

How do coping styles influence the relationship between eco-guilt and pro-environmental behaviour?

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Abstract

Objective

Climate change poses significant challenges to the planet and directly and indirectly affects human health. The stressors of climate change trigger emotional responses like eco-guilt, which is defined as feeling guilty about not meeting environmental standards. People employ different coping styles to deal with these emotional responses, categorized into active/adaptive and avoidant/maladaptive coping. This paper examines the predictive power of eco-guilt on the level of pro-environmental behaviour and how adaptive or maladaptive coping could influence this relationship.

Methods

This study employed a cross-sectional study design, using self-report questionnaires distributed by convenience and snowball sampling. The final sample of 111 participants contained predominantly Dutch and German students. Analyzing the data involved preparing and cleaning the dataset in RStudio, followed by calculating descriptive statistics, correlations, ANOVAs, and regressions.

Results and conclusion

The study found a significant positive effect of eco-guilt on pro-environmental behaviour, suggesting that eco-guilt likely motivates individuals to act more sustainably. However, coping styles did not appear to moderate this relationship, but active/adaptive coping is shown to be associated with higher levels of pro-environmental behaviour. Future research should explore these dynamics more in-depth, using longitudinal or experimental designs.

Keywords: eco-guilt, pro-environmental behaviour (PEB), active/adaptive coping, avoidant/maladaptive coping.

Introduction

Climate change is one of today's most significant challenges to the planet. The increasing frequency of extreme events like rising temperatures, heat waves, floods, tornadoes, hurricanes, droughts, fires, loss of forest and glaciers and disappearances of rivers have direct and indirect effects on human physical and mental health (Cianconi et al., 2020). Direct harm to human beings is primarily a result of extreme weather events. However, according to Maibach et al. (2021), indirect harm can also be caused by worsening air pollution, more contaminated food and water, reduced food production, increased conflict and forced migrations due to climate change. Maibach et al. (2020) believe that a stable climate is the most fundamental human health factor. To minimize these devastating effects of climate change on mental health, the global climate science community has determined that it will be imperative to limit global warming to no more than 1.5 degrees Celsius (Maibach et al., 2020). Mundaca et al. (2019) argue that individual behavioural change regarding more sustainable behaviour is crucial to reach this goal. Thus, studying what motivates individuals to perform more sustainable behaviour is essential.

The effects of climate change can trigger various emotional responses, with some individuals being deeply distressed (Stanley et al., 2021). One common emotional response is guilt, which can be defined as a feeling of worry or unhappiness as a result of one's perception of their own harmful behaviour. There are different new terms on climate change-related emotional responses circulating academia, with one of them being eco-guilt (Ágoston et al., 2022a, 2022b; Stanley et al., 2021). Eco-guilt is similar to guilt and is defined as experiencing guilt due to not meeting personal or societal environmental standards (Ágoston et al., 2022b).

Eco-guilt is an important emotional response to address because individuals experiencing eco-guilt are aware of their individual actions (Fredericks, 2014) and may be more motivated to perform behaviour to protect the environment (Moore et al., 2020). For other eco-emotions, like eco-anxiety or eco-depression, this relationship was not found. It is important to note that eco-guilt refers to feeling wrong about certain actions/behaviour and is thus different from eco-shame, meaning that one might feel that one's own harmful behaviour is embedded in one's flawed character (Ágoston et al., 2022b). In line with Ágoston et al. (2022b), this article will make use of the term 'eco-guilt' instead of 'climate change guilt' because the former is a more comprehensive concept, including emotional responses to environmental pollution and degradation of natural environments, as well as to climate change.

Eco-guilt is widely recognized as an action-oriented emotion and is proven to influence pro-environmental behaviour (PEB) (Ágoston et al., 2022b; Fredericks, 2014). PEB is

behaviour that aims to minimize the negative impact of one's own behaviour on the environment or, in short, reduce harm to the world (Tian & Liu, 2022). Examples of PEB are using environmentally friendly/reusable products, avoiding buying products with excessive packaging, buying organic vegetables, minimizing energy use or even supporting policies that affect the local environment (Mateer et al., 2022). Higher levels of eco-guilt are associated with more PEB or at least intentions to PEB (Ágoston et al., 2022b; Bahja & Hancer, 2021). However, this relationship between eco-guilt and PEB might not be as linear as mentioned above. Research indicates that there might be a 'guilt threshold', a certain level of guilt, after which the relationship between eco-guilt and PEB changes. The study of Bahja and Hancer (2022) suggested that after this guilt threshold, the relationship between eco-guilt and PEB could become negative. Thus, after this threshold, higher levels of eco-guilt would be associated with less PEB. However, because different research papers still indicate different results on this relationship, further research on this topic is necessary.

To deal with emotions, such as eco-guilt, individuals might employ different coping styles. These traditional coping styles are in various ways linked to PEB and how PEB might be used to manage the negative sensations of eco-guilt (Ágoston et al., 2022a). Coping styles can be defined as attempts to use cognitive and behavioural strategies to manage certain emotional responses (Brambila-Tapia et al., 2023). The study of Brambila-Tapia et al. (2023) clustered the traditional coping styles together in three categories: active/adaptive coping, avoidant/maladaptive coping and emotional/neutral coping. Previous research has suggested that more adaptive coping styles may result in more PEB (Ágoston et al., 2022a). In theory, one could suggest that PEB is an example of active coping, as the individual is making an effort to make sustainable choices. It would thus be noteworthy to study how these coping styles influence the extent to which eco-guilt predicts PEB.

Thus, the aim of this study is to examine the relationship between eco-guilt and pro-environmental behaviour and how different coping styles influence this relationship. First, it is hypothesized that individuals experiencing more eco-guilt perform more PEB. Second, it's expected that the positive relationship between eco-guilt and PEB depends on individuals' coping styles: individuals with more active/adaptive coping styles, compared to individuals with more avoidant/maladaptive coping styles, are expected to perform more PEB.

H₁: Higher levels of eco-guilt will result in higher levels of PEB.

H_{2a}: A higher score on active/adaptive coping would function as a moderator/strengthen the relationship between eco-guilt and PEB (see Figure 1).

H_{2b}: A higher score on avoidant/maladaptive coping would function as a moderator/weaken the relationship between eco-guilt and PEB (see Figure 2).

Figure 1:

Moderation effect of Active/Adaptive coping on the relationship between the independent variable eco-guilt and the dependent variable PEB.

