias	**14**
Study size	10	Explain how the study size was arrived at	**14**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**14-16**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**14-16**
		(*b*) Describe any methods used to examine subgroups and interactions	**16**

		(*c*) Explain how missing data were addressed	**14**
		(*d*) If applicable, explain how matching of cases and controls was addressed (*e*) Describe any sensitivity analyses	**-**
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**16-17**
		(b) Give reasons for non-participation at each stage	**16-17**
		(c) Consider use of a flow diagram	**17**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**17-18**
		(b) Indicate number of participants with missing data for each variable of interest	**18**
Outcome data	15*	Report numbers in each exposure category, or summary measures of exposure	**17-18**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	**19-23**

		interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analysis	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	**22-23**
Discussion			
Key results	18	Summarise key results with reference to study objectives	**23-25**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**25-27**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**23-25**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**27-28**
Other information			

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**This study received no funding**

*Give information separately for cases and controls.

*Note***.** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Appendix B

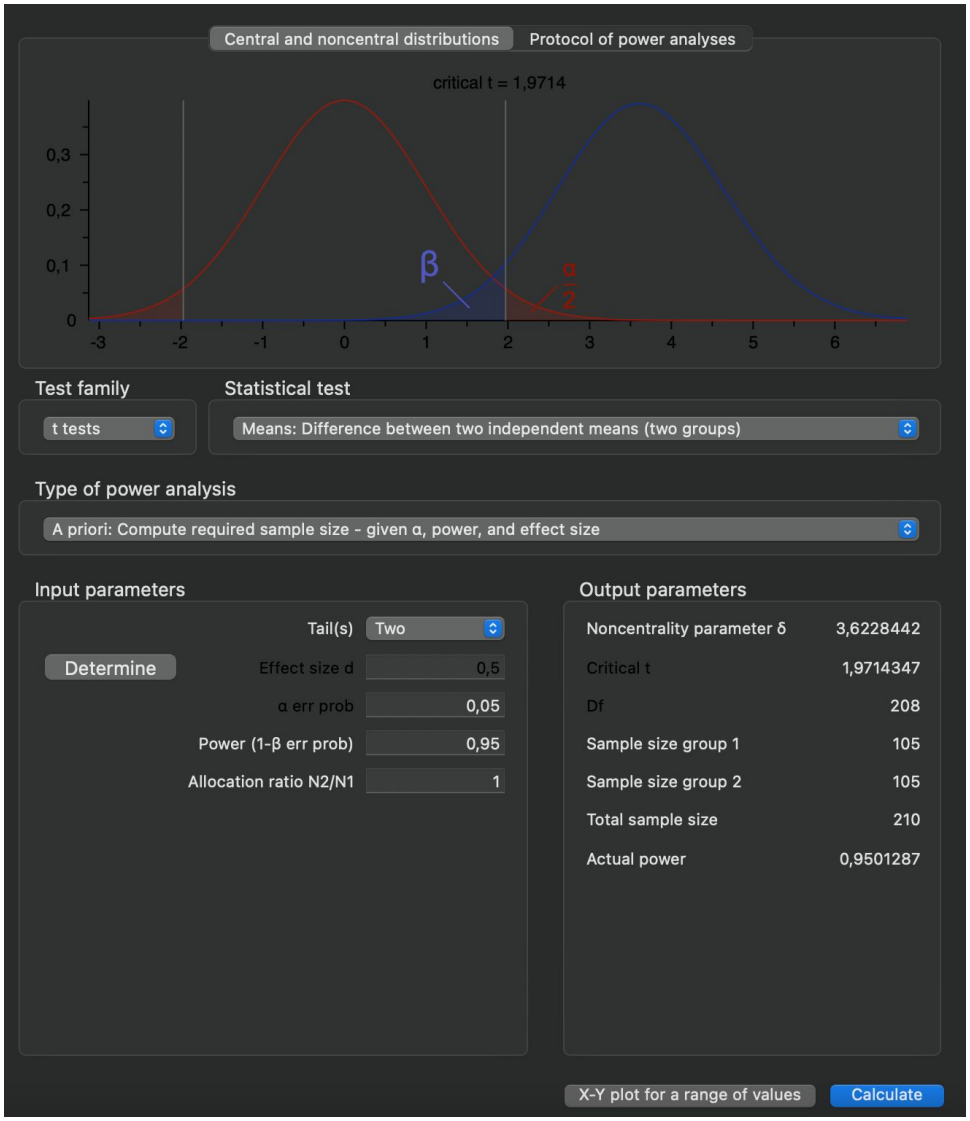
Advertisements for Online Study


Psychische Auswirkungen des Klimawandels
Neugierig?
Dann hilf uns und werde Teil unserer Studie, bei der wir genau dass herausfinden wollen.
Teilnahmebedienungen:
Alter: Mind. 18 Jahre alt
Sprache: Deutsch oder Niederländisch
Psychologische gevolgen van klimaatverandering
Nieuwsgierig?
Help ons dan en neem deel aan ons onderzoek waarin we precies dat willen uitzoeken.
Voorwaarden voor deelname:
Leeftijd: Ten minste 18 jaar oud
Nationaliteit: Duits of Nederlands


Wat zijn de psychologische gevolgen van klimaatverandering?
Nieuwsgierig? Help ons dit te onderzoeken!
Deelname duurt ongeveer 15 minuten. Voorwaarden:
U bent 18+, woont in Nederland of Duitsland, en verstaat Nederlands of Duits

