# Gender Differences in Mental Health Affections due to Climate Change and Climate Paralysis

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## Abstract

**Background:** Climate change referring to global temperature rises has not only been shown to negatively impact the physical health of the human species but has also been found to form a significant risk for individuals' psychological health. Due to significant importance of the topic area and its impact on emotional responses among individuals, studies have already began investigating mental health affections resulting from climate change. Despite the existence of first studies, gaps with special regard to gender differences and the interactions between diverse affections remained. The present thesis focuses on occurrence of climate anxiety, solastalgia and climate paralysis among Dutch and German adults. It investigates gender differences, correlations, and mediating effects for these affections. **Methods:** The study was of quantitative nature where 86 participants answered an online survey measuring climate anxiety (EAQ-22), solastalgia (EGriQ-6) and climate paralysis (EPS). **Results:** Data analyses showed an influence of gender on climate anxiety ($p = .033$) and solastalgia ($p = .017$), but no gender differences were found for climate paralysis ($p = .848$). Further, overall significance ($F(2,83) = 4.82$, $p = .011$) was found. While climate anxiety demonstrated a marginal relation ($p = .102$) on climate paralysis, the effect of solastalgia was not significant ($p = .644$). Additionally, no significant direct effect of gender on climate paralysis ($p = .557$) could be detected. Climate anxiety ($p = .097$) and solastalgia ($p = .592$) entailed direct effects. **Conclusions:** Females were found to score higher in climate anxiety and solastalgia but not in climate paralysis compared to males. Higher levels of climate anxiety or solastalgia did not lead to higher levels of climate paralysis in any gender. No mediation effect of climate anxiety or solastalgia on the relationship between gender and climate paralysis could be detected.

## Content

# Gender Differences in Mental Health Affections due to Climate Change and Climate Paralysis

## Introduction

Climate change refers to prolonged alterations in temperatures and weather patterns (United Nations, n.d.-a). Since the 1800s, human activities have been the primary catalysts of climate change, primarily through actions such as the combustion of fossil fuels like coal, oil, and gas. The leading contributors to this phenomenon have been shown to be greenhouse gases, notably carbon dioxide and methane, stemming from activities such as gasoline-fueled transportation and the utilization of coal for the heating of buildings (United Nations, n.d.-a). The consequences resulting from climate change are extensive and of alarming nature. They include drastic rises in global temperatures and increasing frequencies of more intense wildfires. Moreover, the number and severity of storms expands and events including growing droughts, warming seas, rising sea levels, species extinction, scarcity of food resources, health threats, and heightened poverty (United Nations, n.d.-b). Moreover, climate change contributes to the emergence of zoonotic diseases, illnesses transmitted through food, water, and vectors, as well as social and psychological well-being challenges, especially for vulnerable groups including females, children, and individuals of marginalised groups (World Health Organization: WHO, 2023).

### *Mental Health Affections of Climate Change*

Next to the consideration that climate change puts individuals' physical health at great risk, it also forms a significant risk factor in the development of mental illnesses among the human species (Innocenti, Perilli, et al., 2023). In a study on two million citizens of the United States, the effect of temperature rises on mental health has been investigated. Results demonstrated that increasing temperatures affected individuals' mental health negatively (Obradovich et al., 2018). Additional research has found higher temperatures to be correlated with increased scores in suicidal tendencies among citizens from the United States (US) and Mexico. Study outcomes have shown that the number of suicides increased during warmer periods and decreased at times when the weather cooled down (Burke et al., 2018). But not only do temperature rises play a crucial role with regard to mental health affections. The exposure to certain gases appears to form another threat to the mental health of the human species. Song et al (2023) conducted a study in which they discovered that diverse gases are positively correlated with the risk of developing mental disorders such as schizophrenia.

However, it is important to mention that this study did not take the most prominent greenhouse gas CO2 (United States Environmental Protection Agency [US EPA], 2022) into account when conducting the research. However, besides the occurrence of suicidal ideations or mental disorders such as schizophrenia, there are multiple other mental affections that might form more common affective responses to global changes.

***Climate anxiety, Solastalgia and Climate Paralysis***

Studies have shown significant outcomes that could result from rapid changes in global temperature or mere exposure to multiple gases. Emotional reactions including climate anxiety, solastalgia and climate paralysis collectively capture the complex and nuanced emotional and psychological reactions elicited by climate change, ranging from concerns about the future to distress about changing landscapes and a sense of incapacity to address and react to environmental challenges.

Climate anxiety refers to the deep-seated distress with respect to climate change itself and its impacts on both the environment and human life. Such distress can manifest, on the one hand, as intrusive thoughts or, on the other hand, as the overwhelming sense of unease about potential future ecological disasters. Additionally, concerns about the long-term sustainability of the planet, including the care for future generations form a great part of experiencing climate anxiety (Yale Sustainability, n.d.). Next to climate anxiety, solastalgia is another potential emotional response to global warming. It can be defined as an enduring emotional trauma resulting from environmental changes and losses. It is characterised by feelings of yearning and hopelessness and can be triggered by the negative and distressing changes to one's familiar environment and ecosystems due to climate change (Vanbuskirk, 2023). Climate paralysis, as indicated by multiple sources (Innocenti et al., 2023; BScN, n.d.), represents a state of passive behavioural stagnation. It serves as a common reaction and is characterised by the individual’s belief that their efforts cannot significantly contribute to mitigating the drastic consequences of climate change. This emotional condition is typically marked by symptoms found in depression, heightened anxiety, and the feeling of hopelessness (Innocenti et al., 2023). People experiencing climate paralysis frequently express mental states of powerlessness, which may manifest as indifference, or even apathy (BScN, n.d.). Concerning the emotional experience of climate change and its consequences, different factors could lead to differences in their experience. A prominent factor that leads to diverse experiences of climate change is gender.

### *Gender Differences in the Experience of Climate Change*

Prior studies have focused on gender differences across different populations and found diverse results. Multiple studies reported higher scores in climate anxiety among female individuals, indicating a greater prevalence of this form of anxiety among women. This trend was observed in diverse populations including Indian (Tam et al., 2023), European and African French-speaking participants (Heeren et al., 2022), as well as a German-speaking sample (Wullenkord et al., 2021). Nevertheless, it is worth noting that contrasting results emerged in other geographical locations, such as China, Japan, and the United States. There, contradictory findings have been found? with males displaying higher levels in climate anxiety than their female counterparts (Tam et al., 2023). With respect to the experience of solastalgia, only few studies have been conducted with the few outcomes showing that females experienced greater levels of climate grief than males (Heeren et al., 2022). While prior research on the influence of gender on climate anxiety and solastalgia has been conducted, no such research on climate paralysis has been conducted so far.

### *Interactions among Climate Anxiety, Solastalgia and Climate Paralysis*

Although each affection can be investigated and analysed on its own, their correlations and interactive mechanisms should additionally be taken into consideration in order to gain a more nuanced understanding of their nature.

For example, previous research focused on the interactions between climate anxiety and climate paralysis. They demonstrated that symptoms of anxiety are typical symptoms within the occurrence of climate paralysis (Innocenti et al., 2023). Moreover, depressive symptoms, which form a significant component within solastalgia, have been described to be present in line with the experience of climate paralysis (Innocenti et al., 2023), as well. So far, no studies have been conducted investigating the relations between climate anxiety and solastalgia.

## Rationale

Given the anticipated increase in the frequency and severity of climate change consequences in the coming decades (Arias et al., 2021), an early understanding of its mental health implications is essential. Despite the need for research, no studies could be found for gender differences in climate paralysis, yet. Only few studies have been done concerning gender differences in solastalgia (Heeren et al., 2022) and for climate anxiety, the studies that have been conducted were limited to Indian (Tam et al., 2023), European and African French-

Speaking (Heeren et al., 2022) and German-speaking (Wullenkord et al., 2021) participants. Due to contradictory results, there is still the need for research on gender differences aiming to create more clarity. Besides the interest in gender influences, the relations between climate anxiety, solastalgia and climate paralysis remains unclear due to lack of research on these. In order to address such remaining gaps, the present study will focus on the investigation of climate anxiety, solastalgia and climate paralysis among adults residing in Germany and the Netherlands. It aims to gain more nuanced insights into how the three reactions to climate change are related and how gender might be a part of these.

Thus, this study aims to examine the following research question: **"***How does gender influence the experience of mental health affections due to climate change among German and Dutch adults and what are their relations?*". To answer the research question, the following hypotheses were formulated.

**Hypothesis 1 (H1)**: F*emales score higher in the experience of climate anxiety, solastalgia and climate paralysis due to climate change than males.*

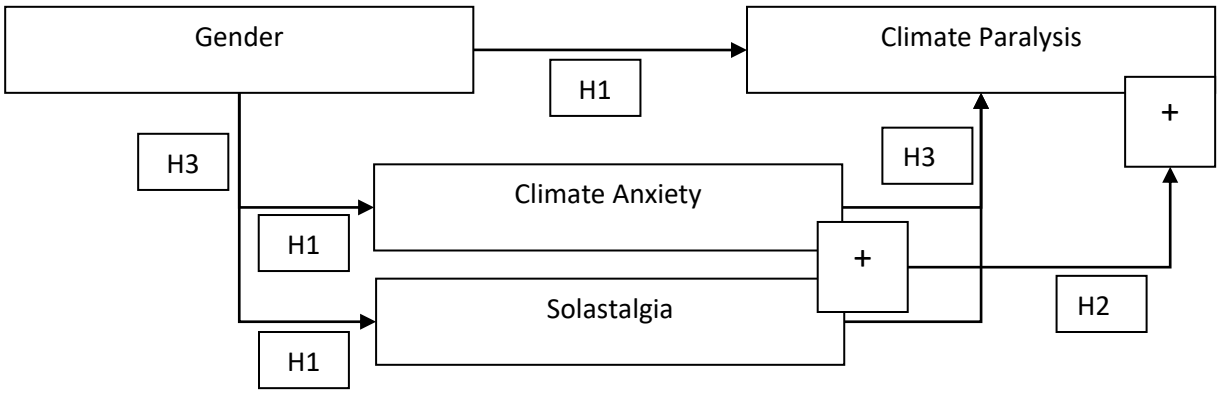
**Hypothesis 2 (H2)**: *Higher levels of climate anxiety and solastalgia are associated with higher levels of climate paralysis.*

**Hypothesis 3 (H3)**: *Climate anxiety and solastalgia mediate the relationship between gender and climate paralysis.*

A graphic representation of the hypotheses can be found in Figure 1.

**Figure 1**

*Representation of Hypotheses*



*Note.* + = higher level of the variable.

## Methods

The method section was written based on the APA 7th edition guidelines on writing methods sections (Moreno & Carrillo, 2019). Additionally, the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) checklist for reporting cross-sectional studies has been oriented on to add points which are not entailed in the APA guidelines. The STROBE checklist can be found in Appendix A.