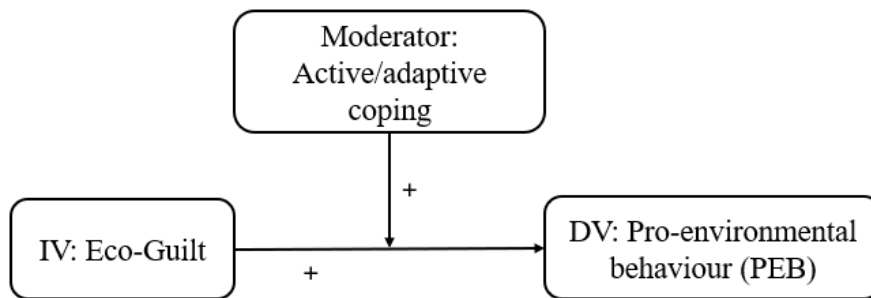
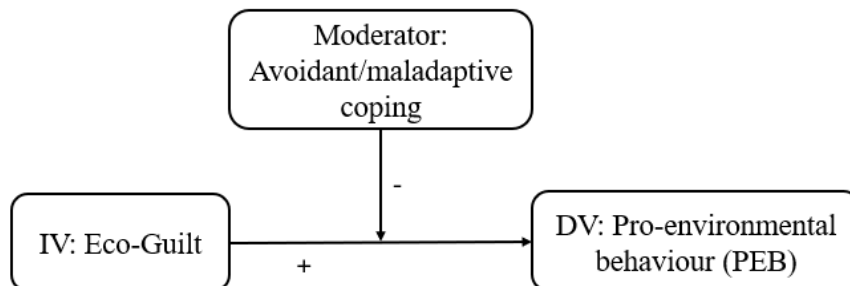


Figure 2:

Moderation effect of Avoidant/Maladaptive coping on the relationship between the independent variable eco-guilt and the dependent variable PEB.



Methods

Design

This study employed a cross-sectional observational design to investigate the relationship between eco-guilt, pro-environmental behaviour (PEB) and coping styles at a single point in time. Quantitative data was collected through self-report questionnaires.

Participants

This study mainly approached students and family members of students above the age of 18 years old. Convenience sampling was applied to collect data more efficiently, recruiting participants from the researcher's own social network and snowball sampling within these networks to obtain a wide variety of participants. The total sample consisted of 170 participants, but due to missing data, 59 participants were deleted. The final sample consisted of 111 participants, mostly Dutch and German university students in their mid-twenties.

Measures

Demographics

The demographics were estimated by age, with an open text entry; gender, with the options "Male", "Female", "Non-binary/third gender", and "Prefer not to say"; nationality, with the options "Dutch", "German" and "Other" including an open text entry for the last option; and educational level, with the five options "Highschool", "Technical college", "University of applied science", "University" and "PhD" (see Appendix 3).

Eco-guilt

To estimate the variable 'eco-guilt', the Eco-Guilt Questionnaire (EGuiQ-11), as created by Ágoston et al. (2022b), was used. The EGuiQ-11 contains 11 statements measuring the level of eco-guilt (e.g., *I feel guilty for not paying enough attention to the issue of climate change*), which are answered on a 4-point Likert scale going from 1 (*Strongly disagree*) to 4 (*Strongly agree*) (see Appendix 3). The eco-guilt questionnaire demonstrated a high internal consistency with a Cronbach's alpha of 0.87.

Pro-environmental behaviour

To measure pro-environmental behaviour (PEB), the PEB Scale (Mateer et al., 2022) was used. This measure asked, "How many times do I..." followed by 11 statements (e.g., *Buy organic vegetables*), which are answered on a 7-point scale ranging from 1 (*Never*) to 7 (*As frequently as possible*). A high mean score on this scale can be interpreted as high levels of PEB (see Appendix 3). The PEB scale demonstrated an acceptable internal consistency with a Cronbach's alpha of 0.77.

Coping styles

Lastly, the different coping styles were measured with the 12-item Mini-COPE (Brambila-Tapia et al., 2023). The Mini-COPE contained three sub-scales (Active/Adaptive, Avoidant/Maladaptive, Emotional/Neutral), each consisting of 4 items. However, for this study, only the sub-scale on active/adaptive coping strategies (e.g., *I've been thinking hard about what steps to take*) and the sub-scale on avoidant/maladaptive coping strategies (e.g., *I've been giving up trying to deal with it*) were used. Brambila-Tapia et al. (2023), also suggested that the measure could effectively be reduced to two subscales. To adapt the measure to the topic of climate change, the phrase "In relation to climate change..." was added in front of the different statements of the Mini-COPE (see Appendix 3). The questions were answered on a 4-point Likert scale, going from 1 (*Strongly disagree*) to 4 (*strongly agree*). A higher score on one of the sub-scales compared to the other would mean that one employs that particular coping style more than the other in relation to climate change. The active/adaptive coping scale demonstrated a high internal consistency with a Cronbach's alpha of 0.86, and the avoidant/maladaptive coping scale demonstrated an acceptable reliability with a Cronbach's alpha of 0.69.

Procedure

Before participants were invited to participate in this study, ethical approval was obtained from the BMS ethics committee of the University of Twente. The questionnaire was made using the program Qualtrics. Participants were invited using three different sampling strategies to obtain more participants and create a diverse sample. First, using convenience sampling, a link to the Qualtrics questionnaire was spread via the researchers' social networks, such as social media platforms like WhatsApp and Instagram. Second, using snowball sampling, previous participants were asked to share the questionnaire link with their social networks. Third, the SONA system was used to reach participants, which is a site from the University of Twente that encourages other BMS students to participate in this research by offering them points (needed to obtain their bachelor's) in return for participation. To recruit people from different backgrounds, the recruitment message was personalized in different languages, namely English, Dutch and German. However, the participants were informed that the questionnaire would be in English. The recruitment message also gave a short description of the study and stated that the questionnaire would take around 15 minutes to complete. At the start of the survey, there was a brief introduction to the research topic (see Appendix 1), after which the participants were asked to fill in informed consent in order to continue with the rest of the questions. The informed consent stated that all the collected data will be treated confidentially and that participation is voluntary (see Appendix 2). After the informed consent,

participants had to fill in some demographic questions (in order of Age, Gender, Nationality and Educational level). Then, they were asked to complete questionnaires, some of which were not used in this study since this study is part of a larger study (see Appendix 3 for the full study). For this study, participants completed the EGuiQ-11 questionnaire, the PEB Scale, and the Mini-COPE. The questionnaire ended with thanking the participants for their responses and offering the researchers' contact details in case of any questions.

Data analysis

To conduct the data analysis, data was transferred from Qualtrics to the statistical software program RStudio. In RStudio, the dataset was first cleaned and prepared for analysis by deleting irrelevant variables produced by Qualtrics (e.g. 'Duration in seconds') and by checking and deleting missing data (e.g. half-filled in questionnaires). For the variable coping styles, two separate mean variables are created for the two different sub-scales (adaptive and maladaptive coping). Then, the descriptive statistics are calculated (min, max, mean, and standard deviation) for all variables of interest, including demographics (age, gender, nationality and educational level), eco-guilt, PEB and coping styles (adaptive/maladaptive). Next, a correlation analysis was conducted by running the `cor()` function in R. In this function, the Pearson correlation coefficient was used to examine the bivariate correlations among continuous/ordinal variables (e.g., age, eco-guilt, PEB and coping styles). An ANOVA analysis was used to examine the association between the categorical variables (e.g., gender, nationality, and educational level) and the continuous/ordinal variables.

Before conducting a regression analysis, the following assumptions were assessed: linearity, independence, homoscedasticity, multivariate normality and outliers/influential data points. Linearity was assessed by plotting the variables eco-guilt and PEB in a scatterplot using the `plot()` function in R. To check for potential violations of interdependence and homoscedasticity, the residuals were plotted against the predicted values using the `plot()` function, inspecting for patterns or clustering of residuals. The assumption of multivariate normality is checked using `Shapiro.test()` function in R, with a p-value greater than 0.05 on the Shapiro-Wilk test, is considered a normal distribution. Outliers and influential data points are identified by computing Cook's distance using the `cooks_distance()` function in R. If values are greater than $4/n$ (n : number of observations), they are considered influential. No deviations of the assumptions were found. Although the data did appear to have seven outliers, these outliers did not have a significant effect on the results of the regression analysis. Therefore, the outliers remained included in the further analyses.