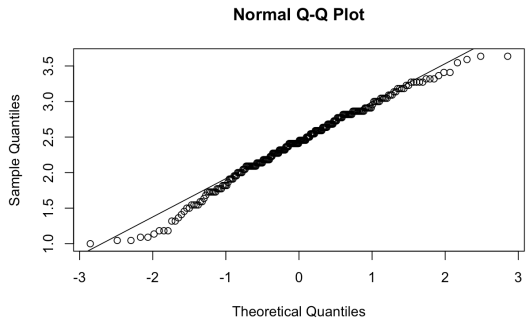
Appendix C

*G*Power Analysis for Sample Size*



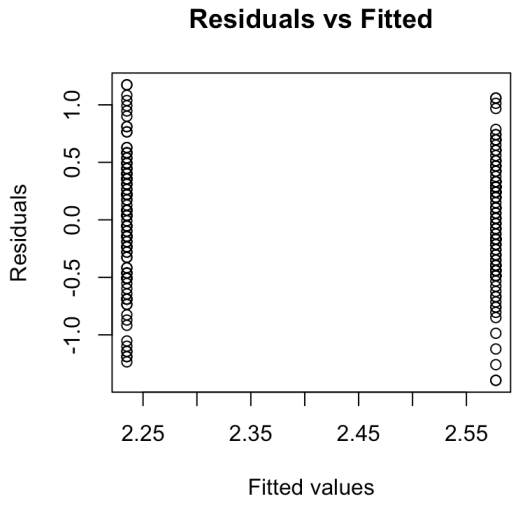
Appendix D

Plot showing Normal Distribution of scores of EAQ-22



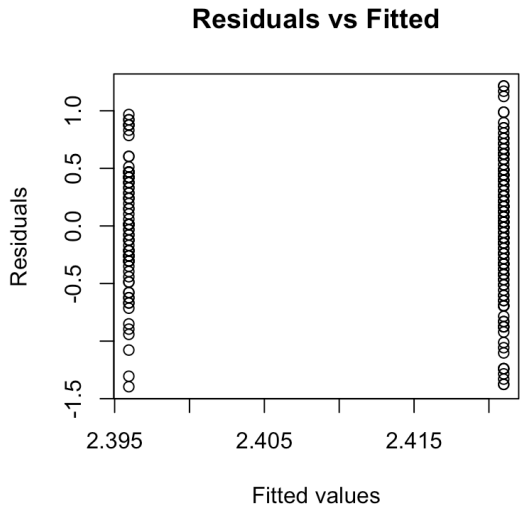
Appendix E

Plot Showing Homoscedasticity for the Linear Model of Hypothesis 1



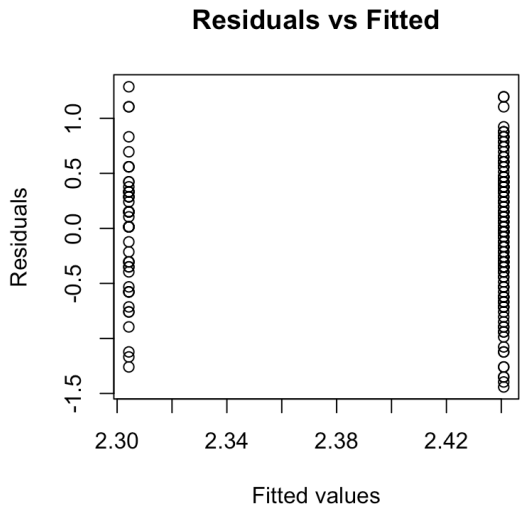
Appendix F

Plot Showing Homoscedasticity for the Linear Model of Hypothesis 2



Appendix G

Plot Showing Homoscedasticity for the Linear Model of Hypothesis 3



Appendix H

Opening Statements of Survey in Qualtrics

German Version

Willkommen

Das Ziel dieser Studie ist es, den Zusammenhang zwischen Klimawandel, psychischen Störungen und umweltfreundlichem Verhalten in der deutschen und niederländischen Bevölkerung zu untersuchen. Die Studie wird von drei Bachelor- und einer Masterstudierenden der Psychologie an der Universität Twente durchgeführt und die gesammelten Daten werden für ihre Bachelor- und Masterarbeit analysiert.

Teilnahme

Um an dieser Studie teilnehmen zu können, müssen Sie mindestens 18 Jahre alt sein und entweder in Deutschland oder den Niederlanden leben. Ausserdem müssen Sie entweder deutsch oder niederländisch sprechen. Personen, die derzeit in Behandlung einer psychischen Krankheit sind oder in den letzten zwei Jahren suizidale Gedanken hatten, können nicht an dieser Studie teilnehmen, um sie vor möglichen Schäden durch die Teilnahme zu schützen.

Ihre Teilnahme an dieser Studie ist vollkommen freiwillig, und Sie haben das Recht, jederzeit ohne Angabe von Gründen oder ohne Konsequenzen zurückzutreten. Alle bis dahin von Ihnen bereitgestellten Daten werden von weiteren Analysen ausgeschlossen. Nach Abschluss des Fragebogens werden jedoch alle Daten anonymisiert und sind daher nicht identifizierbar, was eine Löschung der Daten unmöglich macht. Die Verwendung Ihrer Daten erfolgt ausschliesslich unter vertraulichen Umständen. Nach der Zustimmung zur Teilnahme werden demografische Fragen gestellt. Um Anonymität zu gewährleisten, werden keine identifizierbaren Informationen gesammelt. Der Fragebogen dauert etwa 15-20 Minuten. Ihre Teilnahme an dieser Studie wird sehr geschätzt und wird dazu beitragen, unser Verständnis der psychologischen Auswirkungen des Klimawandels zu vertiefen.