### Design

The study was conducted through the use of a cross-sectional design. The independent variables are, for H1, gender and, for H2, climate anxiety and solastalgia. In the current research, climate anxiety and solastalgia also form potential mediating variables when considering them as mediators for the correlation between gender and climate paralysis in H3. In that context, climate paralysis is treated as another dependent variable. Each dependent and potential mediating variable was measured using instruments containing Likert Scales. All variables are numerical with gender being dichotomous and categorical.

### Participants and Recruitment

Prior to starting participant recruitment, the intended sample size (n=120) was calculated using GPower. In the study, the total number of the online survey respondents was 140. However, 54 (38.57%) respondents were excluded from the study due to exclusion criteria such as not fully answering one or more questionnaires or not meeting the age requirements resulting in a final sample of 86 participants.

For participant recruitment, a combination of convenience and snowball sampling was used. The researchers created and uploaded German and Dutch advertisements on the social media platform Instagram, LinkedIn (Appendix B) and shared further three written advertisements in German, Dutch and English language via the social network of the researchers using the online communication platform WhatsApp (Appendix C). In the advertisements, viewers were asked to share the questionnaire with other individuals. Further, the advertisement contained a brief study description and a link to Qualtrics, where participation took place. The advertisements were published and shared on the 7th of November 2023 and the data collection ended on the 10th of December 2023. Additionally, the SONA system of the University of Twente was involved. It is an online platform on which

psychology students can earn so-called SONA points for studies they participate in and has been used for additional participant recruitment. Engaging in these sampling methods enabled quick recruitment of numerous participants.

Inclusion criteria were being 18 to 60 years old and residing in Germany or the Netherlands. Exclusion criteria were (1) being younger than 18 or older than 60 years of age, (2) not residing in Germany or the Netherlands, (3) currently undergoing treatment for a mental disorder, and (4) having engaged in a suicide attempt within the past two years. Participants fulfilling one or more of the exclusion criteria were excluded from further data usage. The questionnaires were offered in two languages being German and Dutch.

**Materials**

***Eco-Anxiety Questionnaire*.** The EAQ-22 is a questionnaire entailing 22 items developed by Ágoston et al. (2022). The items consist of the two factors h*abitual ecological worry* and *negative consequences of eco-anxiety* aiming to portray the experience of climate related anxiety. The scale is answered on a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). Excellent internal consistency has been found for the *habitual ecological worry* scale (Cronbach's alpha = 0.91) and the *negative consequences of eco-anxiety* scale (Cronbach's alpha = 0.86).

***Ecological Grief Questionnaire*.** The EGriQ-6 (Ágoston et al., 2022) was developed intending to measure the experience of ecological grief, also known as solastalgia. It consists of 6 items that have to be answered on a 4-point Likert Scale ranging from "strongly disagree" (1) to "strongly agree" (4). In the study of Ágoston et al. (2023), excellent internal consistency has been found with a Cronbach's alpha of $\alpha = 0.77$.

***Eco-Paralysis Scale*.** The Eco-paralysis scale (EPS) was developed by Innocenti, Perilli, et al. (2023). It aims to measure behavioural patterns related to climate paralysis and contains 11 items describing ideas and behavioural reactions. These are being answered on a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). It was firstly developed and used for an Italian population and showed excellent reliability with a Cronbach's alpha coefficient of $\alpha = 0.994$ in the study of Innocenti, Perilli, et al. (2023).

In order to guarantee that the participants are able to understand the questionnaire items, they were translated into German and Dutch language before demonstrating them to the respondents.

## Procedure

After following advertisements on social media platforms and the SONA system of the University of Twente, the participants were forwarded to Qualtrics, an online-survey platform. Since any digital device could be used to do so and the link could be accessed from any setting. However, the exact locations when filling out the questionnaire remained unknown. Prior starting the questionnaire, the participants were shown an opening statement stating the nature and the aims of the study. They were informed about the requirements for participation and informed that participation is entirely voluntary and that they have the right to withdraw from the study at any point without providing a particular reason and without any further consequences. Further, the student e-mails from all researchers were provided which could be used for further information or in case of further questions (Appendix D). By ticking boxes, they were able to give consent to participate in the study (Appendix E). Further, demographic data was collected where the participants were asked to share age, gender, highest education and country of residence. In case of participation taking place through SONA, those participants were additionally asked to fill in their SONA ID. All questionnaires were then displayed in a random order to prevent biases resulting from any order effect. By choosing the answers related to each item, the participants were able to share their answers. After the completion of the questionnaires, it was thanked for the participation and the participants were provided with information about available support services to contact in case of psychological distress or discomfort during or after the participation. They were also asked whether they wished to be contacted once again after three and six months to reevaluate how they are feeling. If so, they were given the opportunity to share an email address which could be used to contact them for this.

## Data Analysis

For data analysis, the statistical software program RStudio (version 2023.09.1 +494) was used. The used R code can be seen in Appendix I. Survey data was obtained via Qualtrics and the two surveys in Dutch and German were downloaded as a CSV file. They were then imported to RStudio. For the statistical analysis, the packages “tidyverse”, “readr”, “dplyr” and “mediation” were used. The two datasets were combined into one dataset. The final dataset was then cleaned. For that, participants who did not finish the survey were removed from the dataset. Additionally, test participations who were younger than 18 years or older than 65 years were excluded from further analysis. For cleaning completion, survey questions

measuring eco-guilt and pre-environmental behaviour were removed from the dataset since they are not the focus of the present research. Further, demographic data were computed, and descriptive statistics were analysed by calculating the mean scores (M) and standard deviations (SD) of the age, EAQ-22, EGriQ-6 and EPS. Correlations between gender, the EAQ-22, EGriq-6 and EPS have also been calculated.

***Hypothesis 1.*** In order to examine whether females score higher than males in climate anxiety, solastalgia and climate paralysis, t-tests with gender as the independent variable and climate anxiety, solastalgia and climate paralysis as dependent variables were conducted. Gender is a nominal categorial variable. Climate anxiety resulted from the mean score of the EAQ-22, solastalgia was the mean score of the EGriQ-6 and Climate Paralysis resulted as the mean score from the EPS. All dependent variables were interval variables.

***Hypothesis 2.*** In order to examine whether higher levels of climate anxiety and solastalgia are associated with higher levels of climate paralysis, a multiple regression model, with climate anxiety and solastalgia as the independent variables and climate paralysis being the dependent variable, was conducted. Climate anxiety and solastalgia were treated as interval variables, while climate paralysis was a continuous variable.

***Hypothesis 3.*** In order to examine whether climate anxiety and solastalgia mediate the relationship between gender and climate paralysis. a mediation analysis was performed. Gender was the independent variable, climate anxiety and solastalgia were treated as mediator variables and climate paralysis formed the dependent variable. Gender was a nominal variable, climate anxiety and solastalgia and climate paralysis were treated as interval variables.

## Results

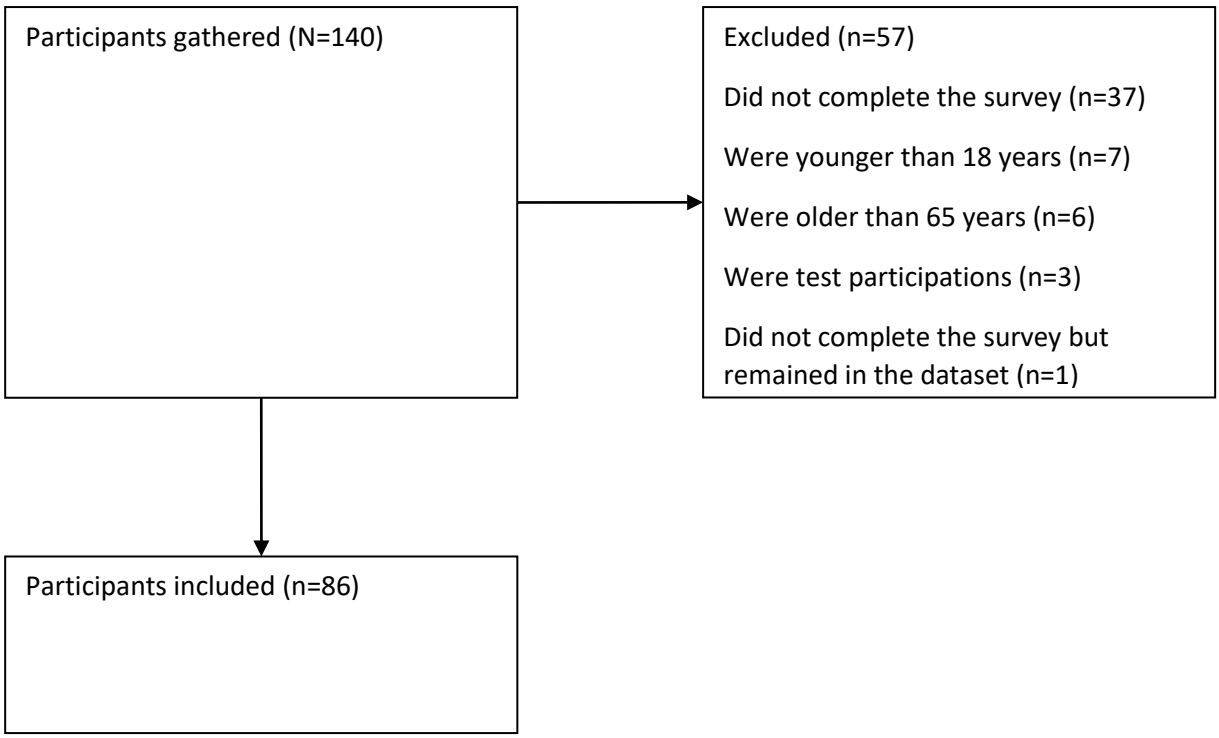
### Demographics

From the 140 gathered online survey respondents, 54 (38.57 %) were excluded from further data analysis. 37 (26.43%) participants were removed because they did not complete the survey. 7 (5%) were younger than 18 years of age and 6 (4.29%) were older than 65 years which formed another reason for elimination from further data analyses. Three (2.14%) were responses that were gathered by the researchers test participations and were thus also deleted from the dataset. One (0.71%) participant who did not answer all questions remained in the dataset and was thus also removed and excluded from data analyses. A representation of the

exclusion process of participants can be found in Figure 2. After exclusion of these recorded responses, the final sample consisted of 86 participants, 31 (36.05%) being male and 55 (63.95%) being female. Their ages ranged from 18 to 63 years, with a mean age of 31.6 (SD=13.37). With respect to the country of residence, 71 (82.56%) lived in Germany and 15 (17.44%) in the Netherlands. With regard to the participants' educational levels, 26 (30.23%) had a bachelor's degree, 25 (29.07%) had a higher school certificate, 18 (20.93%) had a master's degree, 11 (12.79%) had a vocational diploma, 1 (1.16%) had less than an educational degree and 5 (5.81%) participants shared other educational degrees.

