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Shades of Change: Environmental Art Inspiring Pro-Environmental Intentions Through Emotional Pathways

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Abstract

Climate change and other environmental issues must urgently be addressed (IPCC, 2023). Culture and the arts are reasoned to have the unique capacity to engage their audiences and affect environmental attitudes. However, arts' capacity to elicit pro-environmental intentions may depend on how environmental and climate change content is framed and vary depending on the art style. Specifically, whether environmental issues, or solutions and creative futures are illustrated, may influence the audience's emotional reactions to the artworks, and in turn, their environmental intentions (Sommer & Klöckner, 2019). We conducted a survey experiment ($N = 383$) to test the hypothesis that solution-framed visual environmental art is more effective at eliciting pro-environmental change through the evoked emotions. Art frame (solution vs. problem) and art style (representative vs. semi-abstract) alone did not explain changes in pro-environmental intentions. However, the art frame did induce negative and positive emotions, which mediated the relationship between the art frame and intentions, explaining 28.41% change in intentions. The solution frame increased positive emotions ($B = 1.88, p < .001$) and decreased negative emotions ($B = -1.61, p < .001$), with the opposite being true for the problem frame. Art style minimally moderated the effect of the art frame on emotions. We suggest the trajectory of these effects, and other mechanisms should be investigated in further research, to address which frame may be more conducive to pro-environmental actions.

Keywords: environmental art, pro-environmental intention, emotions, climate change solutions

Shades of Change: Environmental Art Inspiring Pro-Environmental Intentions through Emotional Pathways

In light of the first UK Museum COP in London (Cape Farewell, 2015), discussions around the responsibilities of cultural institutions in addressing the climate crisis have been intensifying. Visual art has a long history of dealing with societal issues and, beyond being aesthetically interesting, it can have many cognitive-affective impacts on its observers (Christensen et al., 2023). Environmental art can be defined as “any artwork that aims to stimulate awareness of people’s relationship with nature, as well as art which prompts discussion and/or action around environmental issues” (Marks et al., 2016). Thus, one definition implies the art having been created with the intent of addressing environmental issues (Keller et al., 2020).

With a capacity to go well beyond an informative function, environmental art has the potential to be longitudinally inspiring (Roosen et al., 2017), elicit a complexity of emotions (Keller et al., 2020), as well as affect observers' pro-environmental intentions and behaviour (Curtis et al., 2014; Geiger, 2020). Not all art that is intended to do so, however, has the potential to achieve positive, transformational cognitive-affective changes in the observer (Roosen et al., 2017). This experimental research aims to investigate how the framing of environmental art affects pro-environmental intentions, thus contributing to the development of evidence-based climate change communication. Thereby this thesis builds upon the exploratory research of Sommer and Klöckner (2019), which investigated the cognitive and emotional effects of four facets of environmental artworks at the ArtCOP21 Event in Paris, and a recent study which suggests a comparison of problem- and solution-framed environmental artworks (Holm, 2023).

Climate Change Solutions in Art

Much environmental art is problem-focused, meaning it depicts the adverse consequences

of climate change, biodiversity loss, pollution and other environmental issues (Sommer & Klöckner, 2019). Artworks depicting and imagining futures of climate justice, abundance of biodiversity, and creative solutions are rare. However, such a “poverty of imagination” may constitute a barrier to achieving better futures for the planet, human and non-human inhabitants alike (Damhof, 2023). For example, innovative technologies and creative solutions are essential for a just and sustainable, transformed society (Ploll et al., 2023). However, these solutions often face low acceptability, partially due to public unfamiliarity, as seen with new energy technologies needed for the energy transition (de Groot et al., 2020; Flynn et al., 2013; Ruddat & Sonnberger, 2019). Art can help familiarise the public with such solutions, instigate imagination, and facilitate positive attitudes (Ploll et al., 2023). This may prepare society for the effective implementation of new technologies, which is necessary as public acceptability is crucial for the energy transition (Pfluger et al., 2017). Further, solution-framed artworks may encourage people to visualise a new speculative “normal”, which may stimulate people to fight for futures that dismantle the status quo and the more unjust realities society is headed towards. As such, artworks may have the potential to mobilise their audiences in one way or another. Indeed, art viewing is tied to emotional experiences. The typical problem-framed environmental art has been shown to elicit negative emotions, lead to less positive evaluations of the art and less intention to act pro-environmentally (Sommer & Klöckner, 2019). Similarly, though loss-framed climate change messaging has been shown to increase advocacy behaviour by inducing fear, negative evaluations of the message undermined the positive effect on advocacy behaviour (Nabi et al., 2018). This suggests that instead of negative reactions, including emotions, increasing positive emotions may be more effective in triggering long-lasting motivational engagement (Carter, 2011). Indeed, solution-focused artwork may have the potential to elicit positive affect, such as

inspiration and hope, with positive cognitive and behavioural consequences (Baden, 2019; Sommer & Klöckner, 2019).

Pro-Environmental Change

Ultimately, environmental art aims to go beyond raising awareness on environmental issues. Mainstream climate change communication may be informative, yet it often fails to engage and motivate audiences meaningfully and longitudinally (Clayton & Manning, 2018; Howell, 2014). Further, the enduring effectiveness of common threat and fear appeals (often present in climate change campaigns) in motivating genuine engagement with environmental issues is not supported (Nabi et al., 2018; O'Neill & Nicholson-Cole, 2009). Environmental art can present imaginative, unexpected and futuristic ideas and stimulate personal reflection in its viewers. By involving the observer affectively and cognitively, the art creates personal meaning and relation, striving to induce long-lasting changes. Such changes include pro-environmental intentions and consequently behaviours (Curtis et al., 2014, Marks et al., 2016). The Appraisal Theory of Emotions (Smith & Lazarus, 1990) can explain why positive emotions would lead to more action-focused, pro-environmental change in intention and behaviour and negative emotions may lead to more emotion-focused coping, resulting in a lack of behaviour change. Research has demonstrated that especially ethically-motivated emotions, such as positive eudaimonic emotions, can explain pro-environmental intentions and behaviour (Keller et al., 2020; Zelenski & Desrochers, 2021). In line with the proposition of the Appraisal Theory of Emotions, this study expects that different art frames will have distinct potentials to produce attitudinal and behavioural intention changes through the affective states they elicit (Sommer & Klöckner, 2019).

Emotions in response to Artworks

According to Keller and colleagues (2020), affective reactions to [environmental] art are key in making the content of such artworks personally meaningful to observers and consequently can drive individual pro-environmental change. For instance, Chirico and colleagues (2023) experimentally demonstrated that experiencing awe-inspiring virtual nature (virtual reality) can influence socially engaging pro-environmental attitudes and behaviours and strongly correlates with positive emotional affect. Further, Nabi and colleagues (2018) demonstrated that the positive emotion hope was a key mediator between gain-framed climate change messaging and climate policy attitudes and advocacy. The function of environmental artworks can be described as follows: “because perceiving art could potentially provide a personal, direct experience with climate change, it may help to bring the issue closer and provide the emotional basis for taking action.” (Roosen et al., 2017, p. 8).

The valence and strength of emotions in response to art depend on a multitude of factors, such as the content (Sommer & Klöckner, 2019), the contextualisation (Keller et al., 2020) and style (Roosen et al., 2017) of the artwork. Sommer and Klöckner (2019) studied observer emotions in response to environmental artworks. Art clustered as “The Challenging Dystopia” (problem frame), elicited the most and strongest negative emotions (guilt, apathy, sadness and disappointment, anger and anxiety), the least positive emotions, and little cognitive activation. Cognitive activation here involves reflection, appraisal and awareness of climate consequences and reflection upon one's role in climate change. They concluded that dystopian, problem-framed artworks will not lead to positive change in the observer, similar to fear campaigns or conventional information campaigns, and opposing previous research on the relationship between anticipated negative emotions, especially guilt, and pro-environmental behaviour. Their

results further support the notion that problem-framed artworks decrease inspiration and increase guilt (Sommer & Klöckner, 2019). On the opposite spectrum, the cluster which the researchers titled “The Awesome Solution” consisted of artworks that are beautiful, colourful and offer solutions to environmental issues. These artworks evoked the strongest positive emotions (happy, hopeful, awe, inspiration, enthusiasm), whilst also eliciting negative emotions such as sadness and disappointment. The “mixed feelings”, or emotional ambivalence, may be explained by the dissonance of being aware of severe problems, which must be addressed (threat), and the simultaneous positive notion of solutions and a good or better future being attainable (Jacobsen, 2023). The solution-framed artworks may particularly decrease feelings of anxiety, because they offer solutions to the discomfort of climate change, thereby reducing dissonance (Fischer et al., 2012; Sommer & Klöckner, 2019). In Sommer and Klöckner’s study (2019), art observers were highly cognitively engaged and the researchers concluded the solutions artworks to be the most powerful in making environmental issues personally meaningful and thus having the potential to trigger (long-term) change, especially due to their emotional effect.

Aesthetic Style

Art can vary in style, such as abstract art and representational art, which can influence the message the art conveys and the aesthetic experience of the observer. Because it can influence the message of the artwork itself, it is relevant to consider when comparing solution- to problem-framed artworks. Though individual differences in aesthetic preferences exist, Christiansen and colleagues (2023) propose that abstract art may be more challenging for people to understand and as such disengage some observers from the issue addressed. On the other hand, Aviv (2014) argues that whilst the affective response to abstract art will be more variable, it also fosters creative thinking. Climate change solutions will include elements unfamiliar to

many observers. One may argue that representing such unfamiliar solutions through abstract as opposed to representational art may increase creative thinking and as such facilitate the imagination and exploration of future possibilities. Further, the margin for interpretation of more abstract art may counter reactance to solutions people do not agree with. This may elicit more positive emotions, thus encouraging more pro-environmental intentions.

Cognitive Dissonance

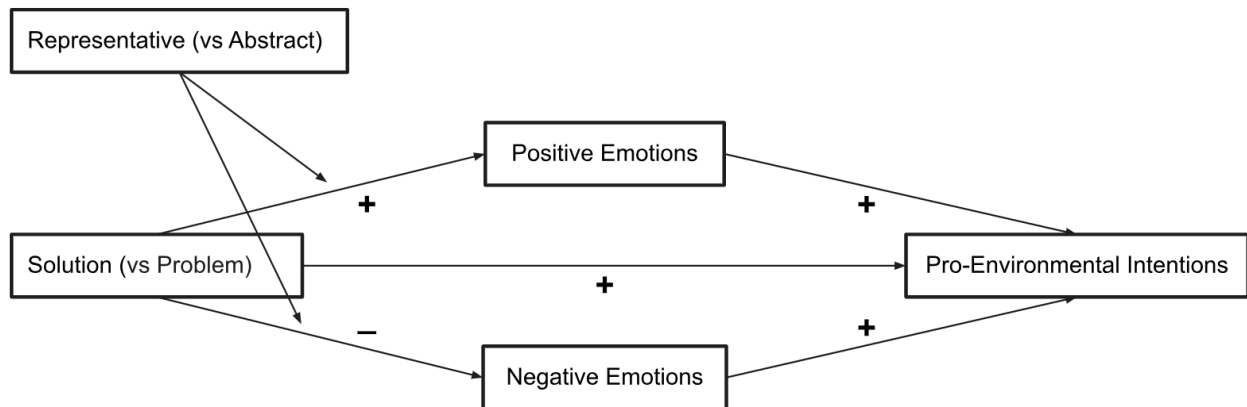
Complicating the pro-environmental outcomes is that the exposure to problem-framed art may elicit spontaneous (overt) pro-environmental intentions to overcome discomfort from cognitive dissonance, which is defined as the discomfort experienced when individuals hold conflicting beliefs, attitudes, or behaviours (Festinger, 1962). This may explain why negative emotions like guilt can induce attitude change or even activate short-term pro-environmental intentions and behaviour (Keller et al., 2020). This effect may also emerge in the current investigation. However, positive emotions may be related to longer-term and stronger changes in intention and behaviour (Sommer and Klöckner, 2019; van Zomeren et al., 2019).

