# "Pollution Pods":

# The merging of art and psychology to engage the public in climate change

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## Abstract

Environmental artists have risen to the challenge of communicating the urgency of public action to address environmental problems such as air pollution and climate change. Joining this challenge, the immersive artwork Pollution Pods (PPs) was created through a synthesis of knowledge from the fields of environmental psychology, empirical aesthetics, and activist art. This study summarizes the scientific process in this transdisciplinary project and reports the findings from a questionnaire study ($N$ = 2662) evaluating the effect of the PPs on visitors. Data were collected at the first two exhibitions of the installation, one in a public park in Trondheim, Norway, and one at Somerset House, London, UK. Intentions to act were strong and slightly increased after visiting the art installation. Individual changes in intentions were positively associated with self-reported emotions of *sadness, helplessness, and anger* and self-reported cognitive assessment their *awareness of the environmental consequences of their action, their willingness to take responsibility for their consequences,* and *belief in the relevance of environmental problems for daily life. Education* and *age* were negatively associated with intentions. Despite favorable intentions, however, taking advantage of an actual behavioral opportunity to track one's climate change emissions behavior after visiting the PPs could not be detected. We conclude that environmental art can be useful for environmental communication and give recommendations for communicators on how to best make use of it. We emphasize the potential benefits of art that encourages personal responsibility and the need for valid behavior measures in environmental psychological research.



Keywords:

Emotions, environmental psychology, installation art, climate change, transdisciplinary research, environmental awareness

## 1. Introduction

Environmental problems such as air pollution and climate change are global and urgent, and, therefore, high on the agenda of organizations such as the World Health Organization, the United Nations Environment Programme and the United Nations Framework Convention on Climate Change. The last report by the International Panel on Climate Change emphasizes that the goal of limiting global warming to 1.5°C is still achievable - if appropriate political measures are taken now (IPCC, 2018). Involving the public is crucial to stimulate support for policy measures and to trigger individual behavior change. For example, Dietz, Gardner, Gilligan, Stern & Vandenbergh (2009) estimated that in the US approximately 20% of direct household climate change causing emissions could be reduced if the public more effectively used already available technologies. This includes citizens reducing their carbon footprints by turning down the heating in their houses and reducing the use of their private motor vehicles (Gardner & Stern, 2008).

Environmental communication has the potential to engage the public in climate change by stimulating cognitions and emotions, thereby catalyzing individual behavior and grass root movements, as well as facilitating public acceptance of climate policies (Geiger, Swim, Fraser, & Flinner, 2017; Swim, Geiger, Sweetland, & Fraser, 2018). Several communication strategies have been tested, many of which have been informational and educational campaigns that have increased knowledge about the climate crisis as their goal. However, more knowledge about environmental problems does not necessarily translate into more pro-environment beliefs, attitudes and behavior (Steg & Vlek, 2009; Suldovsky, 2017). Therefore, alternative means of communication are being sought.

The European Commission acknowledges the importance of including the arts in addressing societal challenges by putting out a call for proposals of research projects that take a multidisciplinary approach to assess and harness the societal impact of the arts. The goal is

to evaluate the potential of artistic research to generate solutions to current and emerging societal challenges such as climate change (European Commission Horizon 2020).

Studies have shown that art can help disseminate scientific information while facilitating engagment and activating emotions which aids communication between researchers, practitioners, and citizens (Arce-Nazario, 2016; Chandler & Baldwin, 2010, Curtis, Reid, & Ballard, 2012; Marks et al., 2016). Art has successfully been used to create engagement in group settings such as discussions (Chandler & Baldwin, 2010; Grant, Baldwin, Lieske, & Martin, 2015), and to stimulate both positive and negative emotions towards natural environments (Marks et al., 2016). In a comprehensive literature review, Roosen, Klöckner and Swim (2017) discuss the benefits of art in comparison to other tools of environmental communication. They explain how contemporary climate change art, such as Olafur Eliasson's and Minik Rosing's "Ice Watch" and Michael Pinsky's "Plunge", can help overcome psychological barriers and facilitate change, by, for example, disrupting routines and offering a space of reflection, or strengthening a sense of group identity among the visitors of the artwork.

In this study, we incorporate theory and findings from environmental psychology and empirical aesthetics to extend these efforts by empirically evaluating environmental art as an innovative approach to climate change communication. We do this with a piece of activist artwork that was specifically created to raise awareness and increase engagement in the topic climate change and air pollution – the "Pollution Pods" by Michael Pinsky – with the ultimate goal of creating behavioral change. Finally, we discuss the implications of our findings for environmental communicators.

### 1.1. The Pollution Pods

Under the umbrella of the transdisciplinary XXX project (www.XXX.xxx), the internationally renowned environmental artist Michael Pinsky collaborated with a team of

environmental psychologists. The goal of this collaboration was to meld the creative thinking and practice of the artist together with scientific findings on psychology and environmental communication on climate change into an artistic project. The result was an art installation called *Pollution Pods* (PPs). The installation consisted of five geodesic domes connected to form a ring. Within each dome, the air quality of five global locations was recreated using safe substances: Trondheim, Norway; London, UK; New Delhi, India; Beijing, China and Sao Paulo, Brazil (see Figures 1 and 2). Starting from Trondheim, the visitor in Norway and the UK walked through increasingly polluted pods, from dry and cold locations to hot and humid. Visitors experienced with their whole bodies, especially when inhaling, a simulation of the effects of toxic gases from domestic and industrial sources, without being actually harmed.