Kontaktdaten

Diese Studie wurde von der Ethikkommission der Universität Twente geprüft und genehmigt. Für zusätzliche Informationen oder bei Fragen wenden Sie sich bitte an die Forscher:

Michele Petkovski (c.m.petkovski@student.utwente.nl)

Anna Rupp (a.b.rupp@student.utwente.nl)

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Jasper Wrana (j.r.wrana@student.utwente.nl)

Alternativ können Sie sich an den Mentor Dr. Alejandro Dominguez Rodriguez (a.dominguezrodriguez@utwente.nl), wenden.

Dutch Version

Welkom

Het doel van dit onderzoek is om de relatie tussen klimaatverandering, psychische

stoornissen en milieuvriendelijk gedrag in de Duitse en Nederlandse bevolking te onderzoeken. Het onderzoek zal worden uitgevoerd door drie bachelor- en één masterstudenten Psychologie aan de Universiteit Twente en de verzamelde gegevens zullen worden geanalyseerd voor hun bachelor- en masterscripties.

Deelname

Om deel te nemen aan dit onderzoek moet u 18 jaar of ouder zijn en in Duitsland of Nederland wonen. U moet ook Duits of Nederlands spreken. Mensen die momenteel onder behandeling zijn voor een psychische aandoening of die de afgelopen twee jaar suïcidale gedachten hebben gehad, kunnen niet deelnemen aan dit onderzoek om hen te beschermen tegen mogelijke schade door deelname. Uw deelname aan dit onderzoek is geheel vrijwillig en u heeft het recht om u op elk moment terug te trekken zonder opgaaf van reden of consequenties. Alle gegevens die u tot op dat moment hebt verstrekt, worden uitgesloten van verdere analyses. Zodra de vragenlijst is ingevuld, worden alle gegevens echter geanonimiseerd en kunnen ze dus niet meer worden geïdentificeerd, waardoor het onmogelijk is om uw gegevens te verwijderen. Uw gegevens worden uitsluitend onder vertrouwelijke omstandigheden gebruikt. Demografische vragen worden gesteld zodra u hebt ingestemd met deelname. Om anonimiteit te garanderen, wordt er geen identificeerbare informatie verzameld. Het invullen van de vragenlijst duurt ongeveer 15-20 minuten. Uw deelname aan dit onderzoek wordt zeer op prijs gesteld en zal bijdragen aan een beter begrip van de psychologische gevolgen van klimaatverandering.