Then, a multiple regression analysis was conducted, using the `lm()` function, to examine the predictive power of the IV eco-guilt on the DV PEB, controlling for all demographic variables. To test the moderation effect of coping styles on the relationship between the IV eco-guilt and DV PEB (see Figures 1 & 2), an interaction regression analysis was conducted using the `lm()` function, running separate analyses for the active/adaptive and avoidant/maladaptive coping. The results of the correlation and regression analysis can be interpreted as significant when the P-values are smaller than .05. The IA service 'chat-gpt' was used during the analysis to help with coding errors from RStudio (see Appendix 1).

Results

The descriptive statistics of the demographic variables are shown in Table 1 and the statistics of the continuous/ordinal variables are shown in Table 2.

Table 1

Descriptive statistics of demographic variables.

| Variable | n = 111 | % | Mean | SD |
|------------------------------|---------|-------|-------|------|
| Gender | | | | |
| Female | 73 | 65.77 | | |
| Male | 36 | 32.43 | | |
| Non-binary/third gender | 2 | 1.80 | | |
| Age | | | 26.03 | 9.67 |
| Nationality | | | | |
| Dutch | 59 | 54.15 | | |
| German | 40 | 36.04 | | |
| Other* | 12 | 10.81 | | |
| Educational level | | | | |
| Highschool | 11 | 9.91 | | |
| MBO/Fachoberschule | 1 | 0.90 | | |
| HBO/Fachhochschule | 18 | 16.22 | | |
| University (bachelor/master) | 81 | 72.97 | | |
| PhD | - | - | | |

Note. *The most common other nationalities were Canadian and Argentinian.

Table 2

Descriptive statistics of outcome variables.

| | Min | Max | Mean | SD |
|--------------------|------|------|------|------|
| Eco-guilt | 1.00 | 3.55 | 2.45 | 0.56 |
| PEB | 1.73 | 5.55 | 3.61 | 0.75 |
| Adaptive coping | 1.00 | 4.00 | 2.44 | 0.74 |
| Maladaptive coping | 1.00 | 3.00 | 1.63 | 0.53 |

Note. PEB = Pro-environmental behaviour.

Pearson correlations for all continuous/ordinal variables are shown in Table 3. A strong and highly significant correlation was found between PEB and adaptive coping. Also, the moderate correlation between PEB and eco-guilt, and the correlation between Adaptive coping and eco-guilt appear to be highly significant. However, most other correlations, though some significant, were shown to be weak.

Table 3

Pearson correlation of all continuous/ordinal variables.

| | Age | Eco-guilt | PEB | Adaptive coping | Maladaptive coping |
|--------------------|-------|-----------|---------------|-----------------|--------------------|
| Age | - | | | | |
| Eco-guilt | 0.04 | - | | | |
| PEB | 0.22 | 0.36** | - | | |
| Adaptive coping | 0.30* | 0.41** | 0.70** | - | |
| Maladaptive coping | -0.15 | 0.05 | -0.26* | -0.13 | - |

Note. PEB = Pro-environmental behaviour.

* $p < .01$, ** $p < .001$

An ANOVA analysis was computed to calculate if any of the categorical variables correlate with any of the outcome variables. Only the association between gender and eco-guilt appeared to be highly significant ($F(2, 108) = 20.71, p < 0.001$), with women and non-binary people experiencing more eco-guilt than men. However, given that there are only two non-binary participants, this result may not be reliable and can be ignored. Other categorical variables (e.g. educational level and nationality) were not significantly correlated with any of the outcome variables.

Before conducting further analysis, the data was checked based on several assumptions. No influential deviations were found, so the analysis continued. A multiple regression analysis was conducted to assess the relationship between eco-guilt and PEB, as shown in Table 4 and Figure 3. The analysis revealed a highly significant positive effect of eco-guilt on PEB, as indicated by the coefficient estimate ($\beta = 0.48, p < 0.001$). When controlling for demographics, age also appeared to be a significant predictor of PEB ($\beta = 0.02, p < 0.02$); only its predictive power is so small that this result can be neglected. Overall, the data supports the first hypothesis, suggesting that eco-guilt has a positive effect on PEB.

Table 4

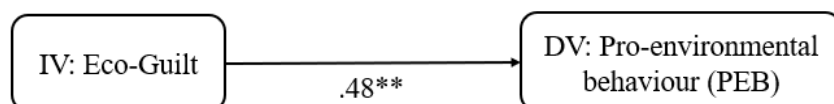
Regression analysis of eco-guilt's effect on PEB.

| | β | SE | t | p |
|--------------|-------------|------|------|------------|
| (Intercepts) | 2.04 | 0.34 | 6.02 | 2.47e-08** |
| Eco-guilt | 0.48 | 0.12 | 4.04 | < 0.001** |

* $p < .01$, ** $p < .001$

Figure 3

Conceptual model concerning the regression analysis of eco-guilt's effect on PEB.



Note. IV = independent variable; DV = dependent variable.

* $p < .01$, ** $p < .001$

When conducting a moderation analysis, no significant moderation effect of either adaptive coping or maladaptive coping on the relationship between eco-guilt and PEB was found. However, adaptive coping did show a positive significant effect on PEB (adaptive: $\beta = 0.58$, $p < 0.05$), as shown in Table 5 and Figure 4. This indicates that, although individuals' engagement in active/adaptive coping might be related to participating in more PEB, the engagement in a certain coping style does not significantly influence the relationship between eco-guilt and PEB. Therefore, the second hypothesis, suggesting that coping styles serve as a moderator in the relationship between eco-guilt and PEB, is not supported by the data. Regardless of individuals' coping styles, the impact of eco-guilt on PEB remains constant. For the R script, see Appendix 4.

Table 5

Moderation analysis of adaptive and maladaptive coping on the relationship between eco-guilt and PEB.

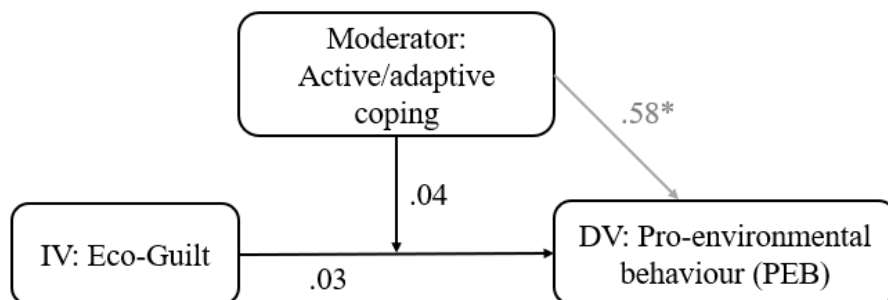
| | Adaptive coping | | | | Maladaptive coping | | | |
|-----------------------|-----------------|------|------|--------|--------------------|------|------|--------|
| | β | SE | t | p | β | SE | t | p |
| (Intercept) | 1.87 | 0.63 | 2.98 | .004** | 2.77 | 0.95 | 2.92 | .004** |
| Eco-guilt | 0.03 | 0.27 | 0.12 | .903 | 0.60 | 0.37 | 1.60 | .112 |
| Adaptive coping | 0.58 | 0.29 | 1.99 | .049* | - | - | - | - |
| Maladaptive coping | - | - | - | - | -0.23 | 0.60 | 0.39 | .697 |
| Eco-guilt:Adaptive | 0.04 | 0.12 | 0.35 | .727 | - | - | - | - |
| Eco-guilt:Maladaptive | - | - | - | - | -0.06 | 0.24 | 0.26 | .793 |

Note. 'Adaptive' refers to adaptive coping, and 'Maladaptive' refers to maladaptive coping.