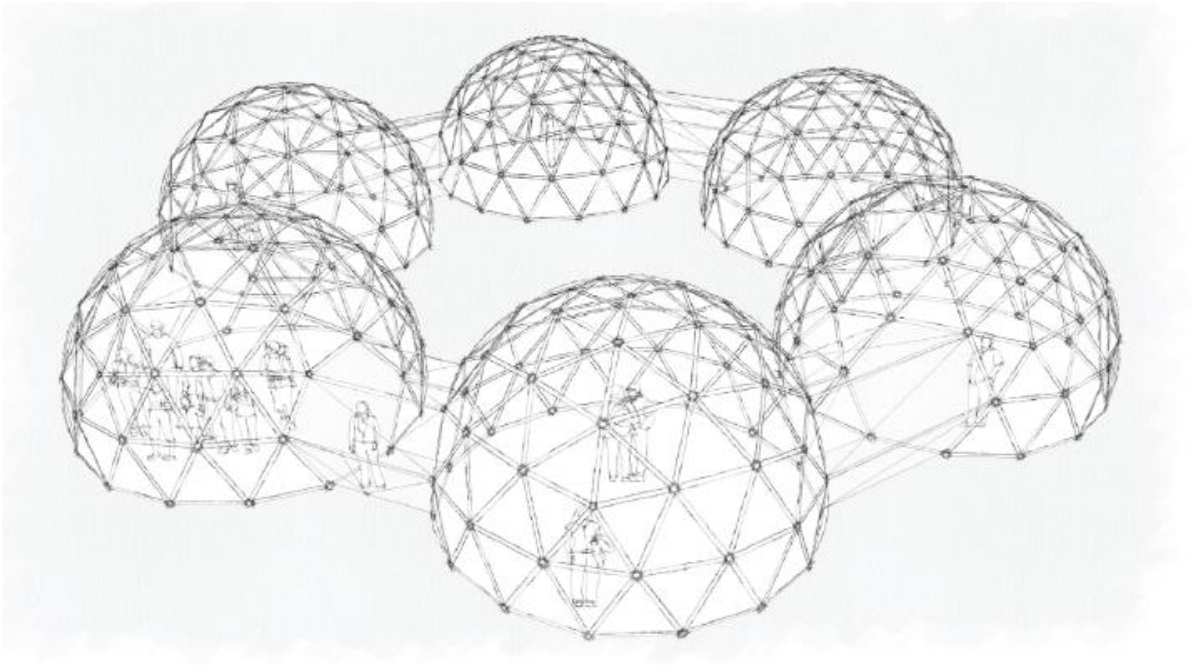

Figure 1. *Initial drawing of the Pollution Pods from above, by the courtesy of the artist Michael Pinsky*

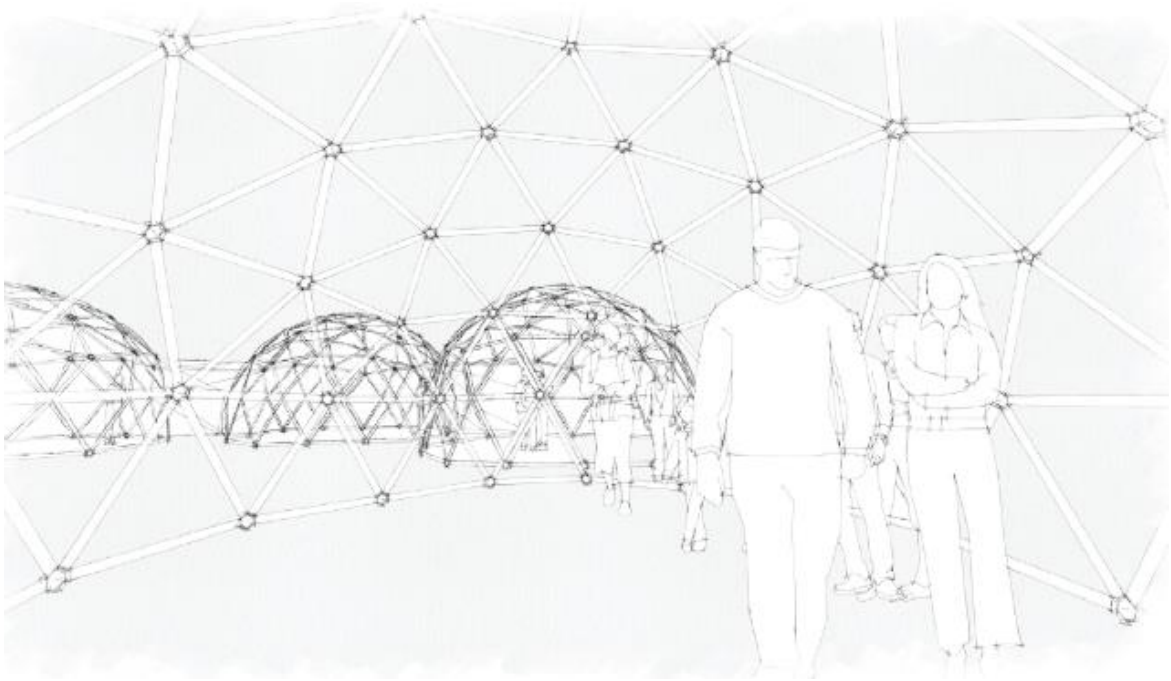

Figure 2. *Initial drawing of the Pollution Pods from inside, by the courtesy of the artist Michael Pinsky*

Pinsky's idea was that visitors would be prompted to reflect on the drivers of this pollution, which often stem from local activities, and they would make the connection between both the direct effect of harmful pollution on their health and the increasing rate of climate change (Pinsky, 2017). In his artistic practice, Pinsky draws on personal experiences from his daily life and came up with the idea of the PPs, when he was travelling from his home in London to the researchers in Trondheim. He was compelled by how fresh the air in Trondheim smelled (Pinsky, 2018). Through the representation of visitors' local environment as well as foreign environments in the PPs, the artwork was designed to both affirm personal connection to the issues as well as visitors' awareness of large scale effects of human actions on the atmosphere that translate to effects on people.

In contrast to Pinsky's focus in this work on air pollution, the goal of the comission was to engage the public in climate change and not air pollution. The team discussed the disconnect and whether it was reasonable to change the exhibit and drew upon previous studies on climate change and air pollution communication, before coming to a decision that the PPs should be implemented. It was deemed unreasonable to add gases that contribute to

climate change to the pods because visitors would not be able to smell the heat trapping gas that have been the primary focus of climate change scientists and policy makers (i.e., carbon dioxide and methane). Air pollution and climate change have many common causes and the experience of walking through the PPs demonstrates the effects of these processes in different cities and countries and stresses the connectedness of global systems. Past research suggests that air pollution and climate change are linked in the public's mind. For instance, educational efforts that raise concern about climate change also appear to raise concern about air pollution, even though the latter was not mentioned in the education programing (Swim, Geiger, & Fraser, 2017). Additionaly, the experience of air pollution has been found to significantly influence the perception and even the behavioral response to climate change (Whitmarsh, 2008). These perceptual links between air pollution and climate change could be because carbon dioxide is often described as an air pollutant (e.g. White House, 2015). Research also points to the potential greater value of an air pollution frame than a climate change frame for engaging the public. Hart & Feldman (2018) demonstrate that air pollution frames are more effective than climate change frames for garnering support for climate change mitigation policies.