Current Research

The current research will be guided by the following questions: (1) How does the framing of environmental art (solution vs. problem) and its style (representative vs. semi-abstract) influence pro-environmental intentions? (2) And is this relationship mediated by emotions, either positive or negative? Our aim was not to restrict artists' creative freedom, or view art solely through a utilitarian view, but to highlight the potential synergies when psychologists, artists, cultural institutions and climate scientists collaborate (Roosen et al., 2017), benefiting society and the environment (Gorsegner, 2016). The proposed relationships of the core variables can be viewed in Figure 1.

Figure 1

Moderated Mediation Model



Note. + denotes a positive relationship; - denotes a negative relationship; It is acknowledged that the direction of these relationships should be drawn in both directions, as the current experiment cannot establish causality entirely. For simplicity, this was omitted.

Art Frame and Intentions

Hypothesis 1: Solution-framed art will relate to higher pro-environmental intentions than problem-framed art.

Emotions

We expect emotions to be a key mediator in this relationship, with some specific emotions having a particularly pronounced effect. Therefore:

Hypothesis 2: Viewing the environmental artworks will be associated with specific emotional reactions.

H2a: The solution-framed art will relate to low anxiety.

H2b: The problem-framed art will relate to high guilt.

H2c: The problem-framed art will relate to low inspiration.

The individual emotions make up a negative and a positive emotions score. Thus, following hypothesis 2, we expect:

Hypothesis 3: The effect of art frame on pro-environmental intentions will be mediated by emotions.

H3a: Solution-framed art will relate to pro-environmental intentions, mediated by higher positive emotions (than in the problem frame).

H3b: Solution-framed art will relate to pro-environmental intentions, mediated by higher inspiration (than in the problem frame).

H3c: Solution-framed art will relate to pro-environmental intentions, mediated by lower negative emotions (compared to the problem frame).

H3d: Problem-framed art will relate to pro-environmental intentions, mediated by higher guilt (compared to the solution frame).

Lastly, it is expected that the art style (representative versus semi-abstract) will influence the mediation model.

Art Style

Hypothesis 4: The style of the artwork will moderate the expected mediation, specifically, by moderating the relationship between art frame and emotion. No direction is hypothesised, making this hypothesis exploratory.

Method

Sample

Based on an a priori G*power analysis, the required sample size for the current study was 244 (Linear Multiple Regression: Fixed Model, power = .80, expected effect size of $f^2 = .05$ at $\alpha = .05$). The effect size was chosen as it indicates a moderate effect (Nabi et al., 2018). To account

for possible exclusions, we decided to recruit approximately 266 participants. In total, 518 responses were collected, of which 135 (26%) were excluded from the main analysis. Please see Appendix A, Table 1 for details on the reasons and number of cases excluded. Importantly, 100 responses (19%) were excluded because a technical error occurred, which allowed participants to participate multiple times. The first response of each repeat participant was saved, and subsequent ones were deleted. The variables of interest had low levels of missing values. No outliers were excluded, which leaves a final sample of 383 participants. Thus, the desired sample size was met. Of the final sample, 75% ($n = 286$) of participants identified as women, 23% ($n = 86$) as men, 2% ($n = 7$) as non-binary/third-gender and three respondents did not indicate their gender identity. The participants' ages were assessed in intervals ranging from 16-24 years (88%) to 65 years or older (1%), of which most participants were younger than 25 years old, indicating a strong right skew of the data. Moreover, 85% ($n = 326$) of participants were first-year psychology students at the University of Groningen. Most participants (75%) held a high school diploma as their highest educational achievement. SONA (first-year psychology) participants had the requirements of good English proficiency and were compensated with 0.4 SONA credits. All participants were required to be a minimum of 16 years old.

Adverse Events. During data collection, an error occurred which led to only 39% ($n = 151$) of respondents encountering the quality check, at the end of the survey. This check asked whether participants had responded truthfully and felt their data should be included in the research. Because this was a substantial number of participants, it was checked whether those who did and those who did not respond (61%, $n = 234$) to this item differed substantially in mean scores of the core dependent variable. As they did not, it was assumed that their responses were valid and were included in the main analysis.

Materials

Image Material: The “Artworks”

Artificial Intelligence (AI) generated images have the capacity to elicit similar, if not the same reactions as human created art (Demmer et al., 2023). Two “artworks”, one rural and one urban scenery motif, were generated for each art frame condition (solution versus problem) using image generating AI (Runway AI, 2024). Prompts were formulated based on climate change related predictions for the Netherlands, to increase their proximity to the participants (IPCC, 2023; OECD, 2012; Scheeper et al., 2022). For an overview of the artworks, the prompts used to generate them, and their accompanying contextualisations view Appendix A, Table 2. A pilot selection of eight images for each condition was pre-tested on snowball sampled voluntary participants ($N = 18$), which resulted in the final prompts being phrased. To exemplify, the final prompt for the solutions-urban image was: “a cityscape of residential area in a Dutch city, traditional and modern houses with an environmentally conscious design, people enjoying leisure time in groups in gardens, lush greenery, abundant trees, vertical urban vegetable farming, technology intersecting with nature in the year 2030, solar panels on roofs, no cars, walk-friendly city, cycling path between houses, solar punk, community, electric drones, moss graffiti, air filter machines, community square in the style of cinematic, cinematography, shallow depth of field, subject in focus, beautiful, filmic”. A set of six satisfying images was selected and edited to look more artistic and less AI generated, using the Fotor AI image editing tool (Fotor, n.d). For the representative condition, the filter “Impressionism” was applied and for the semi-abstract condition a combination of “Structuralism” and “Pavement”, creating the illusion of an impasto oil painting, as well as colour settings were used. A selection of representative images were pre-tested again, based on which a final selection of four images was made. Most (84%) of the

second pre-test respondents indicated they had some affective reaction to all of the artworks as opposed to feeling neutral, which indicated that they should be sufficiently effective. Thus, a total of eight images (2x solution frame/ representative, 2x solution frame/ abstract, 2x problem frame/ representative, 2x problem frame/ abstract) were presented in the study.

Effective contextualising facilitates the cognitive and emotive experience towards art (Keller et al., 2020; Lin & Yao, 2018; Millis, 2001; Swami, 2013). Thus, the artworks were presented with a short contextualisation describing them as being from an environmental art exhibition in Amsterdam, with the solution-framed artworks being intended to depict potential futures and the problem-framed artworks depicting “climate change consequences that are becoming more and more common”. They were further contextualised with specific titles, such as for the rural problem frame artwork: “This artwork is titled Drought. The artist envisions what consequences of climate change may look like in the Netherlands”. The titles and their match with the artworks were tested in the first pre-test.

To further test the quality of the AI generated artworks, their credibility was measured using two items. First it was asked: “Do you believe what you saw were credible artworks?”, and second: “Do you consider what you saw in the artworks to be or could it become realistic?”, each with the response options *yes*, *no*, and *unsure*. Descriptive statistics reveal that the majority (85%) believed the artworks were credible. Thus, the manipulation was deemed successful. Participants who did not believe the artworks were credible were not excluded from data analysis, as a negative response did not warrant this.

Emotions

Positive and negative emotions were measured separately by asking “To what extent do the artworks bring up each of these feelings within you?”. The positive emotions which

respondents rated were hope, happiness, surprise, a sense of awe and inspiration/enthusiasm. The negative emotions rated were anxiety, sadness/disappointment (that nothing is happening to prevent climate change), guilt, apathy/a sense of helplessness, anger and shame, as adapted from Keller et al., (2020) and Sommer & Klöckner (2019). Responses were measured using a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). The individual emotions scores were added and averaged to create the positive emotions score ($M = 3.69$, $SD = 1.31$, $\alpha = .81$) and negative emotions score ($M = 3.93$, $SD = 1.48$, $\alpha = .91$). See Appendix A, Table 3 for the measures of the key variables.

Manipulation Check and Distraction Item

As a manipulation check of the representative versus semi-abstract art style of the images, respondents were asked: “How would you categorise the artistic style (not the content) of the artworks you saw, from representative (realistic) to abstract?”. Response was given in the form of a slider with 10 scale points (0 = *representative*, 10 = *abstract*). To test whether the abstraction manipulation of the “artworks” was successful, a one-way ANOVA was run with the condition as the factor and the manipulation check variable for abstraction as the outcome variable. This yielded a significant mean difference between the solution/abstract (C2) and the solution/representative (C1) condition ($MD = 2.58$, $p < .001$), as well as for the problem/abstract (C4) and the problem/representative (C3) condition ($MD = 1.90$, $p < .001$). It must be noted that the mean for abstraction ($M = 4.8$) is relatively low, thus when *abstract* is used to refer to the artworks, we indeed mean *semi-abstract*. The experimental manipulation was deemed successful and the main analyses were conducted.

To distract from the purpose of the study after assessing the emotions, a question concerning the responsibilities of the cultural sector was asked, in which participants ranked

suggestions such as “Educate visitors and raise and discuss social issues”. The responsibility statements were adapted from Holm (2023).

Pro-Environmental Intentions

To measure the dependent variable pro-environmental intentions, a consolidation of items used in the same context by previous researchers was adapted (pro-environmental intentions: Keller et al., 2020; Chu & Yang 2019, mitigation intentions: Jones et al., 2017, advocacy behaviour: Nabi et al., 2018, mitigation behaviour: Doran et al., 2015) (see Appendix A, Table 3). The scale contains seven items, to which agreement was rated on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). Each item addressed a different pro-environmental intention, ranging from vague: “I plan to (continue to) deliberately act pro environmentally in my everyday life” (Keller et al., 2020) to more concrete intentions: “I plan to sign (more) petitions to urge politicians to take mitigation actions” (based on Nabi et al., 2018). Of the total score, higher values indicate stronger pro-environmental intentions. The scale resulted in a Cronbach’s alpha of $\alpha = .87$, indicating good internal consistency.

Another distraction item entailed rating the acceptability of “out of the box” climate change measures, based on Holm (2023). Acceptability of measures such as: “To give nature the status of a legal entity, which will guarantee its right to exist, prosperity and development” was rated on a 7-point Likert scale (1 = *not at all*, 7 = *absolutely*).

Exploratory Measures

Beyond the main variables, the participants' perception of the reality of climate change, their psychological distance to climate change, their most salient emotion in response to the artworks (qualitative), their anticipated positive and negative emotions, and finally, their art expertise, was assessed. For more information on these variables, view Appendix A, Table 4.