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 4

Conceptual model concerning the moderation analysis of active/adaptive coping on the relationship between eco-guilt and PEB.

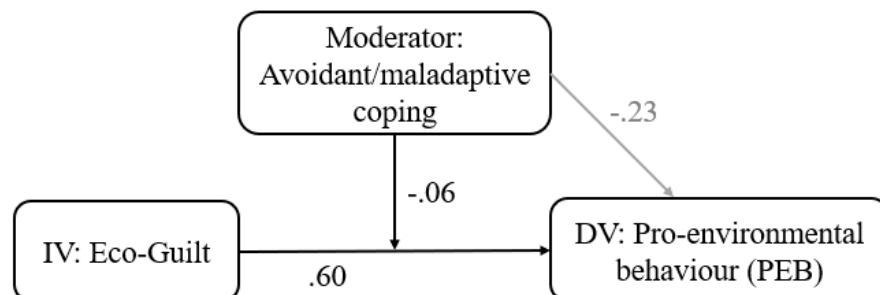


Note. IV = independent variable; DV = dependent variable.

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 5

Conceptual model concerning the moderation analysis of avoidant/maladaptive coping on the relationship between eco-guilt and PEB.



Note. IV = independent variable; DV = dependent variable.

* $p < .05$, ** $p < .01$, *** $p < .001$

Discussion

The aim of this study was to examine the relationship between eco-guilt and pro-environmental behaviour (PEB) and how different coping styles could influence the relationship between eco-guilt and PEB. First, the hypothesized positive effect of eco-guilt on the level of PEB was supported by the results showing a positive significant effect of eco-guilt on PEB. These findings indicate that individuals who experience higher levels of eco-guilt are generally more likely to engage in sustainable behaviours/behaviours that reduce the individuals' environmental impact. This result aligns with previous research, suggesting that eco-guilt can motivate PEB (Ágoston et al., 2022b; Fredericks, 2014). Interestingly, previous research also suggested that the relationship between eco-guilt and PEB could have a certain threshold, after which the relationship would become negative. However, the findings of this study do not support the likelihood of a threshold and imply that this relationship might be more linear than expected by Bahja and Hancer (2021).

The second hypothesis suggested that individual coping styles, namely active/adaptive coping or avoidant/maladaptive coping, would moderate the relationship between eco-guilt and PEB. Contrary to the hypothesis, the results show that coping styles do not moderate this relationship. Although active/adaptive coping was positively associated with PEB, the interaction did not significantly alter the relationship between eco-guilt and PEB. This suggests that while coping styles are relevant for PEB, they do not necessarily influence the relationship of how eco-guilt translates into sustainable behaviour.

Besides the significant association between active/adaptive coping and PEB within the moderation model, the results of this study also showed a strong and highly significant Pearson correlation between the two variables, providing further support for their relevance. This result also aligns with previous research of Ágoston et al. (2022a), who suggest that more adaptive coping styles might translate into more sustainable behaviour. It highlights the importance of active coping strategies in fostering PEB and how individuals who actively seek solutions that address their concerns about climate change are more likely to engage in PEB.

Possible explanations

Interestingly, the absence of a moderation effect for coping styles might simply suggest that the motivational force of eco-guilt is strong enough to overcome variations in coping styles and will, regardless of someone's coping style, push individuals towards pro-environmental behaviour. This result is similar to the observation of Ágoston et al. (2022a), in which the presence of eco-guilt was often accompanied by the mentioning of eco-friendly behaviour, and

can be supported by the significant effect that Moore and Yang (2020) found on the relationship between eco-guilt and environmental behavioural intention.

Another explanation for the absence of a moderation effect could be that a moderation model is not a good fit for the given circumstances. Previous research found that active/adaptive coping significantly correlated with less stress, depression and anxiety (Brambila-Tapia et al., 2023). This relationship between active/adaptive coping and other emotions could indicate that there might also be a relationship between active/adaptive coping and eco-guilt. This is in line with the found correlation between active/adaptive coping and eco-guilt and the study of Ágoston et al. (2022a) identifying problem-focused coping mechanisms (e.g. taking action/planning and confrontation) for coping with eco-emotions. Since the results of this study and previous studies found a relationship between active/adaptive coping and PEB, it would not be surprising if they were all connected in an underlying construct. Thus, a mediation model, in which eco-guilt might influence PEB through active/adaptive coping, could possibly be a more suited model to explain their relationship, which should be investigated in future research.

Implications of the results

The findings of this study can be implicated in several ways. First, from a theoretical perspective, these findings support the understanding of eco-emotions and how they translate into actual behaviour. In general, emotional responses should be taken into account when researching PEB. Specifically, the findings of this study suggest that eco-guilt is a powerful motivator of PEB and would thus be worthy of consideration as a factor in PEB models. From a practical perspective, these findings could contribute to interventions encouraging PEB by increasing eco-guilt through highlighting the personal impact of one's actions on the environment. However, since the possibility of a threshold is not entirely ruled out, one has to be careful not to trigger excessive guilt since this might lead to counterproductive behaviour. Interventions could also use the results of this study by promoting adaptive coping strategies to enhance PEB. The study of Mah et al. (2020) suggests that in order to stimulate adaptive coping, clear information on possible solutions and strategies on how people might minimize their impact on the environment should be provided. Strategies such as problem-solving, information-seeking, and active engagement with the environment could all increase individuals' PEB levels.

Strengths and limitations

This study has several strengths. First, using highly established and validated measures with good internal consistency enhances the reliability of the results. Additionally, the sample

size was of adequate amount to obtain significant results and included participants of various backgrounds, supporting the generalizability of the findings.

However, there are also several limitations in this study. The cross-sectional design of this study prevents the formulation of causal relationships. In this design, all the data is collected from the participants at a single point in time, providing a picture of the relationships as they exist at that moment in time. Thus, while higher levels of eco-guilt are associated with increased PEB, we could not assess whether eco-guilt directly causes individuals to engage in more PEB. It could be possible that individuals who are already engaging in PEB might feel more eco-guilt. Due to the fact that this study was part of a larger study, the questionnaire includes a video at the beginning that depicts either positive or negative communication regarding climate change. This video may also have had an impact on the responses of the participants. The study also relies on self-report questionnaires, which may result in socially desirable answers where participants might overreport PEB or underreport certain coping strategies. According to research, this socially desirable response is due to the tendency for survey respondents to present a favourable image of themselves in their responses (van de Mortel, 2008).