### 1.2. Art in climate communication

Given that artwork like the Pollution Pods with a relation to climate change and other environmental topic are being created with increasing frequency and artists often aim to have an impact on their audience in the direction of increasing environmental action, it is relevant to place it within the context of other research on the use of art that focuses on climate change as a means of motivating public engagement. Curtis and colleagues were among the first to study whether art can be used as a tool for climate communication and how artworks portray environmental problems and affect public understanding (Curtis, 2009; Curtis, 2010; Curtis, 2011; Curtis, Reid, & Reeve, 2014). After conducting several studies on different artworks

and art events, Curtis, et al. (2014) concluded that environmental art can encourage pro-environmental behavior through 1) communicating information in engaging ways, 2) creating empathy towards natural spaces, and 3) including art in sustainable projects to make them more attractive and engaging for the public. Another early researcher in this area, Gabrys and Yusoff (2012) describe the contribution of art to climate communication as a space in which science and creative practices can meet, mutate and experiment. According to them, these shared encounters make reconsidering the role of politics in connection to climate change possible. Turning to participatory aspects of contemporary environmental art, Jacobs, Benford, Selby, Golembewski, Price, and Giannachi (2013) wanted visitors to feel something instead of persuading them. They created an exhibit that added a temporal structure through performance and opening up spaces for spectactors of the artwork to interpret for themselves. They were able to enhance feelings through enriching data with an aesthetic and sensory experience (Jacobs, Benford, Selby, Golembewski, Price, & Giannachi, 2013). Chandler, Baldwin & Marks (2014) and Marks, Chandler, & Baldwin (2016) emphasized in their work the educational and social aspects of art encounters. In their understanding, environmental art offers the opportunitiy to explore nature and to reinforce existing positive environmental values. Recently, Sommer and Klöckner (2019) conducted a cluster analysis of people's emotional reactions and reflections to a set of visual environmental artwork. They found that artwork that made causes and solutions of human behavior visible, were exhibited outside, and depicted sublime nature triggered the strongest emotional reactions and made people reflect more than other environmental artworks that did not show such characteristics. To summarize, studies investigating the effect of environmental art on its audiences have found that there are several pathways with which art may affect people. Relevant in all of them is the space that art creates to step back and reflect, as well as to develop empathy for nature and to allow an emotional connection to grow. These findings, identified in the work of the

XXX project, inspired Pinsky's creative process, when he developed the PPs and ultimately our study around it.

### 1.3. Factors influencing the experience of the Pollution Pods

An aim of the XXX project was not only to inform and inspire the artist behind the PPs, but also evaluate their impact. A major aim of the PPs was to increase willingness to act pro-environmentally and subsequently to promote actual pro-environmental behavior. Correspondingly, we test the effects of exposure to PPs on *pro-environmental intentions* and *pro-environmental behavior*. Based on findings from environmental and aesthetic psychology, we identified emotional and cognitive factors expected to influence changes in pro-environmental intentions. We test their association with changes in intentions to be able to assess potential mechanisms behind the effect of artworks such as the PPs. We focus on changes in intentions because it is a theoretical predictor of behaviors (Ajzen, 1991), as our design, as described in the methods and results section, does not allow us to test associations with changes in behaviors. In the following we introduce these factors and their connection to pro-environmental intentions.

**1.3.1. Emotional factors.** Environmental and climate change communication is loaded with emotions, from the persistent emotional reactance by climate change deniers (Moser, 2016), to the increasing sense of hopelessness and desolation among some scientists (Moser, 2016), to public feelings about collective action to address climate change with hopeful feelings being beneficial and boredom being detrimental to public engagement (Geiger, Swim, Gasper, & Fraser, under review). Emotions play a critical role in decision-making, motivating action and accepting present issues (Moser, 2016) and can be informative to the role of different emotions in changes in pro-environmental behaviors. For example, guilt and empathy can explain pro-environmental intentions and climate change mitigating behaviors (Swim & Bloodhart, 2014; Rees, Klug, & Bamberg, 2015) and, at times, fear or

anxiety can block constructive engagement with climate change (O'Neill & Nicholson-Cole, 2009).

In the field of empirical aesthetics, the general importance of *emotional reactions* to the perception of art has been highlighted (Vessel, 2012; Pelowski et al., 2017; Silvia & Brown, 2007). The intensity of emotions is dependent on the context in which an artwork is presented, for example, a context can include or exclude embedded information (Keller, Sommer, Hanss & Klöckner, 2019). However, it is not clear whether there are any specific emotions central to the experience of art. In empirical aesthetics there has always been an emphasis on positive emotions (Silvia, 2007), since art experience was mostly conceptualized as a pleasant and fascinating experience (Pelowski et al., 2016). Few studies have looked beyond the pleasure of art perception, apart from for example two studies by Silvia (2007; 2009) who investigated emotions such as anger and disgust as reactions to provocative and offensive art.

The immersive experience of the PPs was designed to target a variety of emotions. The physical construction of the PPs is intended to create a pleasant visual experience. However, some smells within the pods and the associations with the environmental issues at hand are expected to trigger negative emotions as well. Therefore, measures for a range of positive *(happiness, hope, a sense of awe, inspiration)* as well as negative emotions (*guilt, sadness, helplessness, anger, anxiety, shame)* were included into the study, based on emotions that were found to be activated by environmental artworks (Sommer & Klöckner, 2019) as well as emotions that have been associated with climate change mitigating behaviors (Swim & Bloodhart, 2014). We do not test whether the PPs cause these emotions, but we anticipate that these emotions, possibly prompted by the PPs, are associated with changes in behavioral intentions. That is, given the emotions one might have in the PPs and research demonstrating associations between positive and negative emotions with pro-environmental

behaviors, we anticipated that feeling these emotions would be associated with changes in intentions attributed to experiences with PPs.

**1.3.2. Cognitive factors.** Artists claim that environmental art provokes "different ways of seeing" (Neal, 2015, p.73), reflecting on the world we live in and our own role within it (Chandler, Baldwin & Marks, 2014). Similar indications have been made in empirical aesthetics research: In a multitude of models describing the processing and effect of art, *reflections on the artwork* are an important processing step (Chatterjee, 2004; Locher, Krupinski, Mello-Thoms & Nodine, 2007; Locher, Overbeeke, & Wensveen, 2010; Leder, Belke, Oeberst, & Augustin, 2004; Leder & Nadal, 2014; Silvia, 2005; Silvia & Brown, 2007; Pelowski & Akiba, 2011; Pelowski, Markey, Lauring, & Leder, 2016). Reflections often involve meaning making and self-discovery (Linguiza, Carter & Swim, 2018) and offer the possibility of self-adjustment (Leder & Nadal, 2014; Pelowski, et al., 2016). Those who reflect more on the art work and find more meaning in the art work, may be more likely to be affected by it, for instance, by being more likely to change their personal behaviors after having experienced the PPs.

We anticipated that the tendency for systems thinking would be an important part of visitors' experiences. Systems thinking hereby refers to a holistic way of considering the world – including peopleand the biosphere – as being in dynamic and interconnected relationships (Randle & Stoink, 2018) . The physical structure of the PPs connects the five domes, with the first or second dome being visitor's probable hometown, either Trondheim or London. The starting point links it to their personal lives. The changed experiences representing different geographic locations with different air qualities was designed to start a process of meaning making and, paired with the complexity of the immersive experience, was anticipated to encourage systems thinking. Per systems thinking: 1) the links among the pods highlight connections among geographic locations, 2) connecting one's home town in

the links and personally moving across geographic locations places oneself in the system, and 3) the air pollutions caused by people links people's actions to environmental quality. Systems thinking, potentially prompted by the PPs, may encourage an individual's realization that their own behavior can have profound implications for the health of the environment elsewhere. Thus, systems thinking, potentially prompted by the experience, may enhance changes in pro-environmental intentions that are a result of the PPs experience.