**Figure 2**

*Flowchart of Participant Exclusion*




***Descriptive Statistics***

For the EAQ-22, the mean score was M = 2.55 with a standard deviation of SD = 0.52. Recorded scores ranged from 1.05 to 3.55 This indicates moderate levels in the experience of climate anxiety among all respondents. The EGriQ-6 showed a mean of M = 2.49 with a standard deviation of SD = 0.64 with the scores ranging from 1 to 3.67. This outcome indicates moderate levels of solastalgia in the participants. The EPS resulted in a mean of M =

2.63 (SD = 0.60) with a score range from 1.36 to 4.36. This indicates moderate levels of climate paralysis among the participants.

**Correlations**

The correlations between all relevant variables can be seen in Table 1. It shows that with a correlation coefficient of .76, there is a strong positive correlation between EAQ-22 and EGriQ-6 indicating that increases in climate anxiety led to increases in solastalgia. Further the coefficient of .32 displayed a positive correlation between EAQ-22 and EPS which means that individuals scoring higher in climate anxiety might also exhibit a certain degree of climate paralysis. Another positive correlation was found between EPS and EGriQ-6 with a correlation coefficient of .27. This displays that respondents experiencing climate paralysis might also report levels of solastalgia.

**Table 1**

*Correlations between relevant Variables*

| | **EAQ-22** | **EGriQ-6** | **EPS** |
|---|---|---|---|
| **EAQ-22** | - | - | - |
| **EGriQ-6** | .76 | - | - |
| **EPS** | .32 | .27 | - |

*Abbrevations.* EAQ-22=Eco-Anxiety Questionnaire; EGriQ-6=Ecological Grief Questionnaire; EPS=Eco-Paralysis Scale.

**Linear Assumptions Testing**

To test the linear assumption of normality, the Shapiro-Wilk Test for normality was conducted. Results showed that, for data of all questionnaires including EAQ-11 (W = .977; p = .137), EGriQ-6 (W = .972; p = .063) and EPS (W = .986; p = .462), the assumption of normality was met. When testing the assumption of linearity, residual vs fitted plots demonstrated no violations and thus the assumption of linearity was met. To test for homoscedasticity, scale-location plot outcomes showed that the assumption was met. Lastly, when checking for independence, residuals vs order plots showed that independence was also met. All visualisations can be found in Appendices F, G and H.

***Hypothesis 1***

*Gender and Climate Anxiety*

The t-test comparing climate anxiety scores between male and female participants demonstrated a statistically significant difference ($t = 2.18$, $df = 60.08$, $p = 0.033$). The positive t-value ($t = 2.18$) showed that the female mean in climate anxiety was greater than the male mean. The p-value ($p = 0.033$) was smaller than the significance level of $p = .05$ and thus the null hypothesis can be rejected.

*Gender and Solastalgia*

The t-test comparing solastalgia scores between male and female respondents revealed a statistically significant difference ($t = 2.45$, $df = 57.928$, $p = .017$). The t-value ($t = 2.45$) being positive demonstrated a higher mean for female participants compared to their male counterparts. The p-value ($p = .017$) did not reach the significance level of $p = .05$ which indicates that the null hypothesis can be rejected.

*Gender and Climate paralysis*

The t-test comparing climate paralysis scores between male and female participants outlined no statistically significant difference ($t = .19$, $df = 55.48$, $p = .848$). Females ($M = 2.64$, $SD = 0.57$) and males ($M = 2.62$, $SD = 0.66$) demonstrated similar scores in climate paralysis. The small t-value ($t = .19$) and the p-value ($p = .85$) exceeding the significance level of $p = .05$ provide insufficient evidence to reject the null hypothesis which indicated that gender might not influence climate paralysis scores

Based on the t-test outcomes, H1 can be partially confirmed. Results showed evidence that females scored higher in climate anxiety and solastalgia when compared to their male counterparts. However, no significant gender difference could be detected for climate paralysis. The results of the t-tests can be seen in Table 2.

**Table 2**

*Results of T-Tests examining Gender Differences in Climate Anxiety, Solastalgia and Climate Paralysis*

| | **Male** | | **Female** | | **t(55)** | **p** | **Cohen's d** |
|---|---|---|---|---|---|---|---|
| | **M** | **SD** | **M** | **SD** | | | |
| **EAQ-22** | 2.39 | .53 | 2.65 | .50 | 2.18 | .03 | .152 |
| **EgriQ-6** | 2.26 | .65 | 2.61 | .60 | 2.45 | .02 | .209 |
| **EPS** | 2.62 | .66 | 2.64 | .57 | .19 | .85 | .016 |

***Hypothesis 2***

The multiple regression model showed overall statistical significance with $F(2,83) = 4.82$ and $p = .011$. However, climate anxiety demonstrated a marginally significant effect on climate paralysis but did not reach conventional significance levels ($\beta = .30$, $t(83) = 1.65$, $p = .102$). Solastalgia ($\beta = .07$, $t(83) = .46$, $p = .644$) did not show a significant effect on climate paralysis. To be concluded, the associations between climate anxiety and climate paralysis as well as the association between solastalgia and climate paralysis were not statistically significant leading to lack of evidence for H2. Thus, H2 can be rejected. The results of the multiple regression model can be seen in Table 3.

**Table 3**

*Results of the Multiple Regression Model examining the Relation between Climate Anxiety, Solastalgia and Climate Paralysis*

| Effect | Estimate | SE | 95% CI | | p |
|---|---|---|---|---|---|
| | | | LL | UL | |
| Intercept | 1.69 | .31 | 1.07 | 2.32 | <.001*** |
| EAQ-22 | .30 | .18 | -.06 | .66 | .102 |
| EGriQ-6 | .07 | .15 | -.22 | .36 | .644 |

Note. *** $p < .001$

***Hypothesis 3***

The results of the mediation analysis showed that, when controlling for climate anxiety and solastalgia, gender did not demonstrate a significant direct effect on climate paralysis (Estimate = .08, p = .557). Climate anxiety (Estimate = .31, p = .097) and solastalgia (Estimate = .08, p = .592), on the other hand, did show significant direct effects on climate paralysis. While the overall model was statistically significant ($F = 3.31$, $p = .024$), the predictors explain a limited amount of variability in climate paralysis scores (Adjusted R-squared = .08). Since the path from gender to climate paralysis is non-significant and no significant mediation effects could be found, H3 can be rejected. The results of the mediation analysis can be seen in Table 4.

**Table 4**

*Results of the Mediation Analysis examining the Influence of Climate Anxiety and Solastalgia on the Relationship between Gender and Climate Paralysis*

| Predictor | Estimate | Std. Error | T Value | P Value |
|---|---|---|---|---|
| **Intercept** | 1.62 | .34 | 4.82 | <.001 |
| **Gender (male)** | .08 | .13 | .59 | .557 |
| **EAQ-22** | .31 | .18 | 1.68 | .097 |
| **EgriQ-6** | .08 | .15 | .54 | .592 |

## Discussion

The current study was done aiming to explore the experience of mental health affections resulting from climate change among German and Dutch adults. The main objective was the investigation of gender differences in climate anxiety, solastalgia and climate paralysis, as well as their interplay and possible mediating effects.

The results showed that H1 indicating that females score higher in climate anxiety, solastalgia and climate paralysis could be partially confirmed. The findings were partially in line with previous literature (Tam et al., 2023; Heeren et al., 2022; Wullenkord et al., 2021) where gender differences with women scoring higher than men have previously been found for climate anxiety and solastalgia in multiple populations including European, Indian as well as African French- and German-speaking individuals. In line these studies, the current thesis showed that women scored higher than men in climate anxiety and solastalgia among Dutch and German citizens, as well. However, no such gender differences in the experience of climate paralysis could be found. These findings support the idea that females experience more anxiety and higher levels of grief with respect to the climate change. However, the findings for climate paralysis were not as expected. Here, it can be assumed that additional factors, which have not been taken into account in the current thesis, might play an influential role in the experience of emotional responses to climate change.

The multiple regression analysis demonstrated that H2 could be rejected. The results demonstrated that individuals who scored higher in either climate anxiety or in solastalgia did not score higher in climate paralysis. Although prior literature (Innocenti et al., 2023) found that climate paralysis was associated with feelings of anxiety and depressive symptoms found in solastalgia, results could not support the idea that climate anxiety or solastalgia are

correlated with climate paralysis. A reason for the results not being in line with previous literature could be that prior research did only take feelings of anxiety and depressive symptoms into account. Although such feelings might be part of climate paralysis, climate anxiety and solastalgia might be more complex and differ thus in their nature.

The mediation analysis results demonstrated that, contradicting H3, the relationship between gender and climate paralysis was not mediated by climate anxiety and solastalgia. Although such mediation effect was expected, the outcome indicates that the interrelations of emotional responses to climate change are much more complex than assumed. One possible reason for the results showing no mediator effect from climate anxiety and solastalgia on the relationship between gender and climate paralysis might be that important other factors were not included in the analysis. Thus, to gain further insight into how mental health affections are related to each other, further studies are needed.

**Limitations**

Since the current study has been conducted in the framework of a bachelor thesis and was thus timely constrained, several limitations could be found related to its findings. Firstly, the sampling strategy of combining convenience sampling and snowball sampling forms the risk of sampling biases which might, in turn, influence the results in terms of limited accessibility to certain individuals and lack of diversity in the participants. This could, in turn decrease the study's external validity. Further, the high drop-out rate for the questionnaires led to a smaller sample size than had been calculated for optimal power. The small sample size might form challenges for result interpretation as it makes collected data less generalisable and less reliable. Moreover, the sample consisted of significantly more German than Dutch participants which, again, makes the findings less representative of both the German and especially the Dutch adult population. The imbalance of German and Dutch respondents might also influence the results due to cultural differences. Another limitation on the representativeness of the findings might be the limited geographical focus on German and Dutch citizens only and the age limitation of 65 years.

Moreover, certain limitations regarding the use of self-report measures should be mentioned, as well. Mental health affections such as climate anxiety, solastalgia and climate paralysis are of subjective nature and simple reliance on self-reports might not obtain the complexity of such emotional experiences. Furthermore, participants might have experienced

the pressure to answer in a sociable desirable manner instead of sharing their actual thoughts. This might have distorted study findings.

Although the study provides valuable insights into how climate change affects mental health, it is crucial to interpret the findings cautiously due to the identified limitations. These limitations highlight areas for improvement in future research.