Directions for future research

To battle the limitation of the cross-sectional study design, future research could consider a longitudinal design to better understand the causal relationships between eco-guilt, PEB and coping styles. In this way, it can be further explored whether these relationships exist and how these evolve over time or if there are other factors to take into account. Another potential direction for future research is to investigate if other emotional responses are interacting with eco-guilt. Emotional responses are complex and could collectively influence PEB instead of singularly, as supported by Stanley et al. (2021), who observed that other eco-emotions, such as eco-anger, could also predict pro-climate behaviours. Moreover, experimental studies could also test if interventions aiming to enhance adaptive coping strategies actually increase PEB or if interventions motivating PEB through eco-guilt actually work.

Conclusion

In conclusion, this study contributes to the growing body of literature on the emotional responses on climate change and the psychological factors enhancing PEB. The findings of this study show that eco-guilt plays a significant role in promoting PEB and that while coping styles do not moderate this relationship, adaptive coping might play a role in encouraging PEB. Future research should continue to explore these mechanisms and use these theories to develop effective interventions to tackle climate change through individual behavioural change.

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Appendix 1 – AI statement

"During the preparation of this work, I used Chat-gpt for assistance with coding errors from RStudio and for help with general structure, making sure I included all necessary information in my report. I also used Grammarly to correct the grammar and spelling in my report and to check for plagiarism. After using these tools/services, I thoroughly reviewed and edited the content as needed, taking full responsibility for the final outcome."

Appendix 1 – introduction to questionnaire**Coping with Climate Change**

Welcome,

You are being invited to participate in a research study. This study is being done by the students Johanna Wolbert, Veerle Wilborts, Samua Omar Maroof and their Supervisor Anneleen Klaassen from the Faculty of Behavioural, Management and Social Sciences at the University of Twente. Your data will thus be used for three different research papers, all surrounding the topic of how individuals cope with climate change.

Taking part in this study will approximately take you 15 minutes to complete. Your participation in this study is entirely voluntary and you can withdraw at any time. We believe there are no known risks associated with this research study; however, as with any online related activity the risk of a breach is always possible. To the best of our ability, your answers in this study will remain confidential. We will minimize any risks by storing the data encrypted on a private device with manually created backups following procedures of the general data protection regulation (GDPR). The data will be stored for a maximum of 3 years after the study has been completed. In the publication, no data will be used that could lead to your identification. If individual results will be used in the publication, they will be anonymized or pseudonymized to ensure confidentiality. The raw data is only accessible to the researchers themselves and their supervisor and will be regularly checked to guarantee data security.

Please read the information given underneath carefully and fill in the informed consent to continue to the questionnaire.

Appendix 2 – informed consent

Informed Consent

Taking part in the study I have read and understood the study information dated [18/03/2024], or it has been read to me. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason. I understand that taking part in the study involves a survey questionnaire completed by the participant.

Risks associated with participating in the study

I understand that taking part in the study involves the following risks: mental discomfort Presented images could be perceived as uncomfortable, however, these are common images shown in news and other media, therefore, we expect limited harm.

Use of the information in the study

I understand that information I provide will be used for the output in form of a report. I understand that personal information collected about me that can identify me, such as demographic data, will not be shared beyond the study team. Future use and reuse of the information by others I give permission for the survey data that I provide to be archived in Qualtrics so it can be used for future research and learning. The data is anonymous since no sensitive data is collected that can lead to the identification of the test subjects. The data is only used for the purpose of this research study.

Contact Details:

j.a.wolbert@student.utwente.nl
s.omarmarroof@student.utwente.nl
V.g.wilborts@student.utwente.nl

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-hss@utwente.nl Do you agree to all the above-mentioned statements and confirm that you consent to take part in this study and for your data to be used for future research as described.

* Do you agree to all the before-mentioned statements and confirm that you consent to take part in this study and for your data to be used for future research as described?

Yes

No

Appendix 3 – all questions of the survey

Q6

*

What is your age?

Q8

*

What is your gender?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Q9

*

What is your nationality?

- Dutch
- German
- Other

Q18

*

What is your highest level of education obtained?
If you are still studying: What is the highest level which you are currently studying?

- Highschool
- Technical college (MBO/Fachoberschule)
- University of applied science (HBO/Fachhochschule)
- University (Bachelor/Master)
- PhD

Q15

Please watch the video

<https://youtu.be/5B8eajjYzjE?si=U9o3erDzjJ5j2wvq>

After watching the video, please return to this survey

Q16

Please watch the video

<https://youtu.be/oUsddpT9cGo?si=R1d5ogD93gHhqXOv>

After watching the video, please return to this survey

Q17

*

Display this question

If Please watch the video <https://youtu.be/5B8eajjYzjE?si=U9o3erDzjJ5j2wvq> After watching the video,... Is Displayed

What is, according to the video, a solution to fight climate change?

- Only planting trees
- Change of mentality

Q18

*

Display this question

If Please watch the video <https://youtu.be/oUsddpT9cGo?si=R1d5ogD93gHhqXOv> After watching the vide... Is Displayed

What is the financial damage of weather disasters adressed in the clip?

- 1 Billion/Every 3 weeks
- 2 Billion/Every month

ICE 💡 ☆

What do you feel in relation to climate change?

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| The increasing public engagement with climate change gives me hope | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I believe that there are emerging solutions that will allow us to stop climate change | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Concrete actions for the climate allow me to be optimistic about the future | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Social mobilization in the fight against climate change makes me feel that together we can achieve this goal | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Page Break

ICE 💡 ☆

What do you feel in relation to climate change?

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| I fear the impact of climate change on peoples' lives. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Being aware of climate change takes away the joy in my life. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I am anxious when I think about the negative effects of climate change. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I am overwhelmed by the awareness of the approaching climate disaster. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Everything seems uncertain because of climate change. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I fear how climate change will affect me and my loved ones. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

EGuiQ-11 💡 ☆

What do you feel in relation to climate change?

| | Strongly disagree | Somewhat disagree | Somewhat agree | Strongly agree |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| At times I feel some personal responsibility for the problems and unfolding impacts of climate change. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I blame myself for often behaving in an environmentally destructive way in situations where it could have been avoided. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I experience some guilt over the fact that my family and friends' lifestyles and consumption patterns are in part responsible for the unfolding impacts of climate change. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I often feel like a hypocrite when it comes to environmental action. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I feel guilty for not paying enough attention to the issue of climate change. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| The more I know about the human causes of climate change, the more things I feel guilty about. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I am constantly angry with myself because I think that I am not doing enough and that I am harming the environment by my very existence. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| It makes me feel uneasy that I am part of a system that is amplifying climate change. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I often blame myself for the fact that my needs and my work are not really important, but they contribute to the destruction of the environment. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I feel guilty when I do something polluting that I had stopped doing before. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I very often feel that what I do for the environment is not enough, because it cannot balance other negative behaviors. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Final PEB Scale

How many times do I...

| | Never | Rarely | Once in a while | Sometimes | Often | Most of the time | As frequently as possible |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------------|
| Buy environmentally friendly and/ or energy efficient products | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Walk or rode a bike when traveling short distances | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Reuse or mend items rather than throwing them away | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Avoid buying products with excessive packaging | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Buy organic vegetables | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Minimize use of heating or air conditioning to limit energy use | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Talk to others in your community about environmental issues | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Work with others to address an environmental problem or issue | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Participate as an active member in a local environmental group | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Sign a petition about an environmental issue | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Donate money to support local environmental protection | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Mini-COPE

In relation to climate change...

| | Strongly disagree | Somewhat disagree | Somewhat agree | Strongly agree |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| I've been concentrating my efforts on doing something about the situation I'm in. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been taking action to try to make the situation better. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been trying to come up with a strategy about what to do. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been thinking hard about what steps to take. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been saying to myself "this isn't real". | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been giving up trying to deal with it. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been refusing to believe that it has happened. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I've been giving up the attempt to cope | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

We thank you for your time spent taking this survey.