Procedure and Design

All participants were guided to the survey on Qualtrics through a link. Data collection took place from the 2nd of February 2024 and was closed on the 1st of March 2024, once the desired sample size was met. The time range for survey completion was large, at an average of 19 minutes ($SD = 99$ minutes). The faculty ethics committee gave fast-tracked ethical approval, meaning this study was exempt from the ethical review due to the low risks of participation.

First, participants were provided with minimally deceiving research information, which informed them that “The purpose of this research is to gain more insight into which responsibilities people ascribe to the cultural sector, as well as how environmental art can benefit sustainability.” and requested informed consent. Then, participants indicated their perception and concern about climate change. Following, they were assigned to one of the four conditions of the 2 (solution vs. problem frame) x 2 (representational vs. semi-abstract style) experimental design, in which they were requested to view two artworks like they would in a museum or gallery. Subsequently, they rated to what extent they experienced certain positive and negative emotions and described their most strongly felt emotion. As a distraction from the purpose of the study, they rated certain responsibilities of the cultural sector. A manipulation check included measuring the perceived abstract versus representativeness of the artworks. Then, pro-environmental intentions and exploratory variables (psychological distance, uncertainty, anticipated emotions, art expertise) were measured. Lastly, socio-demographic information (age, gender, education) was requested. The study ended with a quality check, asking whether the participants had answered the survey truthfully and felt the researchers should include their data. After completion, participants were thanked for their participation and debriefed.

Data Analysis

Using SPSS, first, frequencies and descriptives of the socio-demographic variables were computed. Further, assumptions for each model were checked. Then two MANOVAs were conducted to investigate the effect of the experimental conditions (solution versus problem frame/ abstract versus representational style) on the individual emotions. Thereafter, Hayes' PROCESS mediation analysis (Model 4) (Hayes, 2022) was used to assess the effect of art frame (independent variable) on pro-environmental intentions (dependent variable) via the emotions scores (Mediation 1) and the individual emotions guilt and inspiration (Mediation 2) (mediator). Lastly, a Hayes PROCESS moderated mediation analysis (Model 7) was conducted, in which Mediation 1 is expanded with art style as the moderator. All analyses were conducted using the statistical software package IBM SPSS Statistics (Version 28).

Results

Preliminary Findings

For diagnostic reasons, the data was examined before hypothesis testing.

Random Assignment

Independent group t-tests revealed that group differences across gender and age were not significant. However, group differences were significant on education, with education level being significantly higher for condition 3 compared to condition 1. Because education is not relevant to any hypotheses, this is not considered important. For the condition distributions on the descriptive statistics please refer to Appendix A, Table 5.

Descriptive Statistics

For the descriptive statistics of the key variables, including their central tendencies, variability and correlations please refer to Table 6. Table 7 further presents the descriptive statistics of the key variables pro-environmental intentions, positive emotions and negative

emotions across the conditions, which are illustrated in Figure 2. The data shows that the variable mean of pro-environmental intention (PEI) and the mean for the negative emotion score were skewed left (skewness and kurtosis). Based on the Shapiro-Wilk test ($<.001$) and the QQ-Plots, there was a violation of normality in the residuals for all variables. Attempts were made to improve normality through log, square root, and inverse score transformations, which were unsuccessful. Therefore, the original variables were used in the analysis, with a cautionary note on interpreting the results. All other relevant assumptions for the statistical analyses were met.

Table 6*Descriptive Statistics and Correlations for Study Variables*

Variable	<i>N</i>	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. PEI Score	379	4.64	1.20					
2. PE Score	380	3.69	1.31	.125*				
3. NE Score	379	3.93	1.48	.416**	-.395**			
4. Inspiration	382	3.82	1.78	.126*	.865**	-.364**		
5. Guilt	379	3.71	1.72	.368**	-.199**	.828**	-.179**	
6. Anxiety	382	3.95	1.80	.333**	-.387**	.854**	-.356**	.614**

Note. *Correlation is significant at the .05 level (2-tailed), ** Correlation significant at .001 level (2-tailed), PEI Score = pro-environmental intentions score, PE Score = positive emotions score, NE Score = negative emotions score.

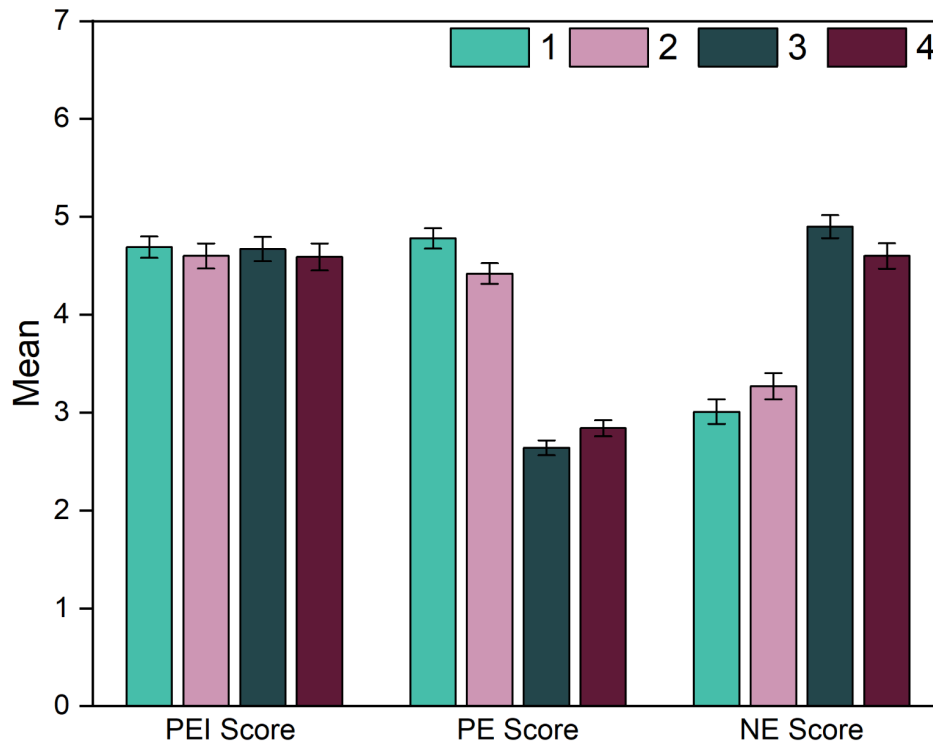
Table 7*Descriptive Statistics for Key Variables by Conditions*

Variable		Condition 1 Solution/Repr esentative	Condition 2 Solution/Abst ract	Condition 3 Problem/Repr esentative	Condition 4 Problem/Abst ract	Total
PEI Score	<i>N</i>	100	97	94	88	379
	<i>M</i>	4.69	4.60	4.67	4.59	4.64
	<i>SD</i>	1.08	1.25	1.20	1.29	1.20
PE Score	<i>N</i>	99	96	96	89	380
	<i>M</i>	4.78	4.42	2.64	2.84	3.69
	<i>SD</i>	1.03	1.02	0.74	0.77	1.31
NE Score	<i>N</i>	98	95	96	90	379
	<i>M</i>	3.01	3.27	4.90	4.60	3.93
	<i>SD</i>	1.25	1.31	1.15	1.23	1.48

Note. PEI Score = pro-environmental intention score, PE Score = positive emotions score, NE Score = negative emotions score.

Figure 2

Means and Standard Errors of the Key Variables Across Conditions



Note. PEI Score = pro-environmental intention score, PE Score = positive emotions score, NE Score = negative emotions score.

Hypothesis Testing

Main Effect on Pro-Environmental Intention

To test the hypothesis that solution-framed art relates to higher pro-environmental intentions than problem-framed art (H1) a one-way ANOVA, with condition as the between factor with four levels, was conducted. Normality was slightly violated, however, due to the large sample size and the nature of the variables the test was still carried out, with no other assumptions being violated. It revealed no statistically significant difference in pro-environmental intention between at least two conditions ($F(3, 375) = 0.159, p = .924$). In

other words, the experimental condition alone did not explain change in pro-environmental intention, meaning H1 was not supported.

Emotional Reactions to the Artworks

To test the hypothesis that viewing environmental artworks is associated with emotional reactions (H2), two MANOVAs were executed. The first MANOVA included all individual positive emotions (happiness, hope, awe, surprise, inspiration), and the second included all individual negative emotions (guilt, sadness, apathy, anger, anxiety, shame). Wilk's Lambda was interpreted as recommended by Field (2009).

Positive Emotions. In the first MANOVA, the multivariate tests revealed a significant large effect ($\Lambda = .328$), indicating an overall influence of experimental condition on the experienced positive emotions ($F(15, 1027) = 34.08, p < .001, \eta^2p = .310$). Based on the univariate test, more variance for happiness, hope and inspiration is explained than for awe and surprise (see Tabel 8). It was hypothesised that the problem-framed art would relate to low inspiration (compared to the solution frame) (H2c). The Games-Howell post hoc test (selected based on unequal group sizes and violation of normality (Field, 2009)) revealed significantly lower inspiration for the problem-framed conditions (representative $M = 2.41$, abstract $M = 2.89$) than for the solution-framed conditions (representative $M = 5.08$, abstract $M = 4.8$) ($p < .001$), supporting hypothesis H2c (view means and significant mean differences in Figure 3, and mean differences in Appendix A, Table 9).

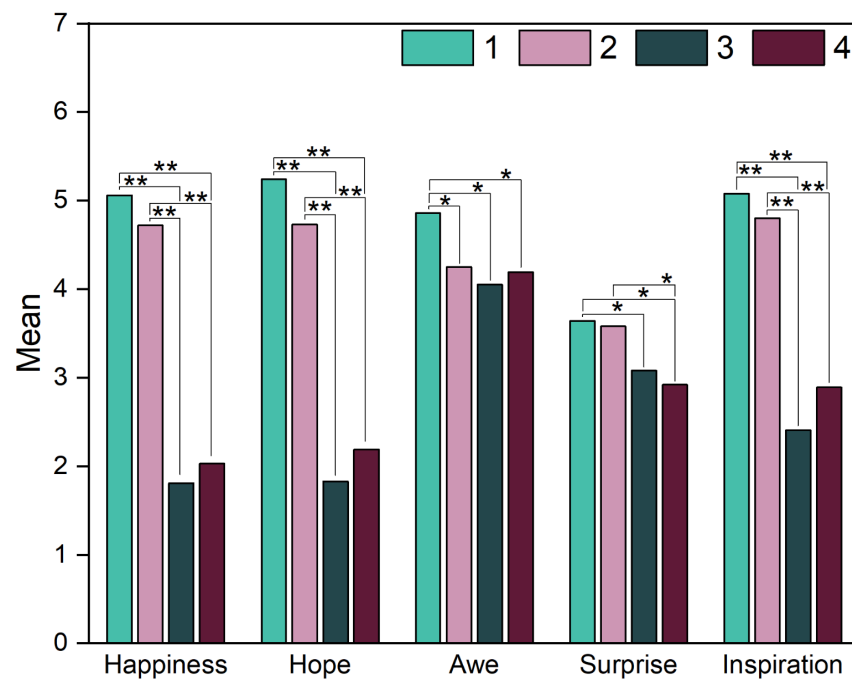
Table 8

Univariate Test Results for Positive Emotions

Dependent Variable	<i>df</i>	<i>df error</i>	Mean Square	<i>F</i>	<i>p</i>	η^2p
Happiness	3	376	282.42	189.44	<.001	.602
Hope	3	376	288.08	182.29	<.001	.593
Awe	3	376	12.44	5.77	<.001	.044
Surprise	3	376	12.03	5.83	<.001	.044
Inspiration	3	376	173.07	95.05	<.001	.431

Figure 3

Positive Emotions Means and Mean Differences



Note. Legend denoting condition with 1 = solution/representative, 2 = solution/abstract, 3 = problem/representative, 4 = problem/abstract. Mean differences: * = significant at <.05, ** = significant <.001. Based on Games-Howell Multiple Comparisons.