Contactgegevens

Dit onderzoek is beoordeeld en goedgekeurd door de Ethische Commissie van de Universiteit Twente. Voor aanvullende informatie of vragen kunt u contact opnemen met de

onderzoekers:

Michele Petkovski (c.m.petkovski@student.utwente.nl)

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Jasper Wrana (j.r.wrana@student.utwente.nl)

U kunt ook contact opnemen met de begeleider Dr. Alejandro Dominguez Rodriguez (a.dominguezrodriguez@utwente.nl).

Appendix I

Informed Consent in Qualtrics

German Version

Indem ich unten auf JA klicke, bestätige ich das Folgende:
Ich habe alle Informationen gelesen und erfülle alle Teilnahmebedingungen. Ich bestätige, dass meine Teilnahme völlig freiwillig ist. Ich erkenne auch mein Recht an, meine Einwilligung jederzeit ohne Angabe von Gründen zu widerrufen, insbesondere wenn ich Unbehagen oder Stress jeglicher Form empfinde. Solch Widerruf wird keine Konsequenzen nach sich ziehen.

Darüber hinaus verstehe ich Folgendes:
- Alle vom Forscher erhobenen Daten bleiben völlig anonym und können nicht auf meine Identität zurückgeführt werden. Ein Rücktritt ist daher nach Beendigung der Umfrage nicht mehr möglich.

- Mir ist bekannt, dass die von mir zur Verfügung gestellten Informationen in Forschungsberichten verwendet werden, deren Ziel es ist, die Auswirkungen des Klimawandels auf die psychische Gesundheit darzustellen.
- Ich befinde mich derzeit in KEINER medizinischen oder therapeutischen Behandlung aufgrund einer psychischen Störung.
- Ich habe in den letzten zwei Jahren KEINE Selbstmordgedanken erfahren.
- Mir ist bewusst, dass die Teilnahme an der Studie aufgrund der Diskussion der sensiblen Thematik des Klimawandels zu psychischem Unbehagen führen kann.
- Ich erkläre mich damit einverstanden, keine Informationen über den Ablauf und die Einzelheiten der Studie zu teilen, da dies die Ergebnisse der Studie beeinträchtigen könnte.
- Ich erkläre mich damit einverstanden, dass meine Antworten in der Umfragedatenbank für mögliche zukünftige Forschungs- und Ausbildungszwecke genutzt werden.

Dutch Version

Door hieronder op JA te klikken, bevestig ik het volgende:
Ik heb alle informatie gelezen en voldoe aan alle deelnamevoorwaarden. Ik bevestig dat mijn deelname volledig vrijwillig is. Ik erken ook mijn recht om mijn medewerking aan dit onderzoek op elk moment in te trekken zonder opgave van reden, vooral als ik ongemak of stress van welke vorm dan ook ervaar. Een dergelijke intrekking heeft geen gevolgen.

Daarnaast begrijp ik het volgende:
- Alle door de onderzoekers verzamelde gegevens blijven volledig anoniem en zijn niet te herleiden tot mijn identiteit. Na afloop van de enquête is terugtrekking dus niet meer mogelijk.

- Ik begrijp dat de informatie die ik verstrek zal worden gebruikt in onderzoeksrapporten die tot doel hebben de impact van klimaatverandering op de psychische gezondheid aan te tonen.
- Ik onderga momenteel GEEN medische of therapeutische behandeling voor een psychische stoornis.
- Ik heb de afgelopen twee jaar GEEN zelfmoordgedachten gehad.
- Ik ben mij ervan bewust dat deelname aan het onderzoek psychologisch ongemak kan veroorzaken als gevolg van de discussie over de gevoelige kwestie van klimaatverandering.
- Ik ga ermee akkoord geen informatie te delen over het proces en de details van het onderzoek, aangezien dit de resultaten van het onderzoek zou kunnen beïnvloeden.
- Ik ga ermee akkoord dat mijn antwoorden worden gebruikt in de enquêtedatabase voor mogelijk toekomstig onderzoeks- en trainingsdoeleinden.