If you have any questions you can contact one of our researchers:

j.a.wolbert@student.utwente.nl

s.omarmarroof@student.utwente.nl

v.g.wilborts@student.utwente.nl

Your response has been recorded.

Appendix 4 – code used for analysis in RStudio

#Coping with climate change - Rscript of Veerle Wilborts

#25/04/2024

#Install packages

```
install.packages("mediation")
```

```
install.packages("lavaan")
```

```
install.packages("semPlot")
```



```
#Load packages
library(haven)
library(tidyverse)
library(dplyr)
library(ggplot2)
library(ltm)
library(car)
library(psych)
library(ggpubr)
library(Hmisc)
library(car)
library(mediation)
library(lavaan)
library(semPlot)

#Rename dataset
FinalDataset <- Coping_with_climate_change_May_13_2024_13_53_1_1_

#Rename descriptive variables
names(FinalDataset)[names(FinalDataset) == "Q6"] <- "Age"
names(FinalDataset)[names(FinalDataset) == "Q8"] <- "Gender"
names(FinalDataset)[names(FinalDataset) == "Q9"] <- "Nationality"
names(FinalDataset)[names(FinalDataset) == "Q9_3_TEXT"] <- "Nationality_Other_TEXT"
names(FinalDataset)[names(FinalDataset) == "Q18"] <- "Educational_level"

#Deleting irrelevant variables produced by Qualtrics
new_data <- subset(FinalDataset, select = -c(StartDate, EndDate, Status, IPAddress, Progress,
Duration__in_seconds_, Finished, RecordedDate, ResponseId, RecipientLastName,
RecipientFirstName, RecipientEmail, ExternalReference, LocationLatitude,
LocationLongitude, DistributionChannel, UserLanguage))

#Assign the new dataset to the original variable name
FinalDataset <- new_data

#Delete variables used by other researchers, not needed for this study
```

```
FinalDataset <- subset(FinalDataset, select = -c(Q17, Q18.0, ICE_1, ICE_2, ICE_3, ICE_4,
ICE_1.0, ICE_2.0, ICE_3.0, ICE_4.0, ICE_5, ICE_6))
```

```
#Deleting participants with missing data
```

```
MISSING <- is.na(FinalDataset$EGuiQ_11_1) |
  is.na(FinalDataset$Final_PEB_Scale_1) |
  is.na(FinalDataset$Mini_COPE_1)
  #Count the number of rows flagged for deletion
  sum(MISSING)
  ##[1] 56
```

```
new_data_no_NA <- subset(FinalDataset,
  subset = !MISSING)
```

```
FinalDataset <- new_data_no_NA
```

```
#CREATING CHARACTERS FOR NUMERIC DISRIPTIVE STATISTICS
```

```
#Gender
```

```
class(FinalDataset$Gender)="character"
for (i in 1:111){
  if (FinalDataset[i, "Gender"] == 1){
    FinalDataset[i, "Gender"] = "Male"
  } else if (FinalDataset[i, "Gender"] == 2){
    FinalDataset[i, "Gender"] = "Female"
  } else if (FinalDataset[i, "Gender"] == 3){
    FinalDataset[i, "Gender"] = "Non-binary/third gender"
  } else if (FinalDataset[i, "Gender"] == 4){
    FinalDataset[i, "Gender"] = "Prefer not to say"
  }
}
```

```
#Nationality
```

```
class(FinalDataset$Nationality)="character"
for (i in 1:111){
  if (FinalDataset[i, "Nationality"] == 1){
    FinalDataset[i, "Nationality"] = "Dutch"
  } else if (FinalDataset[i, "Nationality"] == 2){
```

```

    FinalDataset[i, "Nationality"] = "German"
  } else if (FinalDataset[i, "Nationality"] == 3){
    FinalDataset[i, "Nationality"] = "Other"
  }
}
#Educational level
class(FinalDataset$Educational_level)="character"
for (i in 1:111){
  if (FinalDataset[i, "Educational_level"] == 1){
    FinalDataset[i, "Educational_level"] = "Highschool"
  } else if (FinalDataset[i, "Educational_level"] == 2){
    FinalDataset[i, "Educational_level"] = "Technical college (MBO/Fachoberschule)"
  } else if (FinalDataset[i, "Educational_level"] == 3){
    FinalDataset[i, "Educational_level"] = "University of applied science
(HBO/Fachhochschule)"
  } else if (FinalDataset[i, "Educational_level"] == 4){
    FinalDataset[i, "Educational_level"] = "University (Bachelor/Master)"
  } else if (FinalDataset[i, "Educational_level"] == 5){
    FinalDataset[i, "Educational_level"] = "PhD"
  }
}
}

#CREATING MEAN SCORES FOR MEASURES
#Creating a mean score for EGuiQ_11
FinalDataset$EGuiQ_11 <- rowMeans(FinalDataset[, c("EGuiQ_11_1", "EGuiQ_11_2",
"EGuiQ_11_3", "EGuiQ_11_4", "EGuiQ_11_5", "EGuiQ_11_6", "EGuiQ_11_7",
"EGuiQ_11_8", "EGuiQ_11_9", "EGuiQ_11_10", "EGuiQ_11_11")], na.rm = TRUE)

#Creating a mean score for PEB_scale
FinalDataset$Final_PEB_Scale <- rowMeans(FinalDataset[, c("Final_PEB_Scale_1",
"Final_PEB_Scale_2", "Final_PEB_Scale_3", "Final_PEB_Scale_4", "Final_PEB_Scale_5",
"Final_PEB_Scale_6", "Final_PEB_Scale_7", "Final_PEB_Scale_8", "Final_PEB_Scale_9",
"Final_PEB_Scale_10", "Final_PEB_Scale_11")], na.rm = TRUE)

```

```

#Creating a two separate mean scores for Mini_COPE adaptive vs maladaptive
FinalDataset$Mini_COPE_Adaptive <- rowMeans(FinalDataset[, c("Mini_COPE_1",
"Mini_COPE_2", "Mini_COPE_3", "Mini_COPE_4")], na.rm = TRUE)
FinalDataset$Mini_COPE_Maladaptive <- rowMeans(FinalDataset[, c("Mini_COPE_5",
"Mini_COPE_6", "Mini_COPE_7", "Mini_COPE_8")], na.rm = TRUE)

#CREATING TABLES AND PLOTS WITH DESCRIPTIVE STATISTICS
table(FinalDataset$Gender)
table(FinalDataset$Nationality)
table(FinalDataset$Educational_level)

#Bar plot/histogram for gender/nationality/educational level/age
ggplot(data = FinalDataset, aes(x = Gender)) +
  geom_bar(fill = "skyblue", color = "black") +
  labs(title = "Frequency of Gender")

ggplot(data = FinalDataset, aes(x = Nationality)) +
  geom_bar(fill = "skyblue", color = "black") +
  labs(title = "Frequency of Nationality")

ggplot(data = FinalDataset, aes(x = Educational_level)) +
  geom_bar(fill = "skyblue", color = "black") +
  labs(title = "Frequency of Educational Level")

ggplot(data = FinalDataset, aes(x = Age)) +
  geom_histogram(binwidth = 1, fill = "skyblue", color = "black") +
  labs(title = "Distribution of Age")

#Convert 'age' to numeric
FinalDataset$Age <- as.numeric(as.character(FinalDataset$Age))

#Compute standard deviation for
Age/EGuiQ_11/Final_PEB_Scale/Mini_COPE_Adaptive/Mini_COPE_Maladaptive
age_std <- sd(FinalDataset$Age)