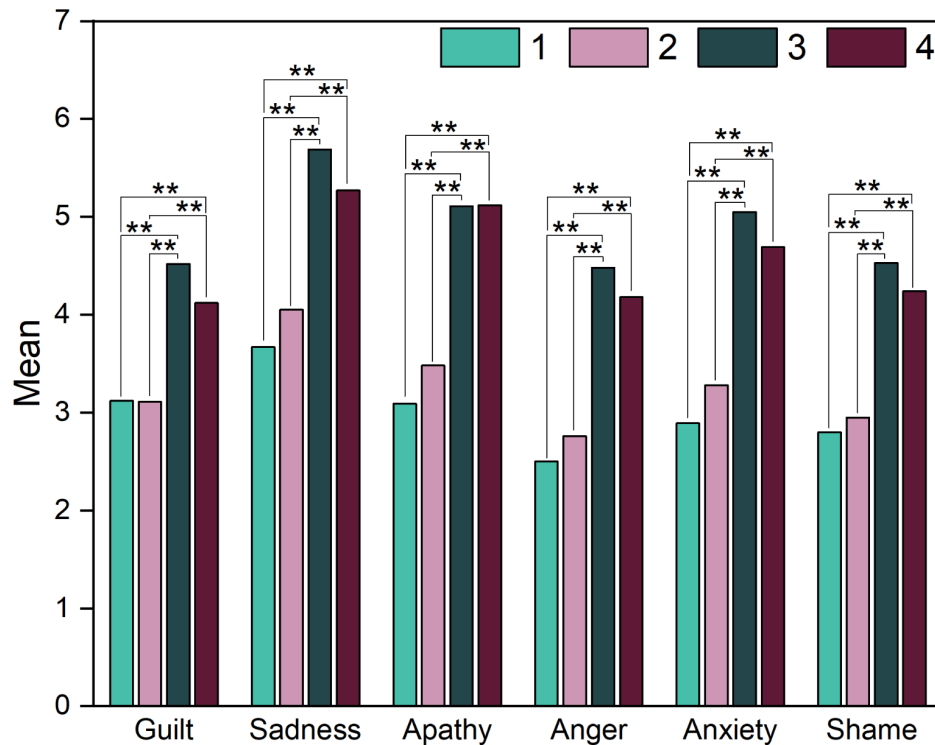
Negative Emotions. For the negative emotions, the MANOVA revealed a significant large effect ($\Lambda = .637$), indicating an overall large influence of experimental condition on the experienced negative emotions ($F(18, 1047) = 10.07, p < .001, \eta^2p = .140$). Based on the subsequent univariate tests, more variance for apathy, anxiety, anger, and sadness is explained than for shame and guilt (view Table 10). It was hypothesised that the solution-framed art would relate to low anxiety, compared to the problem frame (H2a). Indeed, the effect on anxiety was the second strongest, supporting H2a. The Games-Howell post hoc test revealed significantly lower anxiety for the solution-framed conditions (representative $M = 2.29$, abstract $M = 3.28$) compared to the problem-framed conditions (representative $M = 5.05$, abstract $M = 4.69$) ($p < .001$), supporting the hypothesis (view means and significant mean differences in Figure 4, and mean differences in Appendix A, Table 11).

Table 10*Univariate Test Results for Negative Emotions*

Dependent Variable	<i>df</i>	<i>df_{error}</i>	Mean Square	<i>F</i>	<i>p</i>	η^2p
Guilt	3	375	48.99	19.00	<.001	.132
Sadness	3	375	88.30	36.21	<.001	.225
Apathy	3	375	108.59	45.18	<.001	.265
Anger	3	375	94.41	38.69	<.001	.236
Anxiety	3	375	106.12	43.77	<.001	.259
Shame	3	375	74.78	29.92	<.001	.193

Figure 4

Negative Emotions Means and Mean Differences



Note. Legend denoting condition with 1 = solution/representative, 2 = solution/abstract, 3 = problem/representative, 4 = problem/abstract. Mean differences: * = significant at $<.05$, ** = significant $<.001$. Based on Games-Howell Multiple Comparisons.

Further, it was hypothesised that the problem-framed art would relate to high guilt, compared to the solution frame (H2b). The Games-Howell post hoc test revealed significantly higher guilt for the problem-framed conditions compared to the solution-framed conditions ($p <.001$), supporting hypothesis H2b. However, the variance in guilt is less explained by experimental conditions than for all other negative emotions and the mean difference scores between solution- and problem-framed conditions for guilt are small (largest $MD = -1.42$). The

overarching hypothesis that viewing environmental artworks is associated with emotional reactions (H2) is supported.

The Mediating Role of Emotions in the Relationship between Art Frame and Pro-Environmental Intention

It was hypothesised that the effect of art frame on pro-environmental intentions would be mediated by emotions (H3). Two separate PROCESS parallel mediation analyses (Model 4) were run, the first with the mediators positive and negative emotions score and the second with the individual emotions inspiration and guilt. They could not be analysed simultaneously, as the individual emotions influence the emotions scores, by being a contributing variable to the score.

The Mediating Role of Positive and Negative Emotions. It was hypothesised that the solution-framed art would relate to pro-environmental intentions, mediated by higher positive emotions (H3a) and lower negative emotions (H3c), compared to the problem frame. The results of the first mediation revealed a significant positive specific indirect effect of the solution frame on pro-environmental intentions via positive emotions (Path a*b), in line with the hypothesised effect, as well as the results from H2. In other words, people in the solution frame experienced more positive emotions, which was associated with stronger pro-environmental intentions. Further, it revealed a significant negative specific indirect effect of the solution frame on pro-environmental intention via negative emotions (Path a*b), in line with the hypothesised negative effect. In other words, people in the solution frame experienced fewer negative emotions, which was associated with stronger pro-environmental intentions (this is in line with H3c). Furthermore, the direct effect of the art frame on pro-environmental intentions in the presence of both mediators (Path c') was found significant, thus a partial mediation was

discovered. The total model effect is not significant, meaning when considering both mediators together, their combined effect does not explain the observed relationship between the independent and dependent variables, which may be due to complex interactions of the mediators. The art frame and the mediators positive emotions score and negative emotions score explain 28.41% of the change in pro-environmental intentions. H3a and H3c are supported. For the mediation summary view Table 12 and for the mediation model view Figure 5.

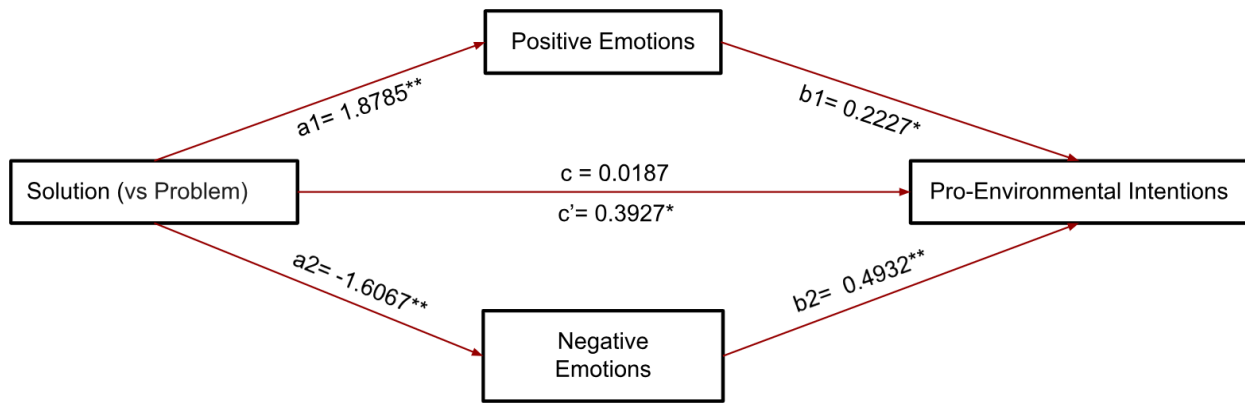
Table 12*Mediation Results with Emotions Scores as the Mediators*

Effect	<i>b</i>	<i>se</i>	<i>R</i> ²	<i>t</i>	<i>p</i>	95% <i>CI</i> [LL, UL]
Pro-Environmental Intentions						
a1: Frame → PE Score	1.88	0.09	.52	19.95	<.001	[1.69, 2.06]
a2: Frame → NE Score	-1.61	0.13	.30	-12.49	<.001	[-1.86, -1.35]
b1: PE Score → PEI	0.22	0.06	.28	3.81	.002	[0.11, 0.34]
b2: NE Score → PEI	0.49	0.04		11.51	<.001	[0.41, 0.58]
c (total): Frame → PEI	0.02	0.13	.0001	0.15	.8814	[-0.23, 0.26]
c' (direct): Frame → PEI	0.39	0.17		2.35	.0195	[0.06, 0.72]
ab1 (indirect) Frame → PE Score → PEI	-0.42	0.12				[0.19, 0.66]
ab2 (indirect) Frame → NE Score → PEI	-0.79	0.09				[-0.94, -1.48]

Note. PEI = pro-environmental intention score, PE Score = positive emotion score, NE Score = negative emotion score, Frame = art frame (solution versus problem).

Figure 5

Mediation Model with Emotion Scores

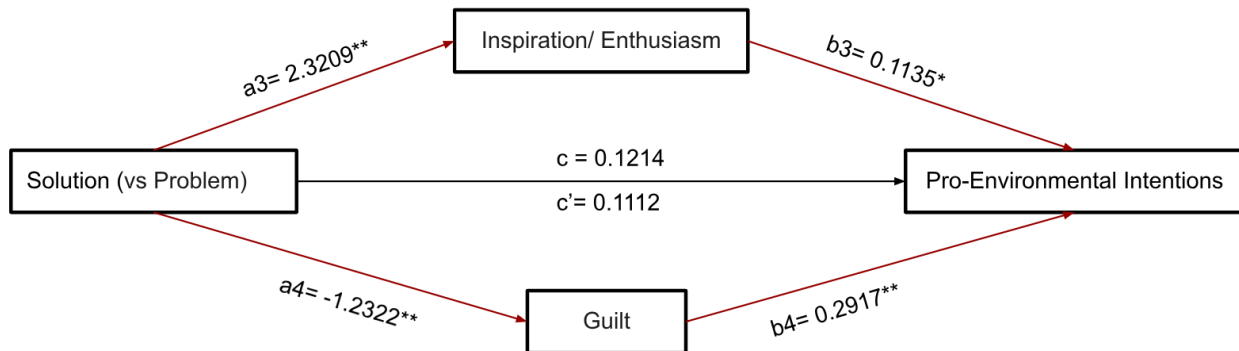


Note. Significant paths are highlighted red, * = significant at $<.05$, ** = significant at $<.001$.