Appendix J

R-Code

```
#BACHELOR THESIS JASPER WRANA#
#install and load packages
install.packages("tidyverse")
library(tidyverse)
install.packages("dplyr")
library(dplyr)
install.packages("ggplot2")
library(ggplot2)
install.packages("lmtest")
library(lmtest)
install.packages("interactions")
library(interactions)
install.packages("sjPlot")
library(sjPlot)
install.packages("MASS")
library(MASS)
install.packages("e1071")
library(e1071)

#1st step: cleaning data#
climate <- read.csv("Updated_Climate.csv")
```

```
View(climate)
names(climate)
climate <- climate[,-c(1:3)]
climate <- climate[,-c(2,4,5,6,7)]
as.character(as.matrix(climate[1,]))
names(climate)<-as.character(as.matrix(climate[1,]))
names(climate)
climate <- climate [-c(1:2),]

#delete all other questionnaires#
climate <- climate[,-c(42:100)]
climate <- climate [, -c(44:46)]
#renaming variables#
names(climate)[4]<- "gender"
names(climate)[5]<- "age"
names(climate)[6]<- "degree"
names(climate)[7]<- "degree2"
names(climate)[8]<- "nationality"
names(climate)[9]<- "closewater"
names(climate)[10]<- "sealevel"
names(climate)[11]<- "floodvictim"
names(climate)[12]<- "ruralurban"

#making age numeric#
climate$age<-as.numeric(as.character(climate$age))
class(climate$age)
#making gender variable ready#
levels(climate$gender)<- c(NA, "Weiblich", "Männlich", "Non-Binär/anderes", NA)
summary(climate$gender)
#removing participants#
num_participants <- nrow(climate)
print(num_participants)
#currently: 343
climate <- climate[climate$Finished == "True", ]
num_participants <- nrow(climate)
print(num_participants)
#after removing non-completers: 259 (84 non-completers)
#removing other nationalities
climate <- climate[climate$nationality != "Sonstige", ]
num_participants <- nrow(climate)
print(num_participants)
#after removing other nationalities: 238 (21 other nationalities)
#need ro remove people who did not conform with second informed consent
names(climate)[3]<-"consent1"
climate <- climate[climate$consent1 != "NEIN (Sie werden zum Ende der Studie
weitergeleitet)", ]
num_participants <- nrow(climate)
print(num_participants)

names(climate)[42]<-"consent2"
```

```
climate <- climate[climate$consent2 != "Nein", ]
num_participants <- nrow(climate)
print(num_participants)
#after removing people who did not cosent at the start and at the end: 232 (-3 respectively)

#check demographics#
#gender#
gender_freq <- table(climate$gender)
print(gender_freq)
gender_prop <- prop.table(gender_freq)
print(gender_prop)
#age#
age_mean <- mean(climate$age)
age_median <- median(climate$age)
age_sd <- sd(climate$age)
age_range <-range(climate$age)
print(age_mean)
print(age_median)
print(age_sd)
print(age_range)
#nationality#
#Renaming german answers to english ones
climate$nationality <- recode(climate$nationality,
                              "Deutsch" = "German",
                              "Niederländisch" = "Dutch")
table(climate$nationality)

climate$closewater <- recode(climate$closewater,
                              "Ja" = "Yes",
                              "Nein" = "No")
table(climate$closewater)

climate$sealevel <- recode(climate$sealevel,
                              "Ja" = "Yes",
                              "Nein" = "No")
table(climate$sealevel)

#degree#
degree_freq <- table(climate$degree)
print(degree_freq)
degree2_freq <- table(climate$degree2)
print(degree2_freq)
#location#
closewater_freq <- table(climate$closewater)
print(closewater_freq)
sealevel_freq <- table(climate$sealevel)
print(sealevel_freq)
floodvictim_freq <- table(climate$floodvictim)
print(floodvictim_freq)
ruralurban_freq <- table(climate$ruralurban)
```

```
print(ruralurban_freq)


#Checking how many people per variable per nationality#