```

```

EGuiQ_11_std <- sd(FinalDataset$EGuiQ_11)
Final_PEB_Scale_std <- sd(FinalDataset$Final_PEB_Scale)
Mini_COPE_Adaptive_std <- sd(FinalDataset$Mini_COPE_Adaptive)
Mini_COPE_Maladaptive_std <- sd(FinalDataset$Mini_COPE_Maladaptive)

#Print statistics for
Age/EGuiQ_11/Final_PEB_Scale/Mini_COPE_Adaptive/Mini_COPE_Maladaptive
summary(FinalDataset$Age)
summary(FinalDataset$EGuiQ_11)
summary(FinalDataset$Final_PEB_Scale)
summary(FinalDataset$Mini_COPE_Adaptive)
summary(FinalDataset$Mini_COPE_Maladaptive)
print(age_std)
print(EGuiQ_11_std)
print(Final_PEB_Scale_std)
print(Mini_COPE_Adaptive_std)
print(Mini_COPE_Maladaptive_std)

#CALCULATE CRONBACH'S ALPHA
#Select the Eco-Guilt items
eco_guilt_items <- FinalDataset[, c("EGuiQ_11_1", "EGuiQ_11_2", "EGuiQ_11_3",
"EGuiQ_11_4", "EGuiQ_11_5", "EGuiQ_11_6", "EGuiQ_11_7", "EGuiQ_11_8",
"EGuiQ_11_9", "EGuiQ_11_10", "EGuiQ_11_11")]
#Calculate Cronbach's alpha
eco_guilt_alpha <- alpha(eco_guilt_items)
print(eco_guilt_alpha)

#Select the PEB items
peb_items <- FinalDataset[, c("Final_PEB_Scale_1", "Final_PEB_Scale_2",
"Final_PEB_Scale_3", "Final_PEB_Scale_4", "Final_PEB_Scale_5", "Final_PEB_Scale_6",
"Final_PEB_Scale_7", "Final_PEB_Scale_8", "Final_PEB_Scale_9", "Final_PEB_Scale_10",
"Final_PEB_Scale_11")]
#Calculate Cronbach's alpha
peb_alpha <- alpha(peb_items)

```

```

print(peb_alpha)

#Select the Adaptive Coping items
adaptive_coping_items <- FinalDataset[, c("Mini_COPE_1", "Mini_COPE_2",
"Mini_COPE_3", "Mini_COPE_4")]
#Calculate Cronbach's alpha
adaptive_coping_alpha <- alpha(adaptive_coping_items)
print(adaptive_coping_alpha)

# Select the Maladaptive Coping items
maladaptive_coping_items <- FinalDataset[, c("Mini_COPE_5", "Mini_COPE_6",
"Mini_COPE_7", "Mini_COPE_8")]
# Calculate Cronbach's alpha
maladaptive_coping_alpha <- alpha(maladaptive_coping_items)
print(maladaptive_coping_alpha)

#CORRELATION ANALYSIS
#Compute Pearson correlation coefficient for continuous variables
continuous_cor <- cor(FinalDataset[, c("Age", "EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")])
print(continuous_cor)

#Function to calculate correlation and p-value
correlation_test <- function(x, y) {
  cor_test <- cor.test(x, y)
  return(c(cor_test$estimate, cor_test$p.value))
}

#Calculate correlations and p-values
cor_results <- sapply(names(FinalDataset[, c("Age", "EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")]),
  function(x) sapply(names(FinalDataset[, c("Age", "EGuiQ_11",
"Final_PEB_Scale", "Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")]),
    function(y) correlation_test(FinalDataset[[x]], FinalDataset[[y]])))

```

```

#Convert to matrix and extract correlation coefficients and p-values
cor_matrix <- matrix(unlist(cor_results), nrow = 6, ncol = 12, byrow = TRUE)
cor_coefficients <- cor_matrix[, seq(1, 12, by = 2)]
cor_pvalues <- cor_matrix[, seq(2, 12, by = 2)]

#Print the correlation coefficients and p-values
print(cor_coefficients)
print(cor_pvalues)

#ANOVA ANALYSIS
#Categorical and continuous variables
anova_results_Gender <- lapply(FinalDataset[, c("EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")], function(var) {
  aov(var ~ Gender, data = FinalDataset)
})
anova_results_Nationality <- lapply(FinalDataset[, c("EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")], function(var) {
  aov(var ~ Nationality, data = FinalDataset)
})
anova_results_Educational_level <- lapply(FinalDataset[, c("EGuiQ_11",
"Final_PEB_Scale", "Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")], function(var) {
  aov(var ~ Educational_level, data = FinalDataset)
})

#Print ANOVA results
names(anova_results_Gender) <- c("EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")
for (i in names(anova_results_Gender)) {
  cat(paste("ANOVA results for", i, ":\n"))
  print(summary(anova_results_Gender[[i]]))
  cat("\n")
}

```

```

names(anova_results_Nationality) <- c("EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive")
for (i in names(anova_results_Nationality)) {
  cat(paste("ANOVA results for", i, ":\n"))
  print(summary(anova_results_Nationality[[i]]))
  cat("\n")
}
names(anova_results_Educational_level) <- c("EGuiQ_11", "Final_PEB_Scale",
"Mini_COPE_Adaptive", "Mini_COPE_Maladaptive", "Combined_COPE")
for (i in names(anova_results_Educational_level)) {
  cat(paste("ANOVA results for", i, ":\n"))
  print(summary(anova_results_Educational_level[[i]]))
  cat("\n")
}

#Perform/print Kruskal-Wallis test
kruskal_result <- kruskal.test(EGuiQ_11 ~ Gender, data = FinalDataset)
print(kruskal_result)

#Create a boxplot for Gender and Eco-guilt
ggplot(FinalDataset, aes(x = Gender, y = EGuiQ_11, fill = Gender)) +
  geom_boxplot() +
  labs(x = "Gender", y = "EGuiQ_11", title = "Distribution of Eco-Guilt by Gender") +
  theme_minimal()

#ASSUMPTIONS
#Linearity - creating a scatterplot
ggplot(FinalDataset, aes(x = EGuiQ_11, y = Final_PEB_Scale)) +
  geom_point() +
  geom_smooth(method = "lm", se = FALSE, color = "blue") + # Add a linear trend line
  labs(x = "Eco-guilt (EGuiQ_11)", y = "Pro-environmental behavior (Final_PEB_Scale)",
  title = "Scatterplot of Eco-guilt and Pro-environmental Behavior with Trend Line") +
  theme_minimal()