The Mediating Role of Inspiration and Guilt. We tested the mediating role of inspiration and guilt in the effect of condition on PEI by conducting a similar parallel mediation to the previously described one. It was hypothesised that the solution-framed art would relate to PEI mediated by higher inspiration (H3b), compared to the problem frame, and that the problem-framed art would relate to PEI, mediated by higher guilt (H3d), compared to the solution frame. For the mediation model view Figure 6 and for the mediation summary view Table 13. The results revealed a significant positive specific indirect effect of the solution frame on pro-environmental intention via inspiration/enthusiasm (Path $a*b$), in line with the hypothesised positive effect. In other words, people in the solution frame condition experienced more inspiration/enthusiasm, which was associated with stronger pro-environmental intentions. Further, it revealed a significant negative specific indirect effect of the solution frame on pro-environmental intentions via guilt (Path $a*b$), in line with the hypothesised negative effect. In other words, people in the solution frame experienced less guilt, which means that people in

Figure 6

Mediation Model with Individual Emotions



Note. Significant paths are highlighted red, * = significant at $<.05$, ** = significant at $<.001$.

Table 13

Mediation Results with Individual Emotions as the Mediators

Effect	<i>b</i>	se	<i>R</i> ²	<i>t</i>	<i>p</i>	95% CI [LL, UL]
Pro-Environmental Intention						
a3: Frame → Inspiration	2.32	0.14	.42	16.56	<.001	[2.05, 2.60]
a4: Frame → Guilt	-1.23	0.12	.13	-7.42	<.001	[-1.56, -0.91]
b3: Inspiration → PEI	0.11	0.04		2.69	.0074	[0.03, 0.20]
b4: Guilt → PEI	0.29	0.04	.17	8.20	<.001	[0.22, 0.36]
c (total): Frame → PEI	0.15	0.13	.00	0.12	.9034	[-0.23, 0.26]
c' (direct): Frame → PEI	0.11	0.16		0.70	.4824	[-0.20, 0.42]
ab3 (indirect) Frame → Inspiration → PEI	0.26	0.11				[0.06, 0.49]
ab4 (indirect) Frame → Guilt → PEI	-0.36	0.07				[-0.49, -0.23]

Note. PEI = pro-environmental intention score, PE Score = positive emotion score, NE Score =

negative emotion score, Frame = art frame (solution versus problem).

the problem frame experienced more guilt, which in turn was associated with stronger pro-environmental intentions. Indeed, art frame explained 13% of change in guilt, which is much lower than the 42% of change explained in inspiration. However, comparing the specific indirect effect of guilt and inspiration, that of guilt is stronger. Furthermore, the direct effect of the art frame on the pro-environmental intentions in the presence of both mediators was not significant (Path c'), which suggests that the effects of the art frame on pro-environmental intentions can only be explained by the mediators. The non-significance of the total effect reinforces the notion that the influence of the independent variable on the dependent variable is entirely explained by the mediators. The art frame and the mediators inspiration and guilt explained 17% of change in pro-environmental intention. H3b and H3d are supported.

Overall, the two mediation models support the rejection of hypothesis 1 and support hypothesis 3, as well as its sub-hypotheses. In other words, the effect of art frame on pro-environmental intentions is mediated by emotions (H3), with positive emotions being more strongly affected by the art frame than negative emotions.

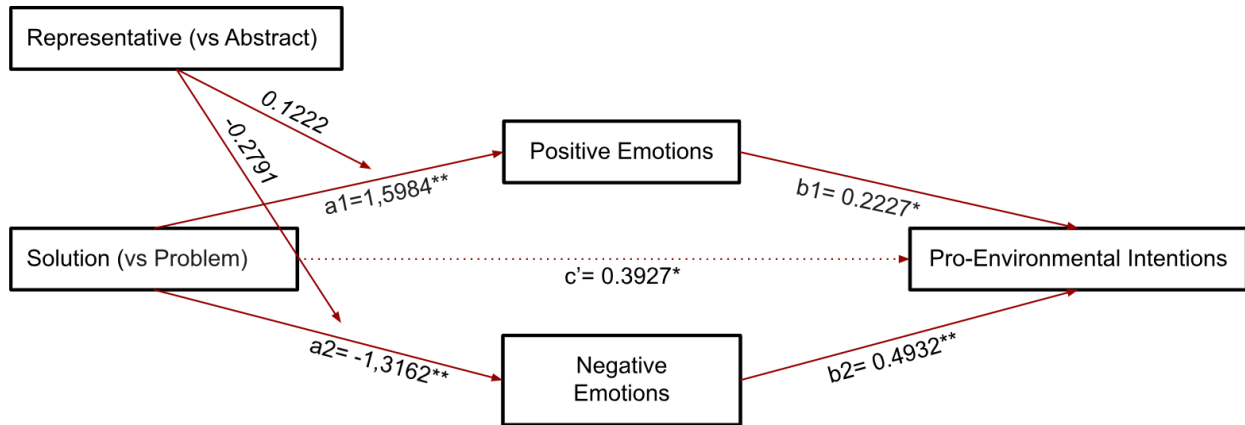
Exploratory: The Moderating effect of Art Style

To investigate whether the style of the artwork moderated the supported mediation (H3), specifically by moderating the relationship between art frame and emotion (H4), (no direction was hypothesised), Hayes PROCESS model 7 was used. An index for moderated mediation was used to assess the significance of the moderated mediation, specifically the variation in indirect effects based on art style (representative versus semi-abstract) (Hayes, 2022). The presence of significant effects was confirmed when zero was not included in the confidence intervals. The

relationships between art frame (IV) and pro-environmental intentions (DV), positive emotions score (M1), negative emotions score (M2) and art style (W) can be viewed in Figure 7.

Figure 7

Moderated Mediation Model



Note. Significant paths are highlighted red, * = significant at $<.05$, ** = significant at $<.001$.

There was a significant direct effect of the art frame on pro-environmental intentions ($B = 0.40$, $t = 2.35$, $p = .02$, LLCI = 0.06, ULCI = 0.72). Art style significantly moderated the mediation for positive emotions (Index = 0.12, $Bse = 0.06$, BootLLCI = 0.03, BootULCI = 0.25) and for negative emotions (Index = -0.28, $Bse = 0.13$, BootLLCI = -0.53, BootULCI = -0.32). The simple slopes indicate that the representative (compared to the abstract) style significantly increased the positive effect of solution frame on positive emotions and decreased the negative relationship between solution frame and negative emotions. For the indirect effects of the art frames on the mediation view Table 14 and for the illustrated interactions of art frame and art style for the emotions scores view Figures 8 and 9.

Table 14

Indirect Effects of Art Style

Representative (vs. Abstract)	<i>Effect</i>	<i>BootSE</i>	<i>BootLLCI</i>	<i>BootULCI</i>
Art Frame → Positive Emotions → PEI				
0	.36	0.10	0.15	0.56
1	.48	0.14	0.20	0.76
Art Frame → Negative Emotions → PEI				
0	-.65	0.11	-0.86	-0.44
1	-.93	0.11	-1.15	-0.71

Note. PEI = pro-environmental intention score, Art Frame = solution versus problem frame.

Figure 8

Interaction of Art Frame and Art Style for Positive Emotions Score

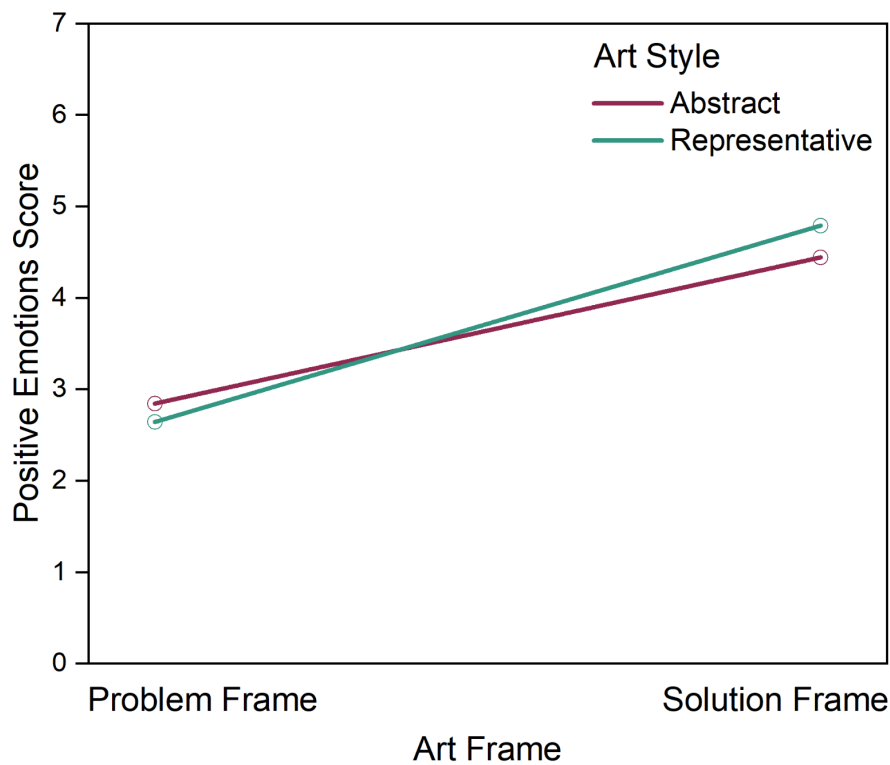
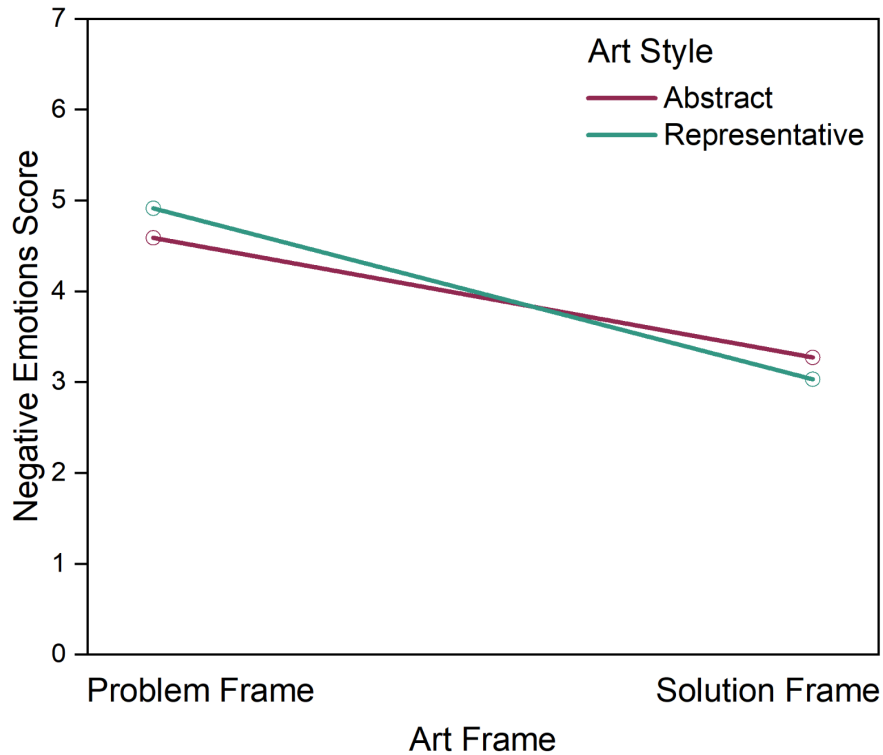


Figure 9

Interaction of Art Frame and Art Style for Negative Emotions Scores



The effect sizes of the significant interactions are small. Indeed, 1% of the variance in positive emotion is explained by the interaction between art frame and art style ($R^2 = .011$, $F(1, 369) = 8.65$, $p = .004$), and less than 1% for negative emotions ($R^2 = .009$, $F(1, 369) = 4.88$, $p = .028$). In other words, though the moderated mediation for the individual pathways was significant, this moderation effect was small. Representative art style increased the positive effect on positive emotions and the negative effect on negative emotions (interaction). Despite the significant moderation, mediation and interaction effects, the direct effect of art frame on pro-environmental intentions was non-significant (supporting H1 and H3), which suggests that this relationship is better explained by the emotions the art frame elicits and marginally, the artistic style used in the artworks, which supports hypothesis 4.