Environmental psychology has also established that *awareness of consequences*, *ascription of responsibility*, and *relevance for daily life* influence pro-environmental intentions and behavior (Bamberg & Schmidt, 2003; Stern, 2000; De Groot & Steg, 2009; O'Neill and Nicholson-Cole, 2009). Awareness of consequences reflects becoming aware of negative consequences of human action on the environment, and it is directly targeted by the PPs which explicitly aim to make the negative consequences of human behavior tangible. The relevance of this factor is in alignment with findings from Curtis, Reed and Reeve (2014) who describe art as raising awareness of the consequences of certain actions. Awareness of negative consequences might be insufficient unless the consequences are connected to one's daily life. O'Neill and Nicholson-Cole (2009) found that highlighting the *relevance for daily life* of natural and pleasant environmental conditions in a non-threatening way is pivotal for constructively engaging people with environmental problems. Another reason why awareness of negative consequences may be insufficient to prompt changes, even when they are perceived to be relevant for one's daily live, is that people may not feel responsible for the consequences (for example, because they ascribe responsibility to structures that force them to act in a certain way). It is possible that the PPs might decrease relevance for daily life and personal responsibility because visitors might believe the problematic air pollution affect the daily lives of people elsewhere and see people in other locations, not themselves as being responsible for it. However, the personal connection noted above to each geographic region

could diminish psychological distance and, therefore, mitigate discounting of personal relevance and responsibilty. The present study does not test changes in the *awareness of consequences, relevance for daily life, and ascription of responsibiltiy.* It does however test and predict that those who report these cognitions are more likely to report changes in intentions as promoted by the PPs experience suggesting that they are psychological mechanisms that facilitate these changes.

### 1.4. Research Hypotheses

According to these theoretical assumptions, we formulated the following hypotheses:

H1: Pro-environmental behavior will be stronger in a group of visitors of the PPs as compared to a comparison group who did not visit the PPs.

H2: Pro-environmental intentions will be stronger after the experience of the PPs than before and stronger than in a comparison group of people not exposed to the PPs.

H3: Emotional activation (both negative and positive emotions) will be positively associated with increased intentions to act in PPs visitors.

H4: Cognitions (those related to general reflections and meaning making, systems thinking, awareness of consequences, ascriptions of responsibility) will be positively associated with pre to post increase in the intention to act in PPs visitors.

We did not have *apriori* predictions about whether emotions versus cognitions or whether particular cognitions or emotions would have stronger relations, but instead leave these questions for exploratory analyses.

## 2. Method

### 2.1 Data collection

Data were collected on two separate occasions and locations: First, as part of the "Starmus Festival – Life and the Universe" (https://www.starmus.com/starmus-iv/ ) in Trondheim, Norway (see Figure 3) and, second, as part of a solo exhibition by Michael

Pinsky in London, United Kingdom (see Figure 4). The data collection in Trondheim took place for three weeks in June and July 2017, extending the period of Starmus Festival by two weeks. The art installation was accessible for eight hours every day. The PPs were exhibited in a public park about 15 minutes walking distance from the city center, with the aim of choosing a location available and frequented by citizens from diverse backgrounds. In London, data were collected at the arts venue Somerset House in the center of the city, which exhibited the PPs for one week in April of 2018 (https://www.somersethouse.org.uk/whats-on/michael-pinsky-pollution-pods). The research assistants at both venues were advised to inform the visitors in the following way:

> "Welcome to the artwork "Pollution Pods". This installation consists of five geodesic domes, containing the air of five different locations from all over the world. If you want to visit the installation, you first have to sign a liability voucher, that you are aware that even though the air inside only simulates air pollution and does not contain harmful substances, the artists cannot be held liable, if anything happens to you inside. If you should have for example, an asthma attack or similar. We would also very much appreciate it, if you want to participate in a questionnaire study around the artwork. You just need to fill out two questions before you enter the pods, and a longer questionnaire after you came out again. Participation is voluntary and anonymous."

Figure 3. *Inside picture of Pollution Pods in Festningsparken in Trondheim, Norway, photo credit: Michael Pinsky*

Figure 4. *Pollution Pods in the courtyard of Somerset House, London, United Kingdom, photo credit: Michael Pinsky*

All visitors of the installation PP during the data collection periods were asked whether they wanted to participate in the study; participation was not a precondition for access to the artwork. When entering, the visitors were asked to only go in one direction, so

the order of cities was the same for all visitors. Pinsky chose the order consciously. First was Trondheim, with the clearest air, followed by London with the smell of diesel fumes and slight fog. Pinsky chose London, since this is where he lives, and he experiences the pollution every day. Next, visitors entered New Delhi the city with the worst pollution levels, high humidity and temperature. The fourth pod, Beijing in winter, is set as a contrast to New Delhi regarding the temperature and the smells, and slightly lower pollution levels. Sao Paulo, the fifth pod, has higher temperatures again and different smells which numb the senses. Pinsky choose the locations based on a mixture of personal experience, differences in smell and levels of humidity and temperature to create the most impressive and diverse experience.

Most visitors came in groups or pairs, with their family and friends. Participants talked and shared their experience with their companions. The installation was never crowded: in London where people queued to visit the installation, the number of people per dome was restricted to five. Visiting the entire installation took between five and 15 minutes, depending on the time people spent in the domes.

Apart from the data collection around the artwork, data were collected from a comparison group in both Trondheim and London. In Trondheim, data collection for the comparison group took place in the city center during three days of a historic folk festival on the market square of Trondheim. This festival draws people from all over the region and from all societal groups. No artwork was shown to this group, and participants were only included in the comparison group if they had neither visited the PPs nor heard about them. Data from a London comparison group was collected among visitors of other sections of Somerset House who had not seen the artwork yet. If they decided to visit the PPs afterwards, they were subsequently excluded from the PP data collection.

The comparison groups provided a quasi-experimental test for effects of exposure to the PPs on pro-environmental behavior. Additionally, intention and behavioral measures

allowed us to test for evidence of "Preaching to the choir" – environmental events attracting people with strong environmental awareness, intentions and pro-environmental behaviors. More specifically, a comparison established baseline intentions and behaviors in a population that had not selected to attend the PPs. Furthermore, a comparison group allowed us to compare socio-demographics of our PPs samples at the PPs to people attending a different event in the same city or an art event that was not specifically about an environmental problem.

Informational material was placed outside the domes in Trondheim and in the control location in Trondheim which either provided information about climate change, or air pollution, or no information to compare the effect of the experience versus information. However, there was no effect of this variable, so we do not discuss this manipulation further.