**Strengths**

Despite the thesis owning multiple limitations, there are certain strengths that are worthy of being outlined. The current study offers new insights into the experience of climate anxiety, solastalgia and climate paralysis. This thesis offered new insights into gender differences on climate change, solastalgia and climate paralysis. And, while previous studies have not yet focused on how German and Dutch citizens experienced climate change, the current research offered insights into emotional responses among the German and Dutch population which added to generalisability among humans.

Moreover, the translation and use of previously established measurement instrument is of high advantage. The EAQ-22, the EGriQ-6 from Ágoston et al. (2022) and the EPS developed by Innocenti, Perilli, et al. (2023) were translated into English, German and Dutch language which added to the possibilities for international studies on climate anxiety, solastalgia and climate paralysis. Thus, this study was also able to offer new insight into how German and Dutch citizens score on these scales.

**Future Directions**

When reflecting on the findings and limitations, it becomes evident that there are important points to consider for future research. One crucial aspect is that a more diverse and representative sample should be gathered and used for data collection. While the current research focused on German and Dutch citizens, the inclusion of participants from various cultural backgrounds and geographical locations is suggested. Further, future research is advised to aim for combating the constraints of small sample sizes. For that, researchers should focus on the challenges associated with dropout rates during data collection and ensure enough researchers and platforms for survey sharing. Additional recruitment strategies might enable the achievement of a larger and more diverse sample. Moreover, having the dynamic nature of climate change in mind, future researchers should conduct longitudinal studies to gain insights into how climate anxiety, solastalgia and climate paralysis evolve over time.

With regard to used methodologies, researchers should use additional qualitative measurements like in-depth interviews or focus group discussions to gather more nuanced and culturally sensitive information. Also, behavioural observations could lead to more reliable and valid findings due to their objectivity.

Due to discrepancies in previous literature with regard gender differences in climate anxiety, solastalgia and climate paralysis, future studies are advised to take underlying factors leading to such differences into account. They should take societal, cultural and environmental backgrounds as additional factors into account. While the current thesis was limited to psychology students as researchers, it could be beneficial to include researchers of additional domains in future studies. Experts from different fields like sociology or environmental science should collaborate to gain holistic knowledge on the complex interplay between gender and the experience of climate anxiety, solastalgia and climate paralysis.

Lastly, climate anxiety, solastalgia, and climate paralysis form only one minor fraction of all emotional responses to climate change. Future studies should thus aim to include additional mental health affections to enable intervention development and further support for individuals suffering under the emotional outcomes of climate change.

## Conclusion

The present study aimed to investigate the experience of climate anxiety, solastalgia and climate paralysis among German and Dutch adults. To do so, special focus was set on gender differences of these three affections resulting from climate change. Further, the interrelations between climate anxiety, solastalgia and climate paralysis were analysed and the mediating effect of climate anxiety and solastalgia on the relationship between gender and climate paralysis was studied.

In order to answer the research question, a cross-sectional approach was used with the implementation of an online survey consisting of the EAQ-22, EGriQ-6 and EPS. 86 participants with German or Dutch residence between the ages 18 to 65 years completed the surveys measuring climate anxiety, solastalgia and climate paralysis and their responses were included in further data analysis to answer the research question and the hypotheses.

For H1, results of the t-tests showed that females experienced higher levels of climate anxiety and solastalgia compared to male respondents. However, no gender differences were found concerning the experience of climate paralysis. Regarding H2, the multiple regression

model demonstrated that individuals that experienced more climate anxiety or solastalgia did not consequently experience higher levels of climate paralysis. For H3, a mediation analysis was used, and its outcomes showed that neither climate anxiety nor solastalgia mediated the relationship between gender and climate paralysis. This contradicts the initial assumption and emphasizes the requirement for a deeper and more nuanced understanding of all possible factors influencing the emotional reactions to climate change.

Despite these contributions to the topic area, the present study demonstrated multiple limitations including a small sample size, limited time frame, potential sampling biases and the challenges of self-report measure which need to be considered in future studies. A larger sample size, more time, additional sampling methods and the inclusion of qualitative measurement tool can thus be suggested to be used in upcoming research.

In conclusion, this bachelor's thesis enables initial insights on the influence of gender on climate anxiety, solastalgia and climate paralysis. Nevertheless, their relations remain uncertain which can be advised to be addressed in future research. For that, additional factors should be taken into account in order to further add to knowledge with regard to the topic of mental health affections resulting from climate change.

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# Appendices

## Appendix A

*STROBE*

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 | 1 |
| | | (*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 | 4 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 9 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 9 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 9 |
| 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 | 10 |
| Bias | 9 | Describe any efforts to address potential sources of bias | - |
| Study size | 10 | Explain how the study size was arrived at | 12 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 9 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 11 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | - |
| | | (*c*) Explain how missing data were addressed | 12 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | - |

| | | | |
|---|---|---|---|
| | | (*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 | 12 |
| | | (b) Give reasons for non-participation at each stage | 12 |
| | | (c) Consider use of a flow diagram | 12 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 13 |
| | | (b) Indicate number of participants with missing data for each variable of interest | - |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 13 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 13 |
| | | (*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 analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 13 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 16 |
| 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 | 17 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 17 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 17 |
| **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 | - |

*Give information separately for exposed and unexposed groups.

**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 www.strobe-statement.org.

## Appendix B

*Advertisements for Social Media Platforms*


## Appendix C

*Written Advertisements for Spread via WhatsApp*

German Version

Gemeinsam für eine grünere Zukunft! 🌍

Im Rahmen der Bachelorarbeit des Psychologiestudiums an der University of Twente untersuchen wir den Einfluss von Alter und Geschlecht auf die mentale Gesundheit und damit zusammenhängenden Verhaltensmustern.

Hilf uns dabei, die psychologischen Auswirkungen des Klimawandels besser zu verstehen und werde Teil unserer Studie!

Teilnahmebedingungen

- Alter: 18-65 Jahre

- Wohnsitz: Deutschland oder Niederlande

Es würde uns sehr helfen, wenn du diese Nachricht mit Familie und Freunden teilen würdest.

Danke für deinen Beitrag!

Zur Umfrage

https://utwentebs.eu.qualtrics.com/jfe/form/SV_9t0kgF7hdyW9jls

Dutch Version

Samen voor een groenere toekomst!

Als onderdeel van de bachelorscriptie van de opleiding psychologie aan de Universiteit Twente onderzoeken we de invloed van leeftijd en geslacht op mentale gezondheid en gerelateerde gedragspatronen.

Help ons de psychologische effecten van klimaatverandering beter te begrijpen en neem deel aan ons onderzoek!

Voorwaarden voor deelname

- Leeftijd: 18-65 jaar

- Woonplaats: Duitsland of Nederland

Het zou ons heel erg helpen als je dit kan delen met vrienden en familie.

Bedankt voor je hulp! 🌿

Naar de enquête

https://utwentebs.eu.qualtrics.com/jfe/form/SV_6sthWu66zvw6NAG

English Version

Together for a greener future! 🌍

As part of the bachelor's thesis in psychology at the University of Twente, we are investigating the influence of age and gender on mental health and related behavioural patterns.

Help us to better understand the psychological effects of climate change and become part of our study! 🦃

Conditions of participation

- Age: 18-65 years

- Residence: Germany or the Netherlands

It would help us a lot if you would share this message with family and friends.

Thank you for your contribution! 🌿

To the survey

German: https://utwentebs.eu.qualtrics.com/jfe/form/SV_9t0kgF7hdyW9jls

Dutch: https://utwentebs.eu.qualtrics.com/jfe/form/SV_6sthWu66zvw6NAG

**Appendix D**

*Opening Statement in Qualtrics*

German Version

Willkommen!

Ziel dieser Studie ist es, den Zusammenhang zwischen Alter und psychischen Störungen sowie geschlechtsspezifische Unterschiede bezüglich Klimaangst, Klimaschuldgefühl und Solastalgie zu untersuchen. Außerdem soll erforscht werden, wie diese emotionalen Reaktionen das Auftreten von umweltfreundlichem Verhalten und Klimalähmung beeinflussen.

Die Studie wird von zwei Studenten durchgeführt, die den Bachelor der Psychologie an der Universität Twente absolvieren. Die gewonnenen Daten werden somit für ihre Bachelor-Arbeiten analysiert.

Teilnahme

Um an dieser Studie teilzunehmen, müssen Sie mindestens 18 und maximal 65 Jahre alt sein. Außerdem wird vorausgesetzt, dass Sie Ihren Wohnsitz entweder in Deutschland oder in den Niederlanden haben.

Wenn Sie sich derzeit wegen einer psychischen Störung in Behandlung befinden oder in den letzten zwei Jahren Suizidgedanken hatten, können Sie aus Sicherheitsgründen nicht an dieser Studie teilnehmen.

Die Teilnahme an dieser Studie ist völlig freiwillig und Sie haben das Recht, jederzeit ohne der Angabe von Gründen und ohne jegliche Konsequenzen zurücktreten. Alle Daten, die Sie bisher eingegeben haben, werden von der weiteren Datenauswertung ausgeschlossen. Sobald

Sie jedoch den Fragebogen vollständig ausgefüllt haben, werden alle Daten anonymisiert und können nicht länger identifiziert werden, sodass eine Löschung der Daten nicht länger möglich ist.

Nach der Zustimmung zur Teilnahme werden demographische Fragen gestellt. Um Anonymität zu gewährleisten, werden keine identifizierbaren Informationen gesammelt. Der folgende Fragebogen wird 15-20 Minuten in Anspruch nehmen.

Ihre Teilnahme an dieser Studie wird sehr geschätzt und formt einen wesentlichen Beitrag zur Vertiefung unseres Verständnisses der psychologischen Auswirkungen des Klimawandels.

Kontaktangabe

Diese Studie wurde von der Ethikkommission der Universität Twente geprüft und genehmigt. Für weitere Informationen oder im Falle noch offenstehender Fragen können Sie die Forscher Killian Doyle (k.l.doyle@student.utwente.nl) oder Melisa Gökoglan (m.gokoglan@student.utwente.nl) kontaktieren. Alternativ können Sie sich auch an den Betreuer Dr. Alejandro Dominguez Rodriguez (a.dominguezrodriguez@utwente.nl) wenden.

Dutch Version

Welkom!

Deze studie heeft tot doel de relatie te onderzoeken tussen leeftijd en geestelijke gezondheidseffecten en genderverschillen hierin, waaronder klimaatangst, klimaatschuld en solastagie. Bovendien zal worden onderzocht hoe deze emotionele reacties het optreden van milieuvriendelijk gedrag en klimaatverlamming beïnvloeden.