Discussion

This study investigated the effects of environmental artworks on individuals' intentions to act pro-environmentally. The artworks differed in content: the solution frame envisioned climate-adapted futures, while the problem frame illustrated devastating consequences of climate change, such as floods and droughts in the Netherlands. They also varied in art style, with a representative condition similar to impressionist paintings and a semi-abstract condition similar to impasto oil paintings. As such, the objective of the research was to answer the following questions: (1) How does the framing of environmental art (solution vs. problem) and its art style (representative vs. semi-abstract) influence pro-environmental intentions? (2) And is this relationship mediated by emotions, either positive or negative?

The overall hypothesis (H1), that solution-framed art would relate to higher pro-environmental intentions than problem-framed art was not supported. However, viewing the artworks did influence the individual emotions, supporting H2. The solution frame was associated with low anxiety, and the problem frame with low inspiration, supporting H2a and H2c, respectively. Although guilt was higher in the problem frame than in the solution frame, supporting H2b, it was the least experienced negative emotion.

The mediation models revealed that positive and negative emotions, inspiration and guilt, mediated the relationship between the art frame and pro-environmental intentions, supporting H3. Indeed, the solution frame was related to PEI, through higher positive emotions and inspiration and lower negative emotions, supporting H3a, H3b and H3c. Higher guilt in the problem-framed condition mediated its relationship with PEI, supporting H3d.

Finally, the art style moderated the mediation for positive and negative emotions, supporting H4. Though the moderation effects were small, solution-framed art related to more

positive emotions when the art style was representative compared to semi-abstract. For the problem frame, negative emotions were lower when the art was more abstract, demonstrating an interaction effect of art style and art frame. The interpretation of these results will be discussed.

Interpretation of Results

Positive Emotions for Positive Change

Based on the experimental results, we can deduce the following, albeit with some caution due to violated assumptions. The experimental conditions (solution vs. problem frame, representative vs. semi-abstract style) alone are not sufficient in explaining changes in pro-environmental intentions. However, when investigating the positive and negative emotions the viewer experienced, this narrative changes. We then observe the different effects the solution frame has, compared to the problem frame. Indeed, single emotions like inspiration and guilt can explain the relationship between art frame and pro-environmental intention.

These findings align with the Appraisal Theory of Emotions and the research by Sommer and Klöckner (2019). They support previous propositions that environmental art can elicit a complexity of emotions (Keller et al., 2020) and influence pro-environmental intentions (Curtis et al., 2014; Geiger, 2020), however only when considering the emotions evoked by the artworks. This somewhat contradicts Hornsey and Fielding's (2016) research, which found that optimistic climate messaging reduces mitigation motivation, by decreasing distress and risk perception, though we can only use intention as a proxy for motivations.

Our solution frame has the potential to increase positive emotions like inspiration and simultaneously decrease negative emotions such as anxiety, thereby increasing the intention to act pro-environmentally. Conversely, our problem frame tends to decrease positive emotions and increase negative emotions, such as sadness, apathy and anxiety, while also boosting

pro-environmental intentions. Although the results do not show which frame is more effective in increasing pro-environmental intention, there is weak evidence suggesting that negative emotions have a stronger positive effect on pro-environmental intention. Nonetheless, the path of art frame through positive emotions appears to increase pro-environmental intention more than through negative emotions.

However, as previously discussed, problem-framed art may only have short-term benefits for pro-environmental attitudes, consistent with cognitive dissonance theory. Notably, guilt, often discussed as a key negative emotion driving pro-environmental behaviour (Keller et al., 2020), was minimally influenced by the experimental conditions. Nonetheless, guilt was also present in the solution frame, indicating that any art addressing climate change, can invoke guilt.

[Eco]-anxiety is widely discussed in the climate action discourse (Stanley et al., 2021). While eco-anger is associated with taking action, high levels of anxiety appear to hinder engagement (Stanley et al., 2021). The effect of the affective dimension of eco-anxiety on pro-environmental behaviour appears to be bell-shaped, however, Hogg et al. (2024) caution against the attempt to elicit “productive” anxiety levels, due to their longitudinal effects. Thus, the problem frame may be dysfunctional for engagement. On the other hand, it does increase anger, which is an activating emotion in terms of climate change action. How these effects interact is unclear based on the current research, but it should be noted that manipulating anxiety may be ethically concerning.

Hope also plays a significant role in environmental engagement. Viewers of solution-framed art felt high levels of hope, which could either increase or decrease their pro-environmental intentions, depending on other emotions and motivations involved, an area that remains unexplored by this study. Some suggest hope is crucial for motivating

pro-environmental actions (Nabi et al., 2018), while others suggest it buffers against distress and fear, thus failing to motivate action (Hornsey & Fielding, 2016).

Consistent with Sommer and Klöckner's (2019) findings, the solution-framed artworks in our study evoked a mix of emotions, suggesting that art focusing on environmental devastation and evoking debilitating emotions, like anxiety, may not be necessary to achieve the desired increase in intention to act upon climate change.

Quitting Doom Messaging

Our results align with findings from both Nabi and colleagues (2018) and Vlasceanu and colleagues (2024) regarding climate change messaging, specifically regarding the importance of emotions as mediators between the artworks (messages) and the pro-environmental outcome. Climate change messaging and art are closely linked, as the emotive effects of art are often used in climate change messaging. As with environmental art, emotions act as a key mediator in climate change messaging. In Nabi et al.'s (2018) experiment, the loss frame, comparable to our problem frame, induced more fear, which boosted advocacy behaviour but was undermined by negative message assessments. Loss frames, similar to fear appeals, often evoke negative emotions and increase motivation to avoid threats, which may lead to compensating attitudes and behaviour (Holm, 2023; Tannenbaum et al., 2018). However, the short-term positive effect on pro-environmental attitudes, intentions, and behaviours induced by negative emotions is insufficient for sustained engagement, as noted by O'Neill and Nicholson-Cole (2009). Similarly, Vlasceanu et al. (2024) concluded that while negative message frames (i.e., fear appeals or doomerism) are the most shared online, where "negativity rules", they are the least effective at motivating pro-environmental action. Therefore, the increase in pro-environmental attitudes through negative emotions in our problem frame can be explained by cognitive dissonance

theory (Festinger, 1962).

Conversely, the gain frame in Nabi et al. 's (2018) experiment, comparable to the solution frame in our study, generated more hope (strong effect in our study), reduced negative message assessments, and boosted supportive attitudes and advocacy behaviour. This implies that we should shift from doom messaging to solution-focused messaging to spark societal behavioural change. Some research however suggests that there is a difference in the effectiveness of climate change loss versus gain frames, depending on whether the pro-environmental behaviour is political or individual (Dedman & Lee, 2023). It may also be beneficial to combine attention-grabbing doom messages with solutions, especially in the online sphere where negativity often dominates (Vlasceanu et al., 2024). However, using art to manipulate emotions for attitude and behaviour change raises ethical concerns. For instance, climate change art that is designed to induce strong negative emotions may have a paralysing effect on the viewer. As such, researchers, artists, curators, and communicators should thoroughly consider their intentions concerning such artworks.

Art Style under the Spotlight

Previous research on the effects of art style on audiences is inconsistent. Although our experiment did demonstrate a link between the art style and emotional responses, it did not investigate the underlying mechanisms, thus the notion that abstract art disengages viewers from the issue (Christensen et al., 2023), could not be supported. Conversely, while Aviv (2014) proposed that abstract art may foster creative thinking, we found no significant evidence that inspiration differed between art styles. Investigating the minimal interaction effect of art style and frame, one might speculate that in the problem frame, a more abstract style could be beneficial as it may buffer against strong negative emotions. Contrastingly, in the solution frame,

more representative art may be advantageous, due to the increased certainty of the presented solutions becoming reality.

Further, despite the artworks having been created with AI, a minimal effect of art style emerged, which prompts the question of whether this effect may be exaggerated when real and more abstract artworks are presented. Our study can thus be conceived as a starting point for further research.

Implications

Harnessing the Potential of Environmental Art

As discussed previously, art is often assumed to have a powerful ability to convey meaning, emotion, and intention effectively (e.g. Dolapoobat, 2023). Supportingly, art history and the psychology of aesthetics also contend that [environmental] art can inspire personal involvement and encourage behaviour change (Aumann, 2022; Roosen et al., 2017; Verducci, 2019), in this case, pro-environmental actions. Loes Damhof (2023) speaks of “futures literacy” which describes art's ability to inspire and “unfreeze narratives” to mobilise a society that is currently in a “poverty of imagination”. Environmental art is thus considered “transformational” (Aumann, 2022; Sommer & Klöckner, 2019). Our study humbles these assumptions but suggests that creative, imaginative solution-framed art can evoke and influence the viewers' intentions to perform pro-environmental behaviours.

Indeed, the Dutch public values the cultural sector for engaging them with new and creative ideas (Holm et al., 2024). The novelty of some solution-focused climate change art can either be a boundary condition or a facilitator of change, especially by engaging audiences emotionally and inspiring them (Liu et al., 2023; Roosen & Klöckner, 2020). This contrasts with problem-framed artworks, or threat appeals, which are not more effective than solution-framed

art in promoting pro-environmental intentions. Thus, engaging people in climate change action may benefit from artists and curators focusing on environmental solutions art (Baden, 2019; Bullot, 2014; Carlson, 2020; Chirico et al., 2023; Sommer & Klöckner, 2019; Vlasceanu et al., 2024).

Our findings align with Sommer & Klöckner's (2019) suggestion that visual art can bridge the gap between scientific information and personal responsibility. Visual artworks can manipulate viewers' emotions to increase pro-environmental constructs, which likely depends on the context and external support for such behaviour change (Ajzen, 1985; Bamberg & Schulte, 2018; Geiger, 2020; Roosen & Klöckner, 2020). Our study demonstrates that understanding the mechanisms of climate change art is crucial for curating programs that inspire action. While this study provides novel insights and addresses previous research suggestions (Holm, 2023; Sommer & Klöckner, 2019), some limitations need to be addressed.