### 2.2 Measures

To get as close to measuring a real impact on behavior as possible, we teamed up with an existing platform for stimulating climate action based on logging and encouraging everyday behaviors. We used this platform as behavior measure in Trondheim, and participants received a log-in code to this online platform called 'Ducky' (https://www.ducky.eco/en/ ). The platform first calculates a personal carbon footprint and then suggests pro-environmental behavioral alternatives and encourages people to log them on the platform, see their $CO_2$-savings and share them with others. The platform also had a feature, which assigns the participants who logged on with our code to a group. The different groups were supposed to compete over who is saving the most $CO_2$ in a two-week period.

PPs visitors were also asked to fill out two questionnaires (see supplementary materials). The first questionnaire provided baseline assessment of intentions. The second, completed immediately after exiting the installation, assessed cognitive and emotional measures and post behavioral intention measures and demographic information. All cognitive

items and the intention and emotional items were measured on a 7-point Likert scale. Dependent upon the question stem, the scales either ranged from either 1 (*not at all*) to 7 (*very much*) or 1 (*strongly disagree)* to 7 (*strongly agree*). The coding of the questionnaire was readjusted to 0 (*not at all*) and 6 (*very much*) or -3 (*strongly disagree*) to +3 (*strongly agree*) to have more easily interpretable mean values in the analysis. Participants of the comparison group filled out a shorter questionnaire which measured pro-environmental intentions and behaviors (Trondheim group only – see below), demographics and cognitive measures. All measures represent averages of responses to the scale items noted below.

**2.2.1. Behavioral intentions**. Two items measured intentions to act on climate change and air pollution before entering the PPs with two items ("I intend to do something actively to prevent climate change / environmental problems in the future").

**2.2.2. Emotions.** Emotions were measured with the question "To what extent does the artwork bring up each of these feelings within you?" followed by a list of the emotions derived from Sommer and Klöckner (2019) and Swim and Bloodhart (2014).

**2.2.3. Cognitive measures.** Participants were asked to provide their *reflections and reactions* to the specific experience with the PPs. Examples of items such as "The artwork made me think about the problem of air qualities in cities." and "The artwork made me think and reflect on its meaning."

A modified version of Lezak and Thibodeau (2016) *systems thinking* scale was used. The items were modified to fit the context of the study (e.g., "I gained a stronger sense of the connection between my actions and the well-being of people in other places" and "This artwork made me think about living conditions for animals and plants".

Items measuring *awareness of consequences* (e.g. "The effects of environmental problems on public health are worse than we realize.") and *ascription of responsibility* (e.g. "I feel partly responsible for the environmental problems on our planet.") were based on De

Groot and Steg (2009) and adjusted to the context of the PP. The items to measure *relevance for daily life* were also adapted from Sommer and Klöckner (2019), to capture how climate change and air pollution both can be perceived to affect people's daily lives. One example is the item "The artwork highlights environmental problems that would affect me personally."

**2.2.4. Covariates** We included control variables of art, lung health issues, climate change knowledge in our regressions that would likely be related to our dependent variables prior to exposure to art. *Experience with art*, which has been shown before to be associated with a more detailed experience of negative emotions (Fayn, Silvia, Erbas, Tiliopoulos & Kuppens, 2018) and in-depth reflections on the artwork (Lin & Yao, 2018). It was measured with the question "What is your experience with art?" from 1 (*I am an art lover and go to exhibitions regularly*), 2 (*I like art, but I am not a connoisseur*), 3 (*Sometimes I like art and sometimes I don't – it depends*), 4 (*I don't really like art, but there are some exceptions),* to 5 (*I really dislike art and anything artistic*) as used by Sommer and Klöckner (2019).

Since the artwork focused on air pollution, we expected that people who have a history of chronic lung disease themselves or in their family would react more strongly to the artwork, or would show higher engagement in pro-environmental behavior, and decided to control for the *personal relevance* of these issues. This was measured via the question "Is ease of breathing an important topic for you or your family?" on a 7-point Likert scale 1 (*not at all*), 7 (*very much*). *Knowledge on climate change* was measured because greater knowledge is associated with more concern about climate change (Swim & Geiger, 2017) and those with more knowledge or concern may self-select into attending the PPs. Knowledge was measured using a four-item items from a knowledge measure developed by Simon, Volmert, Bunten and Kendall-Taylor (2014). Items were selected that targeted climate change (e.g., rather than ocean acidification) asking questions such as "Why is the climate system changing?" offering four possible answers. The number of correct answers ranged

from zero to four. This has been used repeatedly to measure knowledge on climate change among US American citizens (Swim & Geiger, 2017; Swim, Geiger, Fraser & Pletcher, 2017; Geiger, Swim & Fraser, 2017).

### 2.3. Factor analyses of the measurement instruments

Because our measures had not been used before in previous studies, we conducted principle component analyses to reduce the number of variables to fewer components within the theoretical groups of interest, as described in the introduction. Before doing the factor analyses, however, we adjusted for missing data from 5% of the sample using the Expectation-Maximization Method (EM) due to a relatively large number of missing values with around five percent of every variable. Even though the overall data set was relatively large with 2662 participants, simple imputation was used as an adequate way of retaining as much information as possible from the data set and obtaining more reliable results (Schafer & Graham, 2002). Little's MCAR test ($\chi^2$ (1, 7801) = 8940.42, $p < .001$) indicated that the data is most likely not Missing Completely at Random (MCAR). To determine if this lack of randomness was problematic, a sensitivity analysis was conducted to see whether the data was Missing at Random (MAR), a prerequisite to imputation. This analysis indicated that significance patterns were identical between regressions with imputed and with non-imputed data, and therefore we opted for including more data points in our analyses.

After the imputation, we divided the variables that were used to predict changes in intentions into four blocks 1) negative emotions, 2) positive emotions, 3) general reflections on artwork and global systems, such as other people, ecosystems, animals and future generations, 3) cognitive variables on personal relevance of climate change (ascription of responsibility, awareness of consequences and relevance for daily life). Identifying differences within negative emotions and within positive emotions could inform future psychological research in environmental psychology and empirical aesthetics on emotional

reactions to art, as suggested by Silvia (2007; 2009). Principal component analyses (PCA) with oblique rotation was applied and cross-factor loadings lower than .30 were used to eliminate items. After the PCAs, mean scores for all items loading high on one component were calculated. The number of factors was determined for all the PCAs based on the Likelihood ratio test (LR test) which chooses the best model, using a log-likelihood function. Next, we checked the output for components with cross-loading, which were then excluded from the component. Apart from the PCA for general reflections and systems thinking which revealed two factors, all the variables in the second component had cross loadings with the first component. Therefore, the PCA for general reflections and systems thinking was rerun with one factor only.