Het onderzoek wordt uitgevoerd door twee studenten die de bachelor psychologie aan de Universiteit Twente volgen en de verkregen gegevens worden geanalyseerd voor hun bachelorscripties. To access the study in German please go to this link: https://utwentebs.eu.qualtrics.com/jfe/form/SV_9t0kgF7hdyW9jls

Deelname

Om aan dit onderzoek deel te nemen, dient u niet jonger dan 18 jaar en niet ouder dan 65 jaar te zijn. Bovendien moet u woonachtig zijn in Duitsland of Nederland.

Als u momenteel een behandeling ondergaat voor een psychische stoornis of in de afgelopen twee jaar zelfmoordgedachten heeft gehad, kunt u om veiligheidsredenen niet aan dit onderzoek deelnemen.

Deelname aan dit onderzoek is geheel vrijwillig en u heeft het recht om op elk moment, zonder opgaaf van reden en zonder enige gevolgen, uw deelname terug te trekken. Alle gegevens die u tot nu toe heeft ingevoerd, worden uitgesloten van verdere data-analyses.

Zodra u de vragenlijst heeft ingevuld, worden alle gegevens echter geanonimiseerd en kunnen ze niet meer worden geïdentificeerd, waardoor het verwijderen van gegevens niet langer mogelijk is.

Na het geven van toestemming voor deelname worden demografische vragen gesteld. Om de anonimiteit te garanderen, wordt er geen identificeerbare informatie verzameld. De volgende vragenlijst duurt 15-20 minuten.

Uw deelname aan dit onderzoek wordt zeer op prijs gesteld en zal dienen als een integrale bijdrage aan het verdiepen van ons begrip van de psychologische implicaties van klimaatverandering.

Contact details

Dit onderzoek is beoordeeld en goedgekeurd door de Ethische Commissie van de Universiteit Twente. Voor meer informatie of overige vragen kunt u contact opnemen met de onderzoekers Killian Doyle (k.l.doyle@student.utwente.nl) of Melisa Gökoglan (m.gokoglan@student.utwente.nl). U kunt ook contact opnemen met de begeleider: dr. Alejandro Dominguez Rodriguez (a.dominguezrodriguez@utwente.nl).

**Appendix E**

*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 von Alter und Geschlecht auf die psychische Gesundheit aufgrund des Klimawandels 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 gegeven informatie gelezen en voldoe aan alle deelnamevoorwaarden. Ik erken dat mijn betrokkenheid geheel vrijwillig is. Ik erken ook mijn recht om mijn toestemming op elk moment zonder uitleg in te trekken, vooral als ik enige vorm van ongemak of angst ervaar. Hieraan zullen geen consequenties verbonden zijn.

Daarnaast begrijp ik het volgende:

- Alle door de onderzoeker verzamelde gegevens blijven volledig anoniem en zijn niet te herleiden tot mijn identiteit. Daarom is intrekking na voltooiing van het onderzoek niet meer mogelijk.

- Ik ben me ervan bewust dat de informatie die ik verstrek zal worden gebruikt in onderzoeksrapporten die gericht zijn op het bestuderen van de impact van leeftijd en geslacht op de gevolgen voor de geestelijke gezondheid als gevolg van klimaatverandering.

- Ik onderga GEEN enkele vorm van medische of therapeutische behandeling voor een psychische stoornis.

- Ik heb de afgelopen twee jaar GEEN zelfmoordgedachten gehad.

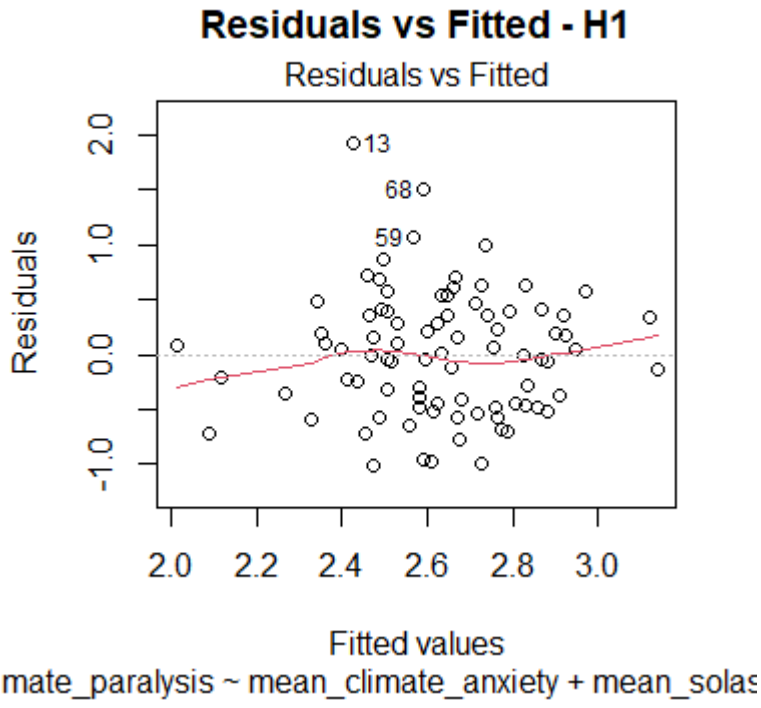
- Ik begrijp dat deelname aan het onderzoek kan leiden tot mentaal ongemak als gevolg van het bespreken van het gevoelige onderwerp klimaatverandering.

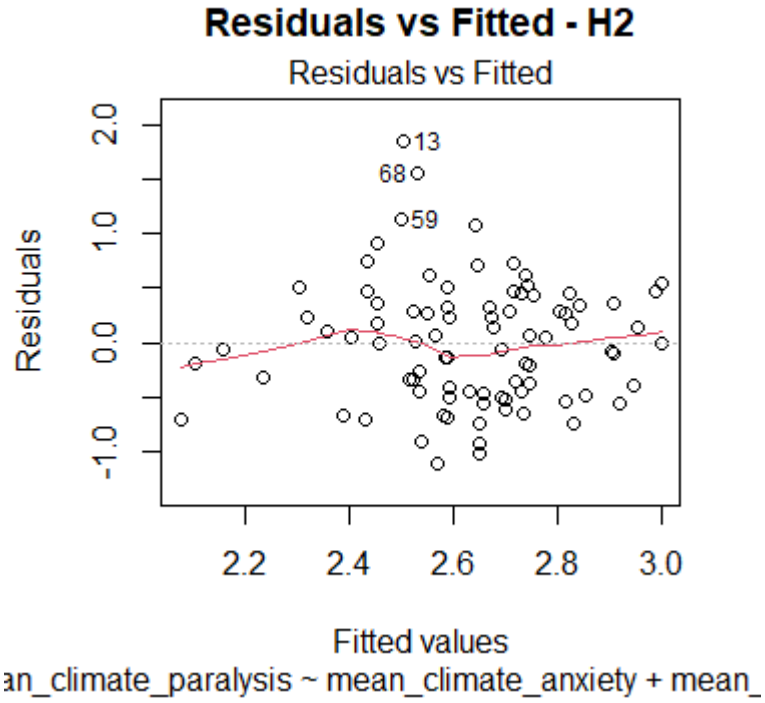
- Ik ga ermee akkoord de vertrouwelijkheid te bewaren met betrekking tot de procedures en details van het onderzoek en deze informatie niet met anderen te delen, aangezien dit de resultaten van het onderzoek negatief kan beïnvloeden.

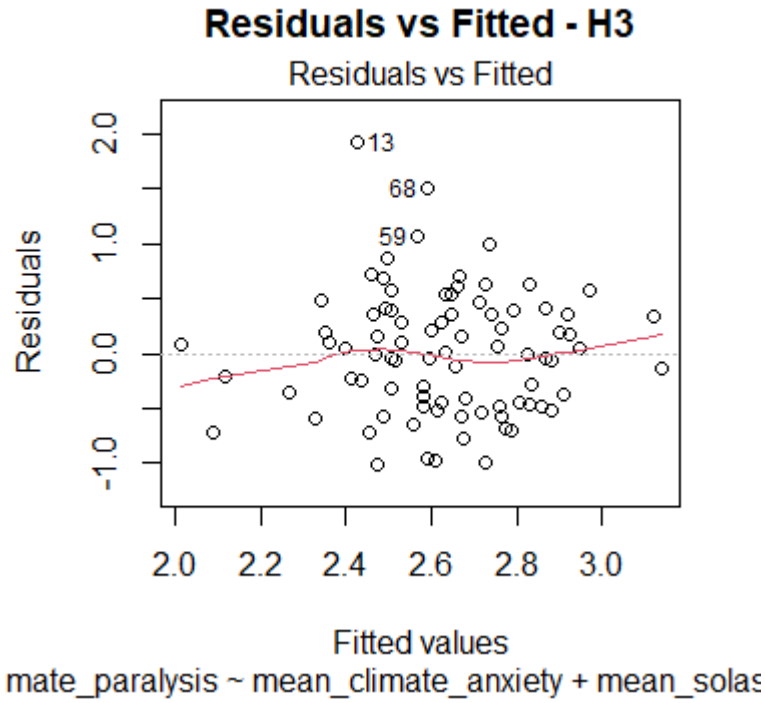
- Ik geef toestemming voor het bewaren van mijn verstrekte antwoorden in de enquêtedatabase voor mogelijk toekomstig onderzoek en educatieve doeleinden.