Limitations

Concerning the artworks, the literature demonstrates that subtle changes in art, such as colour schemes, can affect how they are perceived (Chatterjee et al., 2010; Damiano et al., 2023). Editing the AI-generated images proved challenging, especially maintaining consistent brightness and colour given the contrasting content between solution and problem frames. Moreover, the abstract art manipulation was not sufficiently abstract, hence being called semi-abstract throughout. Thus, future studies could benefit from collaborations with artists, whose art may elicit stronger effects. Further, contextualising text contributes to the cognitive and affective valuation of artworks (Keller et al., 2020; Millis, 2001). This is especially relevant as the contextualisations of the solution frames did not explicitly mention climate change. As such, it may have been less salient than in the problem frames. Though the text was pre-tested

and evaluated as suitable, variations of contextualisation could be explored. Moreover, a manipulation check, testing whether the solution frames were indeed perceived as depicting climate change solutions, should be included.

The external validity was limited as the experiment did not replicate an exhibition, gallery or real-life setting. In experiencing artworks this may be crucial, as their full effects may be easily missed if viewed on mobile phones or laptops, indicating a need for field studies (Christensen et al., 2023). However, the significance of the experimental manipulation also speaks for the manipulation approach used in this study.

Concerning the outcome variable, pro-environmental intention is commonly used as a proxy for behaviour, as it is often its strongest predictor (Ajzen, 1985; Keller et al., 2020; Marks et al., 2016). However, contextual and intrapersonal barriers decrease the predictive accuracy of the relationship (Geiger, 2020; Jones et al., 2017). Future research should investigate behaviours and contextual facilitators relevant to bridging the intention-behaviour gap. Especially field experiments, testing short-term and long-term behaviour change could shed light on the various hypothesised effects. Lastly, the intention measures concerned low impact behaviours, based on previous research (Chu & Yang, 2019; Doran et al., 2015; Jones et al., 2017; Keller et al., 2020; Nabi et al., 2018), but with environmental psychology aiming to increase its impact, future research should also examine high-impact behaviours (van Valkengoed et al., 2021).

Future Research

Increasing Impact through Storytelling

As articulated by prominent cultural researchers, culture serves as both a reflection and a challenge to our norms and ideals, providing a platform to express, share, and shape our values (Simons et al., 2017). Indeed, art is thought to serve as a catalyst for new perspectives and

understanding, guiding individuals through challenging ideas to embrace novel frames of mind (Simms, 2015). To increase the impact of environmental artworks, we propose a hybrid approach, combining problem and solution art frames, which may enhance pro-environmental intentions and subsequent behaviour. This study and prior research (Sommer & Klöckner, 2019) suggest that both problem and solution frames of environmental art have their merits. However, Vlasceanu and colleagues (2024) found that online, negative climate change messages are most frequently shared and capture attention effectively. This hybrid approach, presented in a storytelling format, could take audiences on a journey from the unjust, unsustainable status quo towards alternative, inspiring futures. Providing actionable tools for achieving such futures may further enhance the impact on audiences. Future research should compare such a storyline approach to solution- and problem-framed artworks, and establish their boundary conditions.

Relatedly, art has the potential to communicate scientific facts more engagingly compared to data alone, partly due to the emotional involvement it evokes in their audience (Li et al., 2023). Collaborative efforts between artists and scientists could further explore how climate change solutions can be depicted in artworks, accompanied by actionable suggestions, similar to the storytelling approach suggested. This collaborative and interdisciplinary approach may help bridge the intention-behaviour gap by making complex scientific concepts and realities more accessible and inspiring specific actions.

Completing the Model with Motivation and Subjective Factors

Jones and colleagues (2017) highlighted the uncertainty surrounding the independent or interdependent role of affect in shaping climate change attitudes. Beside emotions, factors such as motivation play a role. Investigating the interaction between motivation, emotion, and art frame (van Valkengoed & Steg, 2019; Yang & Thøgersen, 2022), could shed light on these

dynamics and potentially inform which art frame is more beneficial under which circumstances. An important conceptual limitation of any psychological investigation of the effects of art on their viewers is that art evaluation and its effects are inherently subjective. As such, addressing the viewer's liking of the artworks may reveal an additional moderating effect on environmental attitudes (Nabi et al., 2018). Assessing these constructs in a similar study to the present could unravel these complexities.

Audience Engagement

An overlooked aspect in the current research is the viewer's willingness to engage with environmental topics and its impact on the effectiveness of environmental artworks in triggering cognitive-affective reactions in the audience. Problem-framed art may not fully evoke emotional responses if viewers are defensively shielding themselves from negative emotions. In contrast, solution-framed artworks may bypass this constraint, potentially making them more effective in eliciting desired responses. This highlights the importance of considering audience receptivity when designing environmental art interventions.

Exploring the Impact Trajectory of Art

Our findings lead us to reason that pro-environmental intentions and subsequent behaviour may be best and longitudinally achieved by inspiring and solution-focused artworks. The hypothesised superiority of solution-framed over problem-framed artworks assumes that positive emotions may foster action while negative emotions could lead to coping mechanisms that undermine action, such as cognitive dissonance-driven short-term changes in attitudes. However, the current experiment cannot confirm these assumptions. Therefore, investigating the longevity of artworks' emotional impact on pro-environmental intentions and behaviour is crucial. This inquiry would clarify the relationships between induced positive and negative

emotions, with particular interest in emotions like inspiration, guilt, and anxiety, which have contentious significance in literature (Baden, 2019; Keller et al., 2020; Stanley et al., 2021; Sommer & Klöckner, 2019). This could support the claim that environmental art can have enduring inspiring effects and evoke transformational cognitive-affective (Roosen et al., 2017) and behavioural changes (Curtis et al., 2014; Geiger, 2020).

Conclusion

The current study addressed research gaps by investigating the emotional effects of solution- versus problem-framed environmental artworks on audiences, building on prior work (Holm, 2023; Keller et al., 2020; Sommer & Klöckner, 2019). While neither frame proved more effective in eliciting pro-environmental intentions when considered without influencing factors, they distinctly impacted emotions, with solution-framed art evoking stronger positive emotions like happiness, hope, and inspiration, than negative emotions. Conversely, the problem frame primarily elicited negative emotions. Emotions partially mediated the artworks' effect on consequent pro-environmental intentions, with art style having a minor moderating effect on the emotional experience towards the artwork. These findings suggest that solution-framed art may better engage audiences in pro-environmental actions, by inspiring alternatives to current climate change realities. It further contributes to an interdisciplinary understanding of climate change art and messaging, and warrants further research into the potential of environmental artworks in challenging audiences into pro-environmental action.

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Appendix A

Table 1


Exclusion of Cases

Reason	<i>N</i> before Exclusion	Number of Cases Excluded
Multiple participation	518	100
Trial responses researcher	418	2
Non-response on all variables	416	2
Non-Consent	414	4
No age indication	410	25
Negative quality check	385	2
Final Sample	383	

Note. Reasons are listed in the order of exclusion.

Table 2

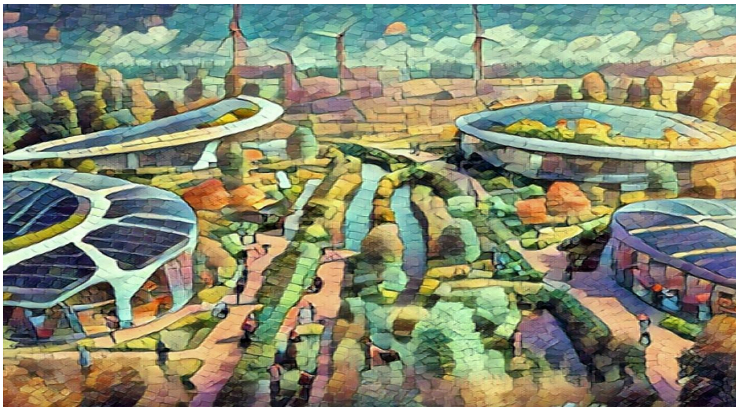
Artworks and their Prompts

Artwork and Description	Prompt
<p><i>Solution Rural Representative</i></p> 	<p>landscape, Netherlands, modern regenerative agriculture, biophilic farm houses, happy farmers and cyclists enjoying leisure time, renewable energy, vertical farming, futuristic greenhouse pods with solar panels for heating, modern farming, Dutch trees, biodiversity, windmills, air filter turbines, Solar Punk</p>

Artwork and Description

Prompt

Solution Rural Abstract



Solution Urban Representative



Solution Urban Abstract



a cityscape of residential area in a Dutch city, traditional and modern houses with an environmentally conscious design, people enjoying leisure time in groups in gardens lush greenery, abundant trees, vertical urban vegetable farming, technology intersecting with nature in the year 2030, solar panels on roofs, no cars, walk-friendly city, cycling path between houses, solar punk, community, electric drones, moss graffiti, air filter machines, community square in the style of cinematic, cinematography, shallow depth of field, subject in focus, beautiful, filmic

Artwork and Description

Prompt

Contextualisation Solution Artworks

The following two artworks are from a Dutch environmental art exhibition. Both depict potential futures. Please take your time to look at them before moving on to the next question. This series is titled *Solutions*. The artist envisions what a climate friendly future may look like in the Netherlands

Problem Rural Representative



landscape farmland netherlands, severe drought, dried farm land, sad farmers, monoculture, no trees, smog, (foggy sunny sky), realistic colours

Problem Rural Abstract



Contextualisation Problem Rural Artwork

The following two artworks are from a Dutch environmental art exhibition. Both depict climate change consequences that are becoming more and more common. Please take your time to look at them before moving on to the next question.

This artwork is titled *Drought*. The artist envisions what consequences of climate change may look like in the Netherlands

Artwork and Description

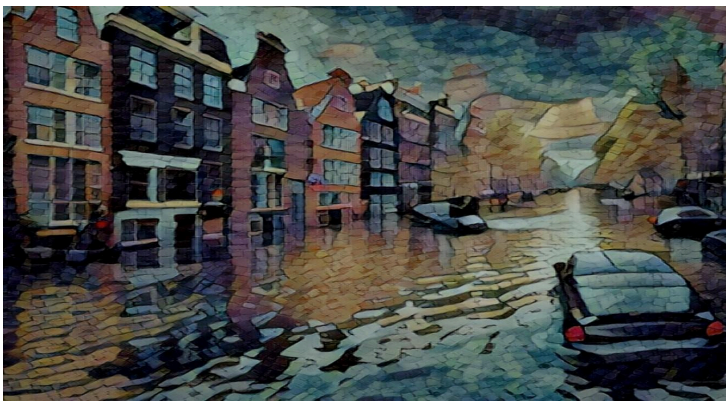
Prompt

Problem Urban Representative



a realistic, Dutch City (Amsterdam), affected by a very high flood, water reaches to the 3rd floor of the buildings, high flood, modern cars are submerged in the water, of road signs only the top is visible, dark and stormy sky, realistic colours

Problem Urban Abstract



Contextualisation Problem Urban Artwork

This artwork is titled *Flood*. The artist envisions what consequences of climate change may look like in the Netherlands.