The factor analyses revealed the following. PCA of negative emotions resulted in three components: 1) moral emotions of guilt and shame (*M*= 1.78, *SD* = 1.47, α = 76), and 2) negative uncertainty emotion of anxiety (*M* = 2.20, *SD* = 1.74) and the remaining negative emotions of 3) sadness, helplessness and anger (*M* = 2.29, *SD* = 1.37, α = .69). PCA of positive emotions resulted in three components: uplifting emotions of awe, inspiration and surprise (*M* = 2.28, *SD* = 1.23; α = .52), positive uncertainty emotion of hope (*M* = 1.45, *SD* = 1.48); and the remaining positive emotions of happiness and pride (*M* = 1.01, *SD* = 1.25; α =. 66). PCA of the first block of cognitive variables, resulted first on two factors but was then rerun with one factor, since all variables in the second factors had cross loadings with the first factor. The resulting factor will be referred to as *general reactions and reflections on the artwork and global systems* (*M* = 3.36, *SD* = 1.28; α = .94). Last, PCA revealed three factors for the second set of cognitive variables: awareness of consequences (*M* = 1.75, *SD* = 0.99, α = .64), ascription of responsibility (*M* = 1.13, *SD* = 1.30, α = .69), and relevance for daily life (*M* = 1.08, *SD* = 1.36; α = .84). Two items (one ascription of responsibility and one relevance for daily life) were excluded due to cross loadings on other components.

# 3. Results

## 3.1 Participants

In Trondheim, responses were obtained from 1016 visitors of PP and an additional *N* = 415 in the comparison group. In London, responses were collected from 851 visitors of PP and an additional *N* = 380, in the comparison group. Socio-demographic characteristics among the two PP groups and combined comparison groups are presented in Table 1.

Preliminary analyses comparing the PP and comparisons groups were tested for possible relatively unique characteristics of people visiting the PPs relative to our comparison groups representing attendees to events that did not represent the unique combination of art and environmental problems. The two comparison groups were combined into one group to make the sample sizes across comparisons similar. For the two categorical variables gender and education chi-square tests were calculated. On average, there were 56 percent women with no significant differences for gender between the PP group and the comparison group ($\chi^2$ (1) = 0.84, p > .05) nor between the two PP groups ($\chi^2$ (1) = 1.25, p > .05). While the PP groups were more educated than the comparison group, the effect size was very small ($\chi^2$ (3) = 12.94, p < .05, Cohen's d = .07). In contrast, the education level between the Trondheim and London PP groups had a large effect size ($\chi^2$ (3) = 279.56, p < .01, Cohen's d = .79). The distribution of participants indicates that London had the highest percentage of university graduates with nearly all being university graduates (79%, 15% college degree, 3% high school diploma, 3% primary school). In contrast, in Trondheim the education distribution was more diverse, yet still with a majority holding a university degree (46%, 18% college degree, 25% high school diploma; 11% primary school).

Table 1. *Sample characteristics - means of continuous socio-demographic variables in comparison group (CG), Trondheim Pollution Pods group and London Pollution Pods group as well as results of an ANOVA with contrasts testing for differences in means between groups*.

| **Variable** | **CG** | **Trondheim** | **London** | **df1** | **df2** | **F** | **CG vs. PP** | **Cohen's d** | **Trondheim vs. London** | **Cohen's d** |
|---|---|---|---|---|---|---|---|---|---|---|
| Age (in years) | 38.33 | 32.66 | 35.57 | 2 | 2661 | 30.29** | **t (1397) =-6.04**** | **.27** | **t (1798) = 4.27**** | **20** |
| Knowledge about climate change[1] | 3.34 | 3.31 | 3.34 | 2 | 2501 | .42 | t (2499) = -.32 | .01 | t (2499) = .83 | .04 |
| Inexperience with art[2] | 2.12 | 2.32 | 1.93 | 2 | 2679 | 50.27** | t (1404) =.16 | .01 | **t (1732) = -10.23**** | **.48** |
| Ease of breathing[3] | 2.59 | 2.41 | 2.31 | 2 | 2638 | .59** | t (1685) =-3.41** | .14 | t (1744) = -1.26 | .06 |
| Intentions baseline[3] | 2.33 | 2.52 | 2.73 | **2** | **2649** | **19.53**** | **t (1326) =5.02**** | **.22** | t (1838) =3.72** | .17 |

*Notes*. * p < .05; ** p <.01; Cohen's D indicates the effect size. Very small effect sizes are not highlighted, however small (Cohen's d < .20) or medium (Cohen's d < .50) effect sizes are indicated in bold.

[1] Possible values range from 0 to 4 correct

[2] Possible values range from 1 to 5 with higher values indicating more experience with art.

[3] Possible values range from -3 to 3 with higher values indicating more ease of breathing and stronger behavioral intentions.

An ANOVA compared the three groups on continuous variables measured prior to experiencing the art that could influence reaction to the artwork (see Table 1). We had asked participants separate questions intending to do behaviors that would address air pollution and climate change. They were strongly correlated with each other, $r$ (2217) = .89, $p$ = .00. Given this similarity, we averaged these two questions together into one measure. The two groups of PP visitors were younger then the comparison group, had stronger pro-environmental intentions, and less problems with 'ease of breathing' with medium, small, and very small effect sizes, respectively (see Table 1). The London PP group had stronger pro-environmental intentions, was older and had more experience with art than the Trondheim PP group with small effect sizes for age and intentions and medium effects sizes for experience. More art experience found in our London participants is likely because the venue in London was an arts venue. In sum, based on effect sizes, meaningful differences between groups were restricted to age and art-experience of participants. The difference in baseline intentions, though with a small effect size, will be addressed in the discussion.

### 3.2 Changes in behavior through the art experience

All the participants in the PP and comparison groups from Trondheim were asked to join the online platform 'Ducky' where they could calculate their carbon footprint and log the behavior they did reduce to reduce their footprint. Unfortunately, only few participants joined the platform (PP: 2%, $n$ = 24; CG: 0%, $n$ = 4). This meant that we were unable to analyze the behavior logged on the platform. A $chi^2$ test did not reveal a significant difference in the rate of joining the platform between the groups ($Chi^2$ = 3.00; $df$ = 1; $p$ = .08). Therefore, the behavior measure was not repeated in the London data collection. The implications of the very low level of participation will be discussed in the Discussion section below. H1 could therefore not be answered conclusively.