sealevel_counts <- climate %>%
  group_by(nationality, sealevel) %>%
  summarize(count = n()) %>%
  arrange(nationality, sealevel)

print(sealevel_counts)

closewater_counts <- climate %>%
  group_by(nationality, closewater) %>%
  summarize(count = n()) %>%
  arrange(nationality, closewater)

print(closewater_counts)

average_scores <- climate %>%
  group_by(nationality) %>%
  summarize(average_score = mean(EcoAnx, na.rm = TRUE))

print(average_scores)

average_scores <- climate %>%
  group_by(nationality) %>%
  summarize(average_score = sd(EcoAnx, na.rm = TRUE))

print(average_scores)

average_scorescloseness <- climate %>%
  group_by(closewater) %>%
  summarize(average_score = mean(EcoAnx, na.rm = TRUE))

print(average_scorescloseness)

average_scorescloseness <- climate %>%
  group_by(closewater) %>%
  summarize(average_score = sd(EcoAnx, na.rm = TRUE))

print(average_scorescloseness)

average_scoressealevel <- climate %>%
  group_by(sealevel) %>%
  summarize(average_score = mean(EcoAnx, na.rm = TRUE))

print(average_scoressealevel)

average_scoressealevel <- climate %>%
  group_by(sealevel) %>%
```

```
  summarize(average_score = sd(EcoAnx, na.rm = TRUE))

print(average_scoressealevel)
# Making Answers of the Questionnaires Numeric #
#For Eco-Anxiety Scale
columns_to_recode <- 13:34
print(columns_to_recode)
climate <- climate %>%
  mutate(across(all_of(columns_to_recode), ~ case_when( . == "stimme nicht zu" ~ 1,
                                        . == "stimme eher nicht zu" ~ 2,
                                        . == "stimme eher zu" ~ 3,
                                        . == "stimme zu" ~ 4,
                                        TRUE ~ NA_real_ )))
climate <- climate %>%
  rowwise() %>%
  mutate(EcoAnx = mean(c_across(all_of(columns_to_recode)), na.rm = TRUE))

#for GAD-7
columns_to_recode <- 35:41
print(columns_to_recode)
climate <- climate %>%
  mutate(across(all_of(columns_to_recode), ~ case_when( . == "Überhaupt nicht" ~ 0,
                                        . == "An einzelnen Tagen" ~ 1,
                                        . == "An mehr als der Hälfte der Tage" ~ 2,
                                        . == "Beinahe jeden Tag" ~ 3,
                                        TRUE ~ NA_real_ )))

climate <- climate %>%
  rowwise() %>%
  mutate(GAD7 = mean(c_across(all_of(columns_to_recode)), na.rm = TRUE))
#making GAD7 numeric#
climate$GAD7<-as.numeric(as.character(climate$GAD7))
class(climate$GAD7)

View(climate)
#### Computing means, SDs and ranges of EAQ-22 & GAD-7 ####
##descriptive statistics
summary(climate)
mean(climate$EcoAnx)
sd(climate$EcoAnx)
mean(climate$GAD7)
sd(climate$GAD7)
class(climate$EcoAnx)
class(climate$GAD7)
summary(climate$GAD7)

#4 assumptions: Normality, Homoscedasticity,

#####check normality
##Eco-Anxiety
```

```
qqnorm(climate$EcoAnx); qqline(climate$EcoAnx)
hist(climate$EcoAnx, main = "Histogram Eco Anxiety")

EcoAnx_skew <- skewness(climate$EcoAnx)
EcoAnx_skew

#Kolmogorov-Smirnov Test#
ks.test(climate$EcoAnx, "pnorm", mean = mean(climate$EcoAnx), sd =
sd(climate$EcoAnx))
#-> seems to be okay (plot is okay, p-value of kolmogorov test is also okay)


#GAD-7
qqnorm(climate$GAD7); qqline(climate$GAD7)
hist(climate$GAD7, main = "Histogram General Anxiety")


#Kolmogorov-Smirnov Test#
ks.test(climate$GAD7, "pnorm", mean = mean(climate$GAD7), sd = sd(climate$GAD7))


#####homoscedasticity
#nationality
model1 <- lm(EcoAnx ~ nationality, data = climate)
plot(fitted(model1), residuals(model1), main = "Residuals vs Fitted", xlab = "Fitted values",
ylab = "Residuals")

bptest(model1)
# -> p-value higher than 0.05! -> homoscedasticity


#close to water