```



```
#Independence/Homoscedasticity - plotting residuals against predicted values
#Fit the regression model
model <- lm(Final_PEB_Scale ~ EGuiQ_11, data = FinalDataset)

#Extract residuals and fitted values
residuals <- resid(model)
predicted_values <- fitted(model)

#Create a scatterplot of residuals vs. fitted values
plot(predicted_values, residuals,
      xlab = "Predicted values",
      ylab = "Residuals",
      main = "Residuals vs. Predicted Values")
#Add a horizontal line at y = 0
abline(h = 0, col = "red")
#Add a smooth line to assess the overall trend
lines(lowess(predicted_values, residuals), col = "blue")

#Multivariate normality - Perform Shapiro-Wilk test
shapiro_test <- shapiro.test(residuals)
print(shapiro_test)
#Visualize the distribution of residuals using a QQ plot
qqnorm(residuals)
qqline(residuals)

#Outliers and influential data point - Cook's distance analysis
model <- lm(Final_PEB_Scale ~ EGuiQ_11, data = FinalDataset)
cooks_d <- cooks.distance(model)
n <- nrow(FinalDataset)
influential <- which(cooks_d > 4/n)
print(influential)
#Visualize Cook's distance
plot(cooks_d, main="Cook's Distance Plot", ylab="Cook's Distance", xlab="Observation
Number")
```

```

abline(h = 4/n, col="red", lty=2)

#Deleting influential data to do regression analysis with and without
FinalDataset_clean <- FinalDataset[~influential, ]

#REGRESSION ANALYSIS
#regression analysis with outliers
model <- lm(Final_PEB_Scale ~ EGuiQ_11 + Age + Gender + Nationality +
Educational_level, data = FinalDataset)
summary(model)
#Plotting the scatterplot of IV (EGuiQ_11) and DV (Final_PEB_Scale)
plot(FinalDataset$EGuiQ_11, FinalDataset$Final_PEB_Scale,
      xlab = "Eco-Guilt (IV)", ylab = "Pro-Environmental Behavior (DV)",
      main = "Scatterplot with Linear Regression Line")
#Adding the linear regression line
abline(lm(Final_PEB_Scale ~ EGuiQ_11, data = FinalDataset), col = "red")

#regression analysis without controlling for demographics
model <- lm(Final_PEB_Scale ~ EGuiQ_11 + Age, data = FinalDataset)
summary(model)

#Regression analysis without outliers
model_clean <- lm(Final_PEB_Scale ~ EGuiQ_11 + Age + Gender + Nationality +
Educational_level, data = FinalDataset_clean)
summary(model_clean)
#Plotting the scatterplot of IV (EGuiQ_11) and DV (Final_PEB_Scale)
plot(FinalDataset_clean$EGuiQ_11, FinalDataset_clean$Final_PEB_Scale,
      xlab = "Eco-Guilt (IV)", ylab = "Pro-Environmental Behavior (DV)",
      main = "Scatterplot with Linear Regression Line")
#Adding the linear regression line
abline(lm(Final_PEB_Scale ~ EGuiQ_11, data = FinalDataset_clean), col = "red")

#MODERATION ANALYSIS
#For Adaptive coping

```

```

mod_adaptive <- lm(Final_PEB_Scale ~ EGuiQ_11 * Mini_COPE_Adaptive, data =
FinalDataset)
summary(mod_adaptive)

#For Maladaptive coping
mod_maladaptive <- lm(Final_PEB_Scale ~ EGuiQ_11 * Mini_COPE_Maladaptive, data =
FinalDataset)
summary(mod_maladaptive)

#Effect if adaptive coping was IV on PEB (as DV)
model_test <- lm(Final_PEB_Scale ~ Mini_COPE_Adaptive + Age + Gender + Nationality +
Educational_level, data = FinalDataset)
summary(model_test)
plot(FinalDataset$Mini_COPE_Adaptive, FinalDataset$Final_PEB_Scale,
      xlab = "Adaptive coping (IV)", ylab = "Pro-Environmental Behavior (DV)",
      main = "Scatterplot with Linear Regression Line")
#Adding the linear regression line
abline(lm(Final_PEB_Scale ~ Mini_COPE_Adaptive, data = FinalDataset), col = "red")

#MEDIATION ANALYSIS
#Define the mediation model
mediation_model <- '
# Direct effect
Final_PEB_Scale ~ c*EGuiQ_11

# Mediator effect
Mini_COPE_Adaptive ~ a*EGuiQ_11

# Direct effect (controlling for mediator)
Final_PEB_Scale ~ b*Mini_COPE_Adaptive

# Indirect effect
indirect := a*b

```

```

# Total effect
total := c + (b)
,

#Fit the mediation model
mediation_fit <- sem(mediation_model, data = FinalDataset)
#Get summary of results
summary(mediation_fit)

#Path diagram
path_diagram <- semPaths(mediation_fit, whatLabels = "est", style = "lisrel", edge.label.cex =
1.5)
#Bar plot of standardized coefficients
coefs <- cbind(Direct = 0.127, Indirect = 0.362, Total = 0.805) # Replace coefficients with
your actual values
barplot(coefs, beside = TRUE, col = c("blue", "green", "orange"), ylim = c(0, 1),
        xlab = "Effect", ylab = "Standardized Coefficients", main = "Direct, Indirect, and Total
Effects")

#POWER ANALYSIS
install.packages("pwr")
library(pwr)

# Model 1: Basic Regression
R2_model1 <- summary(lm(Final_PEB_Scale ~ EGuiQ_11 + Age + Gender + Nationality +
Educational_level, data = FinalDataset))$r.squared
f2_model1 <- R2_model1 / (1 - R2_model1)
num_predictors_model1 = 5 # Number of predictors
sample_size = nrow(FinalDataset)
alpha = 0.05

power_model1 <- pwr.f2.test(u = num_predictors_model1, v = sample_size -
num_predictors_model1 - 1, f2 = f2_model1, sig.level = alpha)
print(power_model1)

```

```
# Model 2: Moderation with Adaptive Coping
```

```
R2_model2 <- summary(lm(Final_PEB_Scale ~ EGuiQ_11 * Mini_COPE_Adaptive, data =  
FinalDataset))$r.squared
```

```
f2_model2 <- R2_model2 / (1 - R2_model2)
```

```
num_predictors_model2 = 3 # Number of predictors (including interaction)
```

```
sample_size = nrow(FinalDataset)
```

```
alpha = 0.05
```

```
power_model2 <- pwr.f2.test(u = num_predictors_model2, v = sample_size -  
num_predictors_model2 - 1, f2 = f2_model2, sig.level = alpha)
```

```
print(power_model2)
```

```
# Model 3: Moderation with Maladaptive Coping
```

```
R2_model3 <- summary(lm(Final_PEB_Scale ~ EGuiQ_11 * Mini_COPE_Maladaptive, data  
= FinalDataset))$r.squared
```

```
f2_model3 <- R2_model3 / (1 - R2_model3)
```

```
num_predictors_model3 = 3 # Number of predictors (including interaction)
```

```
sample_size = nrow(FinalDataset)
```

```
alpha = 0.05
```

```
power_model3 <- pwr.f2.test(u = num_predictors_model3, v = sample_size -  
num_predictors_model3 - 1, f2 = f2_model3, sig.level = alpha)
```

```
print(power_model3)
```