### 3.3 Changes in intentions through the art experience

We predicted that the artwork 'Pollution Pods' would trigger an increase in intention to act in its visitors (H2). We tested for changes from before to after the PP experience for both intentions to address pollution and climate change with a 2 (Time: Pre vs. Post) x 2(Topic: pollution vs. climate change) repeated measures ANOVA. The analyses revealed an interaction between time and topic, $F$ (1, 1767) = 24.67, $p$ = .00, $eta^2$ =.01. Follow-up comparisons indicated increases for both pollution intentions ($M$ = 5.67, $SE$ = .03 vs. $M$ = 5.71, $SE$ = .03) and climate change intentions ($M$ = 5.58, $SE$ = .03 vs. $M$ = 5.67, $SE$ = .03). The difference was stronger for climate change because the initial intentions to address pollution were stronger than final intentions. As with the pre-measures, because the intentions to address pollution and climate change were highly correlated, $r$ (2217) = .89, $p$ = .00, and we found differences on both measures, we averaged the two mentions together to form one measure. Notably, a dependent t-test indicated that mean intention after the Pollution Pods ($M$ = 2.69, $SD$ = .03) were higher than before the PP ($M$ = 2.62, $SD$ = .03), $t$ (1778) = 3.27, $p$ < .01, but However, the effect size (*Cohens d* = .07) was very small, providing only partial support for hypothesis H2. Because the PP groups' baseline intentions were significantly higher than the comparison groups' intentions (see Table 1), we did not compare the comparison group to the after intentions in the PP groups.

**3.3.1 Influences of environmental psychological variables on changes in intentions.** A difference score between intentions after versus before was calculated, such that higher numbers indicate having strong intentions before than after experiencing the PPs. This difference score was regressed on emotions (H3) and cognitions (H4) to test our prediction that that they would be positively associated with an increase in intentions on the individual level. A possible ceiling effect was controlled for by adding the intentions before as a predictor to all regression models.

We included covariates in the regression either because of differences between the Trondheim and London PP sample (education, age, experience with art, intentions, see section 3.1) or because they may be associated with our predictor and independent variables and we wanted to rule them out as reasons for effects for our predictor variables. Because we collected data in two locations, we initially included interactions between all variables and the location of data collection (Trondheim vs. London) to test whether any of the socio-demographic variables or emotional and cognitive factors would interact with the location in which the Pollution Pods were exhibited. From all possible interactions (six socio-demographic variables and ten factor variables) none showed a significant effect. Therefore, we only include location as control variable into the regression models to account for possible differences between people from the two locations not captured by our other covariates.

Four regression models were tested to explore for differences in strength of predictors (see Table 2): 1) intentions and socio-demographic variables as predictors (a base model to compare with latter models, 2) intentions and socio-demographic variables and emotions as predictors (H3), 3) intentions and socio-demographic variables cognitive factors (H4). 4) Finally, all influencing variables were added in a fourth model. Model 4 was tested because empirical aesthetics provides mixed evidence as to whether art provokes emotions or cognitions first (Pelowski, Markey, Forster, Gerger & Leder, 2017) and we wished to test the strength of their effects after controling for the other factor.

Table 2. *Summary of Block-wise Regression Analysis for Variables Predicting Changes in Intentions*

| | Model 1 (N = 1702) | | | Model 2 (N = 1702) | | | Model 3 (N = 1702) | | | Model 4 (N = 1702) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | *B* | *SE B* | *β* | *B* | *SE B* | *β* | *B* | *SE B* | *β* | *B* | *SE B* | *β* |
| Intentions before | -.29 | .02 | -.42** | -.31 | .02 | -.46** | -.41 | .02 | -.59** | -.41 | .02 | -.60** |
| Socio-demographics | | | | | | | | | | | | |
| Gender | -.22 | .04 | -.13** | -.17 | .04 | -.10** | -.06 | .04 | -.04 | -.06 | .04 | -.04 |
| Age | -.01 | .00 | -.13** | -.01 | .00 | -.11** | -.01 | .00 | -.12** | -.01 | .00 | -.12** |
| Education | .05 | .02 | .06* | .06 | .02 | .06** | .06 | .02 | .06** | .06 | .02 | .06** |
| Inexperience with art | -.10 | .02 | -.09** | -.08 | .02 | -.08** | -.04 | .02 | -.04 | -.04 | .02 | -.04 |
| Knowledge of climate change | .04 | .03 | .03 | .03 | .03 | .03 | .04 | .02 | .03 | .04 | .02 | .03 |
| Ease of breathing | .06 | .01 | .12** | .05 | .01 | .11** | -.01 | .01 | -.02 | -.01 | .01 | -.02 |
| Location | .08 | .04 | .05* | .06 | .04 | .03 | .03 | .04 | .02 | .03 | .04 | .02 |
| Emotion | *B* | *SE B* | *β* | *B* | *SE B* | *β.* | *B* | *SE B* | *B* | *B* | *SE B* | *B* |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factor 1 – Sadness, helplessness & anger | | | | .06 | .02 | .10** | | | | .04 | .02 | .07* |
| Factor 2 – Guilt & shame | | | | .03 | .02 | .06* | | | | -.03 | .02 | -.05 |
| Factor 3 – Anxiety | | | | -.01 | .01 | -.02 | | | | -.02 | .01 | -.03 |
| Factor 4 – Happy & pride | | | | -.04 | .02 | -.06* | | | | -.02 | .02 | -.03 |
| Factor 5 – Hope | | | | .02 | .01 | .04 | | | | .01 | .01 | .02 |
| Factor 6 – Sense of awe, inspiration & surprise | | | | .06 | .02 | .08** | | | | .02 | .02 | .03 |
| Cognitions | *B* | *SE B* | *β* | *B* | *SE B* | *B* | *B* | *SE B* | *B* | *B* | *SE B* | *B* |
| Factor 1 – General reaction and reflections on the artwork and global systems | | | | | | | .10 | .02 | .15** | .10 | .02 | .14** |
| Factor 2 – Awareness of consequences | | | | | | | .10 | .02 | .12** | .10 | .02 | .11** |
| Factor 3 – Ascription of responsibility | | | | | | | .17 | .02 | .27** | .18 | .02 | .28** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Factor 4 – Relevance for daily life | | | .04 | .02 | .07* | .04 | .02 | .06* |
| *Adjusted* $R^2$ | .18 | .21 | | .32 | | | .32 | |
| *F* for change in $R^2$ | 48.72** | 32.90** | | 68.27** | | | 46.20** | |

*Note.* *p < .05. **p < .01.

Coding: Gender: 0 = female, 1 = male; Education: 1 = primary school diploma, 2 = college or technical degree; 3 = High school diploma, 4 = University degree; Higher numbers in predictor variables indicate greater knowledge, more ease of breathing, less previous experience with art, and more intentions to engage in pro-environmental behaviors before experiencing the Pollution Pods, stronger emotions, and stronger cognitions: see text under 'Measures'

All four models have an overall significant *F*-value, providing evidence that the independent variables in the models improve the fit of the model. The adjusted $R^2$ values give an indication of how much the model fit improved with the additional variables, which is more by adding the cognitive than the emotional factors (see individual model results below).

Intention before was positively associated with changes in intentions, with the highest (negative) standardized coefficient across all variables and models. This means that those who already reported stronger intentions prior to experiencing the PP had less positive change in intentions from before to after the experience.

The first model revealed that, if the participant was a man, older or had less experience with art, the participant was less likely to change his/her intention. Additionally, the more the participant was educated, or concerned about ease of breathing or 'in London', the more likely a change of intention was detected.