**Appendix F**

*Residuals vs Fitted Plots to test for Linearity*



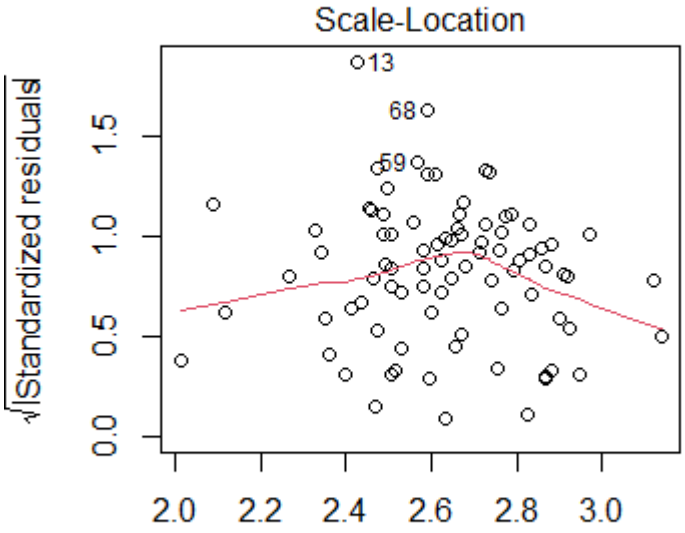



**Appendix G**

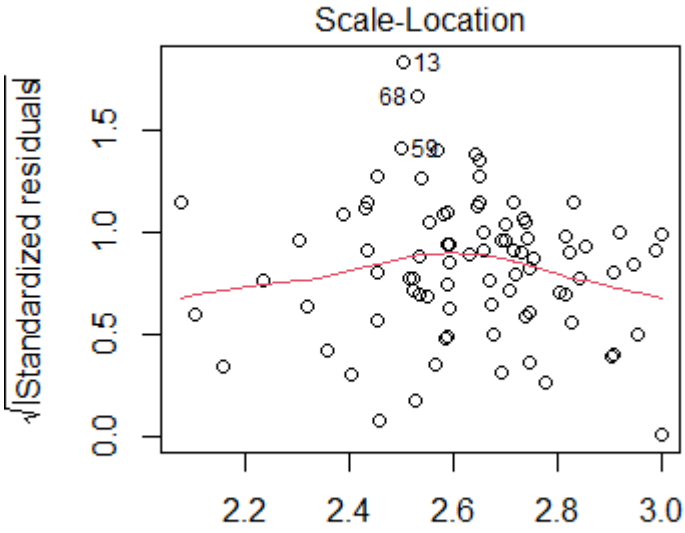
*Scale-Location plots to test for Homoscedasticity*

**Scale-Location - H1**

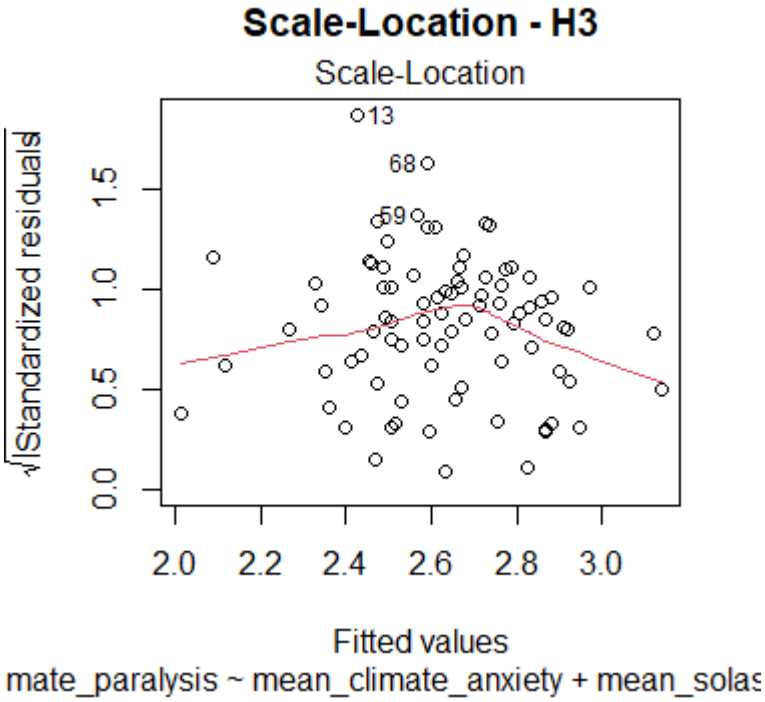



mate_paralysis ~ mean_climate_anxiety + mean_solas

**Scale-Location - H2**

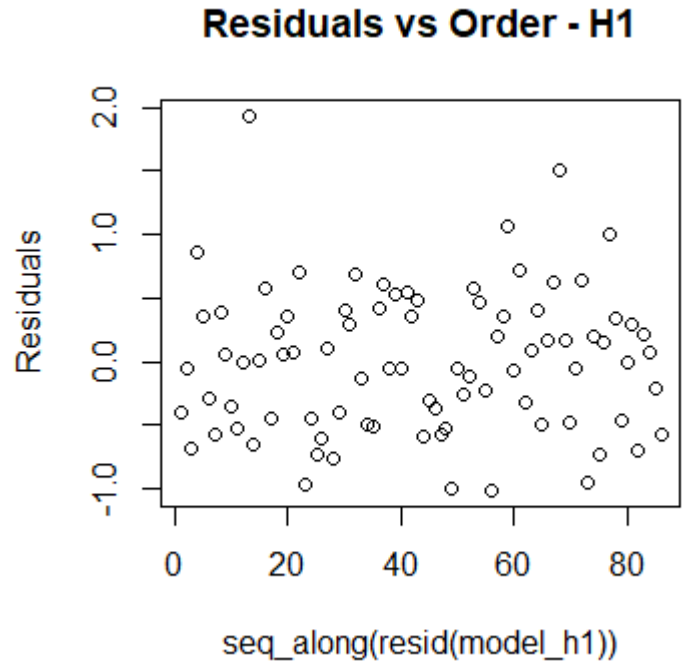


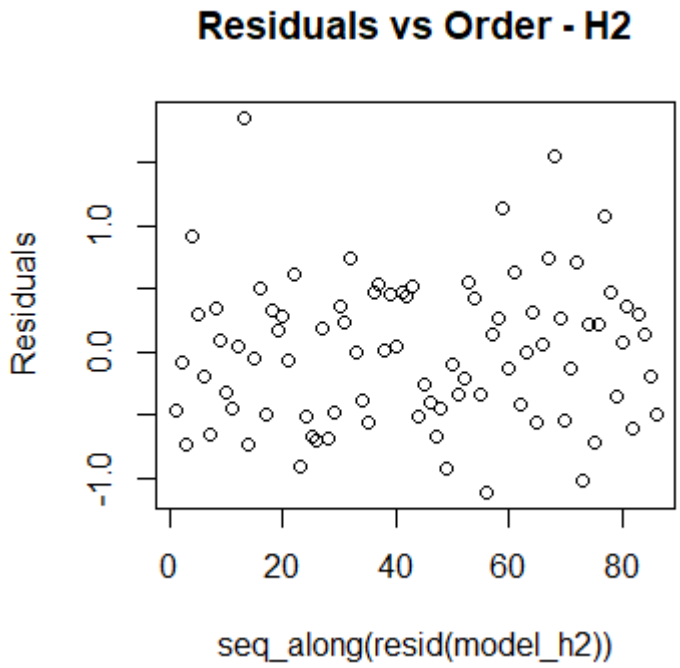

an_climate_paralysis ~ mean_climate_anxiety + mean_

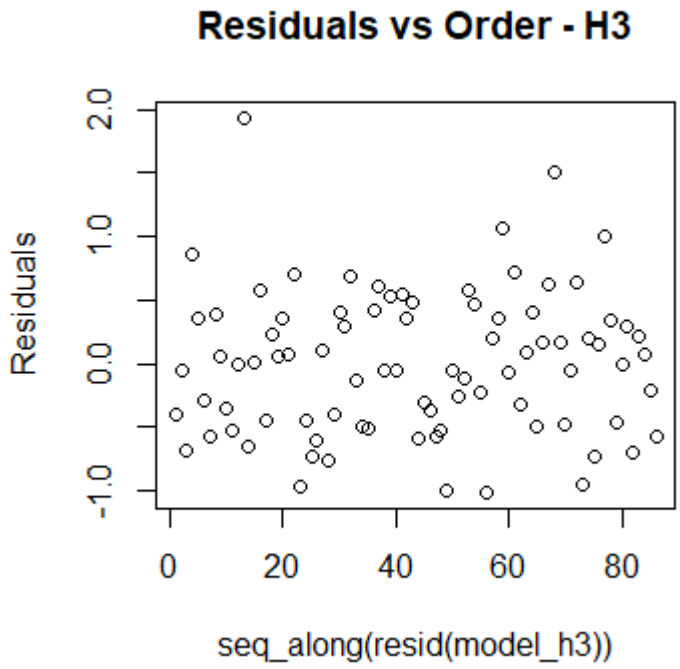



**Appendix H**

*Residuals vs Order Plots to test for Independence*






**Appendix I**

*R Code for the Statistical Analyses*

```
install.packages("tidyverse")

library(tidyverse)
```

```
install.packages("readr")

library(readr)

setwd("C:/Users/User/Desktop/Bachelor Thesis/Data Analysis/Qualtrics Datasets 10.12.23 15.45/")

german_data <- read_csv("german_survey_data.csv.zip", col_types = cols())

dutch_data <- read_csv("dutch_survey_data.csv.zip", col_types = cols())
```

**Combining Datasets**

```
common_columns <- intersect(names(german_data), names(dutch_data))

data1_sub <- german_data[, common_columns]

data2_sub <- dutch_data[, common_columns]

combined_data <- rbind(data1_sub, data2_sub)
```

**Data Cleaning**

```
combined_data <- combined_data[tolower(combined_data$Finished) == "true", ]

combined_data <- subset(combined_data, Age >= 18)

combined_data <- subset(combined_data, Age <= 65)

combined_data <- subset(combined_data, tolower(DistributionChannel) == "anonymous")

combined_data <- combined_data[-31, ]


# Removing Irrelevant Info and Questions from Eco-guilt and PEB

install.packages("dplyr")

library(dplyr)

columns_to_remove <- c("StartDate", "EndDate", "Status", "IPAddress", "Progress", "Duration (in
seconds)", "RecordedDate", "ResponseId", "RecipientLastName", "RecipientFirstName",
"RecipientEmail", "ExternalReference", "LocationLatitude", "LocationLongitude",
"DistributionChannel", "UserLanguage", "Q8_1", "Q8_2", "Q8_3", "Q8_4", "Q8_5", "Q8_6", "Q8_7",
"Q8_8", "Q8_9", "Q8_10", "Q8_11", "Q9_1", "Q9_2", "Q9_3", "Q9_4", "Q9_5", "Q9_6", "Q10_1",
"Q11_1", "Q11_2", "Q12_1", "Q12_2", "Q13_1", "Q14_1", "Q15_1", "Q15_2", "Q15_3", "Q16_1",
"Q16_2", "Q16_3")

final_data <- combined_data %>% select(-one_of(columns_to_remove))
```