Note. Artworks generated using Runway AI and edited using Fotor. The semi-abstract art was edited using the settings “Structuralism” and “Pavement”, each at around 50% strength.

Table 3

Key Survey Items and Response Options

Survey items	Response Range	Source
<p>Emotions Scales</p> <p>“To what extent do the artworks bring up each of these feelings within you?”</p> <p><i>Positive Emotions</i></p> <p>Happiness Hope A sense of awe Surprise Inspiration, enthusiasm</p> <p><i>Negative Emotions</i></p> <p>Guilt Sadness/disappointment that nothing is happening to prevent climate change Apathy, or a sense of helplessness Anger Anxiety Shame</p>	<p>1= <i>strongly disagree</i>; 7= <i>strongly agree</i></p>	<p>adapted from Keller et al., 2019; Sommer & Klöckner, 2019</p>
<p>Pro-Environmental Intentions Scale</p> <p>“To what extent do you agree with the following statements on a scale of 1 (strongly disagree) to 7 (strongly agree)”</p> <p><i>Pro-Environmental Intention</i></p> <p>I plan to (continue to) deliberately act pro environmentally in my everyday life</p> <p>I plan to change my food consumption patterns to have a lower impact on the environment</p> <p><i>Mitigation Intentions</i></p>	<p>1= <i>strongly disagree</i>; 7= <i>strongly agree</i></p>	<p>Keller et al., 2020</p> <p>Inspired by Chu & Yang, 2019</p>

Survey items	Response Range	Source
I am prepared to significantly reduce my energy use to help tackle climate change		Jones at al., 2016
I don't feel any sense of urgency to change my behaviour in order to reduce the effects of climate change (reverse scored)		Jones at al., 2016
<i>Advocacy Behaviour</i>		
I plan to sign (more) petitions to urge politicians to take mitigation actions		Inspired by Nabi et al., 2018
I plan to sign (more) petitions for grass root initiatives that support mitigation efforts		Inspired by Nabi et al., 2018
<i>Mitigation Behaviour (Transport)</i>		
I am prepared to use environmentally friendly means of transportation although this might be more expensive		Inspired by Doran & Larsen, 2015
Manipulation Check Abstraction		
“How would you categorise the artistic style (not the content) of the artworks you saw, from representative (realistic) to abstract?”	Slider from 0= <i>Representative</i> to 10= <i>Abstract</i>	
Uncertainty		
“Do you believe what you saw were credible artworks?”	Forced Choice: <i>Yes, No, Unsure</i>	
“Do you consider what you saw in the artworks to be or could it become realistic?”		

Note. For more information concerning the measures, please contact the researcher.

Table 4

Exploratory Variables in Survey

Survey items	Response Range	Source
<p>Climate Change Reality</p> <p>“Do you think climate change is caused by natural processes, human activity, or both?”</p>	<p>Forced Choice:</p> <p><i>I don't think the climate is changing,</i> <i>Entirely by natural processes,</i> <i>Mainly due to natural processes,</i> <i>About as much due to natural processes as due to human activity,</i> <i>Mainly due to human activity,</i> <i>Entirely due to human activity</i></p>	<p>ESS ERIC, 2020, round 8</p>
<p>Climate Change Concern</p> <p>“How concerned are you about climate change?”</p>	<p>Forced Choice:</p> <p><i>Not concerned at all,</i> <i>Not so concerned,</i> <i>Somewhat concerned,</i> <i>concerned, very concerned</i></p>	
<p>Psychological Distance</p> <p>“As you saw the artworks from an environmental art exhibition, to what extent did you feel like a distant observer or involved in it?”</p>	<p>Involvement (1 = <i>very much distant</i>, 7 = <i>very much involved</i>)</p>	<p>Chu & Yang, 2019; White et al., 2019</p>
<p>Anticipated Emotions</p> <p><i>Anticipated Emotions 1</i></p> <p>“If during the next 2 weeks, you will deliberately act pro environmentally in your every day life, how much do you think you would feel...”</p> <p>“If during the next 2 weeks, you will deliberately act non/anti environmentally in your every day life, how much do you think</p>	<p>1 = <i>Not at all</i>, 7 = <i>Completely</i></p> <p>Positive Emotions rated = <i>proud, happy, self-assured, satisfied, excited</i></p> <p>Negative Emotions rated = <i>unsatisfied, guilty, angry, embarrassed, frustrated</i></p>	<p>Odou & Schill, 2020; Rezvani et al. 2017</p>

Survey items	Response Range	Source
you would feel....”		
<i>Anticipated Emotions 2</i>		
“If during the next 2 weeks, you will consume a low impact diet (e.g. reduce meat and dairy as much as possible), how much do you think you would feel....”	Positive Emotions rated = <i>proud, happy, self-assured, satisfied, excited</i>	
“If during the next 2 weeks, you will NOT consume a low impact diet (e.g. reduce meat and dairy as much as possible), how much do you think you would feel....”	Negative Emotions rated = <i>unsatisfied, guilty, angry, embarrassed, frustrated</i>	
<i>Anticipated Emotions 3</i>		
“If during the next 2 weeks, you will use environmentally friendly means of transportation although this might be more expensive, how much do you think you would feel....”	Positive Emotions rated = <i>proud, happy, self-assured, satisfied, excited</i>	
“If during the next 2 weeks, you will NOT use environmentally friendly means of transportation although this might be more expensive, how much do you think you would feel....”	Negative Emotions rated = <i>unsatisfied, guilty, angry, embarrassed, frustrated</i>	
Art Expertise		
“On average, you visit art museums/ galleries about once every:”	Forced Choice: <i>Almost never, year, 6 months, 2 months, month, week</i>	Chatterjee et al., 2010
“In the average week, how many hours do you spend looking at visual art?”	Forced Choice: <i>0 to 5 or more</i>	
“How many art classes have you taken at the high school level or above?”		

Note. Detailed here are the exploratory variables that were included in the survey, that were however not analysed. Please contact the researcher for the data and more information on these variables.

Table 5*Condition Distributions for Descriptive Statistics*

Experimental Condition		Age Group	Education	Gender	SONA (vs. General)
Condition 1	<i>n</i>	100	100	100	83 (17)
<i>Solution/Representative</i>	<i>M</i>	2.28	2.73	1.32	
	<i>SD</i>	0.95	2.24	0.58	
Condition 2	<i>n</i>	97	97	97	84 (13)
<i>Solution/ Abstract</i>	<i>M</i>	2.22	2.89	1.31	
	<i>SD</i>	0.74	2.40	0.55	
Condition 3	<i>n</i>	96	96	96	80 (16)
<i>Problem/Representative</i>	<i>M</i>	2.35	3.58	1.27	
	<i>SD</i>	1.03	3.52	0.51	
Condition 4	<i>n</i>	90	90	89	79 (11)
<i>Problem/Abstract</i>	<i>M</i>	2.22	2.94	1.24	
	<i>SD</i>	0.79	2.76	0.50	
Total	<i>n</i>	383	383	382	326 (57)
	<i>M</i>	2.27	3.03	1.29	
	<i>SD</i>	0.89	2.78	0.54	

Note. Age Group (2= 16-24, 3= 25-34, 4= 35-44, 5= 45-54, 6= 55-64, 7= 65 or older), Education (1 = Primary School, 2 = High School, 3 = Vocational education/college/MBO, 4 = Bachelor's degree, 5 = Master's degree, 6 = PhD or similar, 7 = other, 8 = Prefer not to say), Gender (1 = Woman, 2 = Man, 3 = Non-Binary, 4 = Prefer not to say), SONA (first year psychology students: 1= SONA, 2 = general participant).

Table 9*MANOVA Positive Emotions Games-Howell Multiple Comparisons*

Dependent Variable	(I) Condition	(J) Condition	Mean Difference (I-J)	SE	p	95% CI	
						Lower Bound	Upper Bound
Happiness	C 1	C3	3.25	0.17	<.001	2.81	3.69
		C4	3.03	0.18	<.001	2.56	3.49
	C2	C3	2.91	0.17	<.001	2.46	3.35
		C4	2.69	0.18	<.001	2.21	3.16
Hope	C1	C3	3.41	0.18	<.001	2.95	3.86
		C4	3.05	0.19	<.001	2.56	3.54
	C2	C3	2.90	0.17	<.001	2.45	3.34
		C4	2.54	0.19	<.001	2.05	3.02
Awe	C1	C2	0.61	0.20	.014	0.09	1.13
		C3	0.81	0.22	.002	0.24	1.37
		C4	0.67	0.20	.006	0.14	1.19
Surprise	C1	C3	0.55	0.21	.050	0.00	1.11
		C4	0.72	0.21	.003	0.18	1.25
	C2	C4	0.66	0.20	.007	0.14	1.18
Inspiration	C1	C3	2.67	0.19	<.001	2.19	3.16
		C4	2.19	0.20	<.001	1.67	2.72
	C2	C3	2.40	0.19	<.001	1.90	2.89
		C4	1.91	0.21	<.001	1.38	2.45

Note. Only the significant pairwise comparisons are shown.

Table 11*MANOVA Negative Emotions Games-Howell Multiple Comparisons*

Dependent Variable	(I) Condition	(J) Condition	Mean Difference (I-J)	SE	p	95% CI	
						Lower Bound	Upper Bound
Guilt	C 1	C3	-1.40	0.23	<.001	2.81	3.69
		C4	-1.00	0.25	<.001	-1.63	-0.37
	C2	C3	-1.42	0.22	<.001	-1.99	-0.84
		C4	-1.02	0.24	<.001	-1.64	-0.40
Sadness	C1	C3	-2.01	0.22	<.001	-2.59	-1.43
		C4	-1.59	0.24	<.001	-2.21	-0.97
	C2	C3	-1.63	0.22	<.001	-2.19	-1.08
		C4	-1.21	0.23	<.001	-1.81	-0.62
Apathy	C1	C3	-2.02	0.22	<.001	-2.59	-1.45
		C4	-2.03	0.22	<.001	-2.59	-1.47
	C2	C3	-1.63	0.23	<.001	-2.23	-1.03
		C4	-1.64	0.23	<.001	-2.23	-1.04
Anger	C1	C3	-1.98	0.22	<.001	-2.54	-1.42
		C4	-1.68	0.23	<.001	-2.27	-1.08
	C2	C3	-1.72	0.23	<.001	-2.31	-1.14
		C4	-1.42	0.24	<.001	-2.04	-0.80
Anxiety	C1	C3	-2.16	0.22	<.001	-2.74	-1.59
		C4	-1.80	0.23	<.001	-2.40	-1.20
	C2	C3	-1.77	0.22	<.001	-2.34	-1.20

Shades of Change

Dependent Variable	(I) Condition	(J) Condition	Mean Difference (I-J)	SE	<i>p</i>	95% CI	
						Lower Bound	Upper Bound
		C4	-1.40	0.23	<.001	-2.00	-0.80
Shame	C1	C3	-1.74	0.22	<.001	-2.32	-1.15
		C4	-1.45	0.24	<.001	-2.07	-0.83
	C2	C3	-1.58	0.22	<.001	-2.16	-1.01
		C4	-1.30	0.24	<.001	-1.91	-0.68

Note. Only the significant pairwise comparisons are shown.