model2 <- lm(EcoAnx ~ closewater, data = climate)
plot(fitted(model2), residuals(model2), main = "Residuals vs Fitted", xlab = "Fitted values",
ylab = "Residuals")

bptest(model2)
# -> p-value much higher than 0.05 -> homoscedasticity

#sealevel#
model3 <- lm(EcoAnx ~ sealevel, data = climate)
plot(fitted(model3), residuals(model3), main = "Residuals vs Fitted", xlab = "Fitted values",
ylab = "Residuals")

bptest(model3)
# -> p-value much higher than 0.05 -> homoscedasticity


##############Creating dummy variables#
#nationality
```

```
climate$nationality_dummy <- as.integer(factor(climate$nationality == "Dutch", levels =
c(FALSE, TRUE)))

#closewater
climate$closewater_dummy <- as.integer(factor(climate$closewater == "No", levels =
c(FALSE, TRUE)))

#sealevel
climate$sealevel_dummy <- as.integer(factor(climate$sealevel == "No", levels = c(FALSE,
TRUE)))

#Hypothesis Testing#
#hypothesis 1: nationality#
model_nationality <- lm(EcoAnx ~ nationality, data = climate)
summary(model_nationality)

ggplot(climate, aes(x = nationality_dummy, y = EcoAnx)) +
  geom_point() +
  geom_smooth(method = "lm", se = FALSE) +
  labs(x = "Nationality", y = "Eco-Anxiety") +
  theme_minimal()

boxplot(EcoAnx ~ nationality, data = climate,
        names = c("Dutch", "German"))

custom_colors <- c("white", "grey")

ggplot(climate, aes(x = nationality, y = EcoAnx, fill = nationality)) +
  geom_bar(stat = "summary", fun = "mean", position = "dodge", color = "black") +
  labs(title = "EcoAnxiety mean of each population",
       x = "Nationality",
       y = "Mean level of Eco Anxiety") +  scale_fill_manual(values = custom_colors)

#hypothesis 2: moderation
model_moderation <- lm(EcoAnx ~ nationality_dummy * sealevel_dummy, data = climate)
summary(model_moderation)

conf_intervals <- confint(model_moderation)
print(conf_intervals)

#hypothesis 3: close to water#
model_closewater <- lm(EcoAnx ~ closewater_dummy, data = climate)
summary(model_closewater)

boxplot(EcoAnx ~ closewater, data = climate,
        names = c("Yes", "No"))

ggplot(climate, aes(x = closewater, y = EcoAnx, fill = closewater)) +
  geom_bar(stat = "summary", fun = "mean", position = "dodge", color = "black") +
  labs(title = "EcoAnxiety mean of each population",
```

```
      x = "Close to water",
      y = "Mean level of Eco Anxiety") +  scale_fill_manual(values = custom_colors)
#hypothesis 4: under sea level#
model_sealevel <- lm(EcoAnx ~ sealevel_dummy, data = climate)
summary(model_sealevel)

ggplot(climate, aes(x = sealevel, y = EcoAnx, fill = sealevel)) +
  geom_bar(stat = "summary", fun = "mean", position = "dodge", color = "black") +
  labs(title = "EcoAnxiety mean of each population",
      x = "Below Sea level",
      y = "Mean level of Eco Anxiety") +  scale_fill_manual(values = custom_colors)

boxplot(EcoAnx ~ sealevel, data = climate,
       names = c("Yes", "No"))

#####EXTRA TESTS######
#multiple linear regression#
modelMLR <- lm(EcoAnx ~ nationality + sealevel + closewater + GAD7, data = climate)
summary(modelMLR)

conf_intervals <- confint(modelMLR)
print(conf_intervals)

#ANXIETY IN POPULATIONS+
model_nationalityGAD <- lm(GAD7 ~ nationality, data = climate)
summary(model_nationalityGAD)

ggplot(climate, aes(x = nationality, y = GAD7)) +
  geom_point() +
  geom_smooth(method = "lm", se = FALSE) +
  labs(x = "Nationality", y = "Eco-Anxiety") +
  theme_minimal()


#correlation between questionnaires
correlation <- cor(climate$EcoAnx, climate$GAD7)
correlation

cor.test <-cor.test(climate$EcoAnx, climate$GAD7)
cor.test

count_df <- climate %>%
  filter(sealevel == 'Yes') %>%
  group_by(nationality) %>%
  summarize(count = n(), .groups = 'drop')

print(count_df)
```