**Demographics**

```
# Count male and female participants
count_male <- final_data %>%
  filter(Gender %in% c("Männlich", "Mannelijk")) %>%
  nrow()
count_female <- final_data %>%
  filter(Gender %in% c("Weiblich", "Vrouwelijk")) %>%
  nrow()
# Print number of males and females
cat("Count of 'Männlich' and 'Mannelijk' together:", count_male, "\n")
cat("Count of 'Weiblich' and 'Vrouwelijk' together:", count_female, "\n")

# Calculate the age range
age_range <- range(final_data$Age)
cat("Age Range: ", age_range[1], " to ", age_range[2], "\n")

# Calculate the mean age and the Standard Deviation
# Convert "Age" column to numeric, replacing non-numeric values with NA
final_data$Age <- as.numeric(as.character(final_data$Age))

# Calculate the mean age, handling missing values
mean_age <- mean(final_data$Age, na.rm = TRUE)
# Print the mean age
cat("Mean Age: ", mean_age, "\n")
# Calculate the standard deviation of age, handling missing values
sd_age <- sd(final_data$Age, na.rm = TRUE)
# Print the standard deviation of age
cat("Standard Deviation of Age: ", sd_age, "\n")

# Count occurrences of "Deutschland" and "Duitsland" together
count_germany <- final_data %>%
  filter(Residence %in% c("Deutschland", "Duitsland")) %>%
```

```
  nrow()


# Count occurrences of "Niederlande" and "Nederlands" together
count_netherlands <- final_data %>%
  filter(Residence %in% c("Niederlande", "Nederland")) %>%
  nrow()
# Print the counts
cat("Count of 'Deutschland' and 'Duitsland' together:", count_germany, "\n")
cat("Count of 'Niederlande' and 'Nederlands' together:", count_netherlands, "\n")


# Count Education Column
# Count occurrences of "weniger als ein Schulabschluss" and "minder dan middelbareschooldiploma" together
count_low_education <- final_data %>%
  filter(Education %in% c("weniger als ein Schulabschluss", "minder dan middelbareschooldiploma")) %>%
  nrow()
# Count occurrences of "Fachhochschulreife (Fachabitur / HAVO)" and "diploma middelbaar onderwijs dat kwalificeert voor hogeschool (Fachabitur / HAVO)" together
count_medium_education <- final_data %>%
  filter(Education %in% c("Fachhochschulreife (Fachabitur / HAVO)", "diploma middelbaar onderwijs dat kwalificeert voor hogeschool (Fachabitur / HAVO)")) %>%
  nrow()
# Count occurrences of "Schulabschluss mit Hochschulreife (Abitur / VWO)" and "diploma middelbare school dat kwalificeert voor universiteit (Abitur / VWO)" together
count_high_education <- final_data %>%
  filter(Education %in% c("Schulabschluss mit Hochschulreife (Abitur / VWO)", "diploma middelbare school dat kwalificeert voor universiteit (Abitur / VWO)")) %>%
  nrow()
# Count occurrences of "Bachelor-Abschluss" and "bachelordiploma" together
count_bachelor <- final_data %>%
  filter(Education %in% c("Bachelor-Abschluss", "bachelordiploma")) %>%
  nrow()
```

```
# Count occurrences of "Master-Abschluss (Diplom)" and "masterdiploma (diploma)" together

count_master <- final_data %>%

  filter(Education %in% c("Master-Abschluss (Diplom)", "masterdiploma (diploma)")) %>%

  nrow()

# Count occurrences of "PHD / Doktortitel, oder ähnliches" and "PHD / doctoraatsdiploma, of vergelijkbaar" together

count_phd <- final_data %>%

  filter(Education %in% c("PHD / Doktortitel, oder ähnliches", "PHD / doctoraatsdiploma, of vergelijkbaar")) %>%

  nrow()

# Count occurrences of "Sonstiges, bitte angeben" and "Andere, specificeer" together

count_other <- final_data %>%

  filter(Education %in% c("Sonstiges, bitte angeben", "Andere, specificeer")) %>%

  nrow()

# Print the counts

cat("Count of 'weniger als ein Schulabschluss' and 'minder dan middelbareschooldiploma' together:", count_low_education, "\n")

cat("Count of 'Fachhochschulreife (Fachabitur / HAVO)' and 'diploma middelbaar onderwijs dat kwalificeert voor hogeschool (Fachabitur / HAVO)' together:", count_medium_education, "\n")

cat("Count of 'Schulabschluss mit Hochschulreife (Abitur / VWO)' and 'diploma middelbare school dat kwalificeert voor universiteit (Abitur / VWO)' together:", count_high_education, "\n")

cat("Count of 'Bachelor-Abschluss' and 'bachelordiploma' together:", count_bachelor, "\n")

cat("Count of 'Master-Abschluss (Diplom)' and 'masterdiploma (diploma)' together:", count_master, "\n")

cat("Count of 'PHD / Doktortitel, oder ähnliches' and 'PHD / doctoraatsdiploma, of vergelijkbaar' together:", count_phd, "\n")

cat("Count of 'Sonstiges, bitte angeben' and 'Andere, specificeer' together:", count_other, "\n")


# Making Answers of the Questionnaires Numeric

## For Eco-Anxiety Scale And Solastagia Scale

# Specify the mapping

response_mapping <- c(

  "stimme nicht zu" = 1,

  "mee oneens" = 1,
```

```
  "stimme eher nicht zu" = 2,
  "erder mee oneens" = 2,
  "stimme eher zu" = 3,
  "erder mee eens" = 3,
  "stimme zu" = 4,
  "mee eens" = 4
)
# Columns to apply the mapping
columns_to_map <- c("Q5_1", "Q5_2", "Q5_3", "Q5_4", "Q5_5", "Q5_6", "Q5_7", "Q5_8", "Q5_9",
"Q5_10",
                    "Q5_11", "Q5_12", "Q5_13", "Q5_14", "Q5_15", "Q5_16", "Q5_17", "Q5_18", "Q5_19",
                    "Q5_20", "Q5_21", "Q5_22", "Q7_1", "Q7_2", "Q7_3", "Q7_4", "Q7_5", "Q7_6")
# Apply the mapping
final_data <- final_data %>%
  mutate_at(vars(columns_to_map), ~factor(., levels = names(response_mapping), labels =
response_mapping))


## For Climate Paralysis Scale
# Specify the mapping
response_mapping <- c(
  "stimme überhaupt nicht zu" = 1,
  "helemaal mee oneens" = 1,
  "stimme nicht zu" = 2,
  "mee oneens" = 2,
  "weder, noch" = 3,
  "noch eens, noch oneens" = 3,
  "stimme zu" = 4,
  "mee eens" = 4,
  "stimme voll und ganz zu" = 5,
  "helemaal mee eens" = 5
)
# Columns to apply the mapping
```

```
columns_to_map <- c("Q17_1", "Q17_2", "Q17_3", "Q17_4"
, "Q17_5", "Q17_6", "Q17_7", "Q17_8", "Q17_9", "Q17_10", "Q17_11")
# Apply the mapping
final_data <- final_data %>%
  mutate_at(vars(columns_to_map), ~factor(., levels = names(response_mapping), labels = response_mapping))


####  Computing means, SDs and ranges of EAQ-22, EGri-6 and EPS ####
## For EAQ-22
climate_anxiety_columns <- final_data[, c("Q5_1", "Q5_2", "Q5_3", "Q5_4", "Q5_5", "Q5_6",
                                          "Q5_7", "Q5_8", "Q5_9", "Q5_10", "Q5_11",
                                          "Q5_12", "Q5_13", "Q5_14", "Q5_15", "Q5_16",
                                          "Q5_17", "Q5_18", "Q5_19", "Q5_20", "Q5_21", "Q5_22")]
# Ensure columns are numeric
climate_anxiety_columns <- sapply(climate_anxiety_columns, as.numeric)
# Calculate the mean for each row
final_data$mean_climate_anxiety <- rowMeans(climate_anxiety_columns, na.rm = TRUE)
# Print the mean climate anxiety scores
cat("Mean Climate Anxiety Score: ", mean(final_data$mean_climate_anxiety, na.rm = TRUE), "\n")
# Calculate the standard deviation of the mean climate anxiety scores
sd_of_means <- sd(final_data$mean_climate_anxiety, na.rm = TRUE)
# Print the standard deviation of the mean climate anxiety scores
cat("Standard Deviation of the Mean Climate Anxiety Scores: ", sd_of_means, "\n")
# Find the lowest and highest mean climate anxiety scores
lowest_mean <- min(final_data$mean_climate_anxiety, na.rm = TRUE)
highest_mean <- max(final_data$mean_climate_anxiety, na.rm = TRUE)
# Print the lowest and highest mean climate anxiety scores
cat("Lowest Mean Climate Anxiety Score: ", lowest_mean, "\n")
cat("Highest Mean Climate Anxiety Score: ", highest_mean, "\n")


## For EGri-6
```

```
solastalgia_columns <- final_data[, c("Q7_1", "Q7_2", "Q7_3", "Q7_4", "Q7_5", "Q7_6")]
# Ensure columns are numeric
solastalgia_columns <- sapply(solastalgia_columns, as.numeric)
# Calculate the mean for each row
final_data$mean_solastalgia <- rowMeans(solastalgia_columns, na.rm = TRUE)
# Print the mean climate anxiety scores
cat("Mean Solastalgia Score: ", mean(final_data$mean_solastalgia, na.rm = TRUE), "\n")
# Calculate the standard deviation of the mean climate anxiety scores
sd_of_means <- sd(final_data$mean_solastalgia, na.rm = TRUE)
# Print the standard deviation of the mean climate anxiety scores
cat("Standard Deviation of the Mean Solastalgia Scores: ", sd_of_means, "\n")
# Find the lowest and highest mean climate anxiety scores
lowest_mean <- min(final_data$mean_solastalgia, na.rm = TRUE)
highest_mean <- max(final_data$mean_solastalgia, na.rm = TRUE)
# Print the lowest and highest mean climate anxiety scores
cat("Lowest Mean Solastalgia Score: ", lowest_mean, "\n")
cat("Highest Mean Solastalgia Score: ", highest_mean, "\n")


## For EPS
climate_paralysis_columns <- final_data[, c("Q17_1", "Q17_2", "Q17_3", "Q17_4", "Q17_5",
"Q17_6", "Q17_7", "Q17_8", "Q17_9", "Q17_10", "Q17_11")]
# Ensure columns are numeric
climate_paralysis_columns <- sapply(climate_paralysis_columns, as.numeric)
# Calculate the mean for each row
final_data$mean_climate_paralysis <- rowMeans(climate_paralysis_columns, na.rm = TRUE)
# Print the mean climate anxiety scores
cat("Mean Climate Paralysis Score: ", mean(final_data$mean_climate_paralysis, na.rm = TRUE), "\n")
# Calculate the standard deviation of the mean climate anxiety scores
sd_of_means <- sd(final_data$mean_climate_paralysis, na.rm = TRUE)
# Print the standard deviation of the mean climate anxiety scores
cat("Standard Deviation of the Mean Climate Paralysis Scores: ", sd_of_means, "\n")
```

```
# Find the lowest and highest mean climate anxiety scores
lowest_mean <- min(final_data$mean_climate_paralysis, na.rm = TRUE)
highest_mean <- max(final_data$mean_climate_paralysis, na.rm = TRUE)
# Print the lowest and highest mean climate anxiety scores
cat("Lowest Mean Climate Paralysis Score: ", lowest_mean, "\n")
cat("Highest Mean Climate Paralysis Score: ", highest_mean, "\n")
```

**Computing Correlations**

```
# Calculate the mean for each row in all three datasets
mean_climate_anxiety <- rowMeans(climate_anxiety_columns, na.rm = TRUE)
mean_solastalgia <- rowMeans(solastalgia_columns, na.rm = TRUE)
mean_climate_paralysis <- rowMeans(climate_paralysis_columns, na.rm = TRUE)
# Compute the correlation between mean climate anxiety and mean solastalgia scores
correlation <- cor(mean_climate_anxiety, mean_solastalgia, use = "complete.obs")
# Print the correlation
cat("Correlation between Mean Climate Anxiety and Mean Solastalgia: ", correlation, "\n")
# Compute the correlation between mean climate anxiety and mean climate paralysis scores
correlation <- cor(mean_climate_anxiety, mean_climate_paralysis, use = "complete.obs")
# Print the correlation
cat("Correlation between Mean Climate Anxiety and Mean Solastalgia: ", correlation, "\n")
# Compute the correlation between mean solastagia and mean climate paralysis scores
correlation <- cor(mean_solastalgia, mean_climate_paralysis, use = "complete.obs")
# Print the correlation
cat("Correlation between Mean Solastalgia and Mean Climate Paralysis: ", correlation, "\n")
```

**Testing Linear Assumptions**

```
# Total Scores of Climate Anxiety, Solastagia and Climate Paralysis
final_data <- final_data %>%
  mutate(total_score_Q5 = rowSums(select(., starts_with("Q5_")) %>% mutate_all(as.numeric), na.rm
= TRUE))
final_data <- final_data %>%
  mutate(total_score_Q7 = rowSums(select(., starts_with("Q7_")) %>% mutate_all(as.numeric), na.rm
= TRUE))
```

```
final_data <- final_data %>%

  mutate(total_score_Q17 = rowSums(select(., starts_with("Q17_") &
!matches("Q17_OQ|Q17_OQ_Text")) %>% mutate_all(~as.numeric(as.character(.))), na.rm = TRUE))


## Test for NORMALITY: Shapiro-Wilk test for NORMALITY ##

# For Climate Anxiety

# Extract the variable and convert to numeric if needed

total_score_Q5 <- as.numeric(final_data$total_score_Q5)

# Do Shapiro-Wilk test

shapiro_test <- shapiro.test(total_score_Q5)

# Print the results

cat("Shapiro-Wilk Test for Normality of total_score_Q5:\n", "Statistic =", shapiro_test$statistic, "\n",
"p-value =", shapiro_test$p.value, "\n")

# For Solastagia

# Extract the variable and convert to numeric if needed

total_score_Q7 <- as.numeric(final_data$total_score_Q7)

# Do Shapiro-Wilk test

shapiro_test <- shapiro.test(total_score_Q7)

# Print the results

cat("Shapiro-Wilk Test for Normality of total_score_Q7:\n", "Statistic =", shapiro_test$statistic, "\n",
"p-value =", shapiro_test$p.value, "\n")

# For Climate Paralysis

# Extract the variable and convert to numeric if needed

total_score_Q17 <- as.numeric(final_data$total_score_Q17)

# Do Shapiro-Wilk test

shapiro_test <- shapiro.test(total_score_Q17)

# Print the results

cat("Shapiro-Wilk Test for Normality of total_score_Q17:\n", "Statistic =", shapiro_test$statistic,
"\n", "p-value =", shapiro_test$p.value, "\n")

## Creation of Models for each Hypothesis ##

model_h1 <- lm(mean_climate_paralysis ~ mean_climate_anxiety + mean_solastalgia +
Numeric_Gender, data = final_data)
```

```
model_h2 <- lm(mean_climate_paralysis ~ mean_climate_anxiety + mean_solastalgia, data = final_data)

model_h3 <- lm(mean_climate_paralysis ~ mean_climate_anxiety + mean_solastalgia + Numeric_Gender, data = final_data)


## Test for LINEARITY using residuals vs fitted plots ##

# Residuals vs Fitted plots

par(mfrow = c(1, 1))

plot(model_h1, 1, main = "Residuals vs Fitted - H1")

plot(model_h2, 1, main = "Residuals vs Fitted - H2")

plot(model_h3, 1, main = "Residuals vs Fitted - H3")


## Test for HOMOSCEDASTICITY using scale-plots ##

par(mfrow = c(1, 1))

plot(model_h1, 3, main = "Scale-Location - H1")

plot(model_h2, 3, main = "Scale-Location - H2")

plot(model_h3, 3, main = "Scale-Location - H3")


## Test for INDEPENDENCE using residuals vs order plots ##

par(mfrow = c(1, 1))

plot(resid(model_h1) ~ seq_along(resid(model_h1)), main = "Residuals vs Order - H1", ylab = "Residuals")

plot(resid(model_h2) ~ seq_along(resid(model_h2)), main = "Residuals vs Order - H2", ylab = "Residuals")

plot(resid(model_h3) ~ seq_along(resid(model_h3)), main = "Residuals vs Order - H3", ylab = "Residuals")
```

**Hyptheses Testing**

```
#### H1: T-Test ####

# Recode values in the "Gender" column

final_data <- final_data %>%

  mutate(Gender = case_when(

    Gender %in% c("Männlich", "Mannelijk") ~ "male",
```

```
  Gender %in% c("Weiblich", "Vrouwelijk") ~ "female",
  TRUE ~ as.character(Gender)  # Keep other values as they are
 ))
# Subset data for female and male participants
female_data <- final_data[final_data$Gender == "female", ]
male_data <- final_data[final_data$Gender == "male", ]
# Perform t-tests for climate anxiety, solastalgia, and climate paralysis
t_test_climate_anxiety <- t.test(female_data$mean_climate_anxiety,
male_data$mean_climate_anxiety)
t_test_solastalgia <- t.test(female_data$mean_solastalgia, male_data$mean_solastalgia)
t_test_climate_paralysis <- t.test(female_data$mean_climate_paralysis,
male_data$mean_climate_paralysis)

# Print the results
cat("T-Test Results for Mean Climate Anxiety Scores:\n")
print(summary(t_test_climate_anxiety))
cat("\n")
print(t_test_climate_anxiety)
cat("T-Test Results for Solastalgia Scores:\n")
print(summary(t_test_solastalgia))
cat("\n")
print(t_test_solastalgia)
cat("T-Test Results for Climate Paralysis Scores:\n")
print(summary(t_test_climate_paralysis))
cat("\n")
print(t_test_climate_paralysis)
# Calculate Cohen's d
t_test_result_climate_anxiety <- t_test_climate_anxiety
# Extract mean estimates and standard deviations
mean_of_x_climate_anxiety <- t_test_result_climate_anxiety$estimate[1]
mean_of_y_climate_anxiety <- t_test_result_climate_anxiety$estimate[2]
sd_of_x_climate_anxiety <- sd(female_data$mean_climate_anxiety)
```

```
sd_of_y_climate_anxiety <- sd(male_data$mean_climate_anxiety)

# Check the values before Cohen's d calculation

cat("Mean of x (female):", mean_of_x_climate_anxiety, "\n")

cat("Mean of y (male):", mean_of_y_climate_anxiety, "\n")

cat("SD of x (female):", sd_of_x_climate_anxiety, "\n")

cat("SD of y (male):", sd_of_y_climate_anxiety, "\n")

# Calculate Cohen's d without a pooled standard deviation

cohens_d_climate_anxiety <- (mean_of_x_climate_anxiety - mean_of_y_climate_anxiety) /
sqrt((sd_of_x_climate_anxiety^2 / length(female_data$mean_climate_anxiety)) +
(sd_of_y_climate_anxiety^2 / length(male_data$mean_climate_anxiety)))

# Print Cohen's d for Climate Anxiety

cat("Cohen's d for Climate Anxiety:", cohens_d_climate_anxiety, "\n")

# for solastalgia

# Assuming your t-test result object is named t_test_solastalgia

t_test_result_solastalgia <- t_test_solastalgia

# Extract mean estimates and standard deviations

mean_of_x_solastalgia <- t_test_result_solastalgia$estimate[1]

mean_of_y_solastalgia <- t_test_result_solastalgia$estimate[2]

sd_of_x_solastalgia <- sd(female_data$mean_solastalgia)

sd_of_y_solastalgia <- sd(male_data$mean_solastalgia)

# Check the values before Cohen's d calculation

cat("Mean of x (female):", mean_of_x_solastalgia, "\n")

cat("Mean of y (male):", mean_of_y_solastalgia, "\n")

cat("SD of x (female):", sd_of_x_solastalgia, "\n")

cat("SD of y (male):", sd_of_y_solastalgia, "\n")

# Calculate Cohen's d without a pooled standard deviation

cohens_d_solastalgia <- (mean_of_x_solastalgia - mean_of_y_solastalgia) /
sqrt((sd_of_x_solastalgia^2 / length(female_data$mean_solastalgia)) + (sd_of_y_solastalgia^2 /
length(male_data$mean_solastalgia)))

# Print Cohen's d for Solastalgia

cat("Cohen's d for Solastalgia:", cohens_d_solastalgia, "\n")

# for climate paralysis
```

```
# Assuming your t-test result object is named t_test_climate_paralysis

t_test_result_climate_paralysis <- t_test_climate_paralysis

# Extract mean estimates and standard deviations

mean_of_x_climate_paralysis <- t_test_result_climate_paralysis$estimate[1]

mean_of_y_climate_paralysis <- t_test_result_climate_paralysis$estimate[2]

sd_of_x_climate_paralysis <- sd(female_data$mean_climate_paralysis)

sd_of_y_climate_paralysis <- sd(male_data$mean_climate_paralysis)

# Check the values before Cohen's d calculation

cat("Mean of x (female):", mean_of_x_climate_paralysis, "\n")

cat("Mean of y (male):", mean_of_y_climate_paralysis, "\n")

cat("SD of x (female):", sd_of_x_climate_paralysis, "\n")

cat("SD of y (male):", sd_of_y_climate_paralysis, "\n")

# Calculate Cohen's d without a pooled standard deviation

cohens_d_climate_paralysis <- (mean_of_x_climate_paralysis - mean_of_y_climate_paralysis) /
sqrt((sd_of_x_climate_paralysis^2 / length(female_data$mean_climate_paralysis)) +
(sd_of_y_climate_paralysis^2 / length(male_data$mean_climate_paralysis)))

# Print Cohen's d for Climate Paralysis

cat("Cohen's d for Climate Paralysis:", cohens_d_climate_paralysis, "\n")

#### H2: Linear Regression Model ####

regression_model <- lm(mean_climate_paralysis ~ mean_climate_anxiety + mean_solastalgia, data =
final_data)

summary(regression_model)

#### H3: Mediation Analysis ####

# Install and load the mediation package

install.packages("mediation")

library(mediation)

mediation_model <- lm(Mean_Climate_Paralysis ~ Gender + Mean_Climate_Anxiety +
Mean_Solastalgia, data = mediation_data)

summary(mediation_model)
```