Adding the emotion factors in the second model improved the ability to predict change in intentions and most of the associations were positive. *Sadness, helplessness and anger* showed the largest beta-coefficient with changes in intentions, followed by *awe, inspiration and surprise*, *guilt and shame* and *happiness and pride* – the latter was the only significant negative association. However, all emotional effects were small and the adjusted $R^2$ only increases by 3% between the first and second model.

As illustrated in the third model, all cognitive factors showed a significant positive association with changes in intentions, with *ascription of responsibility* showing the highest standardized coefficient. The adjusted $R^2$ increases by 14% between the first and third model. In this model, gender and experiences with art were no longer significant predictors of changes in intention.

In the final model that included all variables, age and education as well as all cognitive variables were again associated with changes in intentions. Regarding the

emotional variables, only the factors that was the strongest predictor in the second model (i.e., sadness, helplessness and anger) was positively associated with changes in intention. The adjusted $R^2$ increased again by 14% with respect to the first model.

## 4. Discussion

The aim of this study was to for an artist to create an immersive experience with air pollution which would presumably be relevant to climate change and to investigate the effect of this artwork on pro-environmental intentions and behaviors and psychological mechanism that provide insights in possible mechanisms by which they alter pro-environmental intentions. We conducted a questionnaire study around the immersive art installation Pollution Pods (PP), created by environmental artist Michael Pinsky and psychological predictors based on findings from environmental psychology and aesthetics. Data was collected from two different venues, a public park in Trondheim, Norway and the arts venue Somerset House in London, UK.

### 4.1. Behavior

We cannot come to a strong conclusion about effects of the exhibits on pro-environmental behaviors (H1) because the rate of participants who even registered to join the platform to assess behavioral change was very low. The low sign-up raises the question as to whether the artwork did not reach its goal to motivate people to make changes in their daily life's, or whether there was another reason preventing participants from joining the platform. It may be that the problem is the platform and not changes in behavior. It is possible, that the step to accept a personal code, log on, and track the personal carbon footprint was too big. Unfortunately, the platform was not available in the form of an app, but only via the browser, which might have added to the difficulty in using the program. It is also possible, that participants engaged more in environmental behavior as a result of their experience, but failed to report it online. A solution could have been, that the research assistant could have

logged on with the participants for the first time at the venue. That way the participants only needed to log their behavior daily on the platform.

Generally, environmental psychologists struggle with implementing behavior measures in their studies. Often, they demand repeatedly information on personal behavior, such as the number of meals containing meat, or how long the person showers. Researchers rely on reported information or on approximations through other variables, such as intention to act environmentally. With 'Ducky' we would have received several different behaviors, from transport, meal and bigger consumption choices, associated with the attached carbon footprint. We argue, that it is important to try to implement behavior measures in studies, despite associated difficulties, especially since participants through all groups reported high intentions to act, which we cannot say if it translated into behavior or not.

We need to acknowledge though, that there is a possibility that people were initially motivated by the PP to act, but that this motivation was lost after their experience. That people's attitudes often do not correspond to their behavior is a well-known finding and has also been documented in the environmental domain (e.g., Boulstridge & Carrrigan, 2000; Juvan & Dolnicar, 2014). So even if the PP succeeded with activating people's emotions and cognitions, it is not unlikely that the action did not follow from intentions. For artists, this means that the art experience alone cannot be expected to make people change their behavior, but that other measures helping people to act upon their intentions need to be implemented after the art experience.

### 4.2. Intentions

Participants reported stronger intention to act on climate change and air pollution after the PP (H2). It is also notable that this effect was present for both changes in intentions to address pollution and climate change. This suggests that at a general level, participants did not differentiate between the two types of behaviors and potentially a reason why

interventions that address air pollution may be effective at addressing a range of pro-environmental behaviors. However, it also notable that increases in intentions were, on average, very small. This small increase might be because participants at the PP started with strong intentions before entering the installation, suggesting a strong ceiling effect in our measurements of intentions. It is also possible that those most likely to have high intentions were also likely to visit the PPs. Supporting this assumption, the PP groups had stronger intentions than the comparison groups (see section 3.1) and those who had stronger intentions entering the PPs showed less change in intentions. Thus, the small effect strong intentions at the start of the study could possibly explain little changes in behaviors – participants may have reported intending to do the behaviors because they did them before visiting the venue. On the other hand, it is notable that given the likelihood of prior strong intentions, the PPs were able to increase participants' intentions. XXX and XXX (under review), ran a qualitative study with interviews of visitors of the PP and found that participants reported an increase in motivation to change their behavior suggesting that the change over time was not a measurement problem.

Other reasons than self-selection as to why those who visited the PPs may have had stronger initial intentions to engage in PPs prior to visiting the PPs than our comparison group may be a special effect of art. Seeing the PP from the outside may have made already existing intentions more salient or prompted first reflections, leading to an increase in intentions pre-visit. A recent study by Pelowski, Gerger, Chetouani, Markey, & Leder (2017) shows that calling an object 'art' influences the way it is being perceived by the spectator, associated with increased liking, higher aesthetic ratings, and even a search for the artist's intention. Accordingly, it seems probable that participants who were aware of visiting an environmental artwork would experience salient environmental intentions and that the differences in intentions between the comparison group and the PPs groups hint at a priming,

and not at a sampling bias. This would mean, that we may not have been able to detect differences from before to after visiting, because the PPs had their strongest effect before even entering them. It needs to be recognized in this respect that the "before intentions" were measured after the participants received their instructions about that the PPs.

### 4.3. Baseline differences predicting change in intentions

A base model determined that if the participant was a man, older or disliked art more, they were less likely to change their intentions. The results for gender and age are in accordance with earlier findings on the relationship between socio-demographics and environmental concern: women more than men (Buttel, 1979; Jones & Dunlap, 1992; Kanagy, Humphrey & Firebaugh, 1994; Ozanne, Humphrey & Smith, 1999) and younger people have been reported to be more environmentally concerned than older people. It is notable that effect of gender was no longer significant when our cognitive variables were included in the model suggesting that differences between women and men were a result of the different way they think about the environment. We conclude from this, that artists, curators and environmental communicators should consider how especially those groups could be addressed with environmental art. For example, they may want to particularly target thoughts, perhaps especially those regarding ascription of responsibility given its relatively strong association, to reach men.

We also found that experience with art increased changes in intention. Studies on the connection between art experience and the perception of art have shown that art expertise is associated with greater flexibility in art appreciation (Leder, Gerger, Dressler & Schabmann, 2012) and reduced emotional responses to provocative or negative art (Leder, Gerger, Brieber & Schwarz, 2014). This seems to indicate that even though participants less familiar with art might have experienced the PP more emotionally than art experts, they were less inclined to change their appreciation of the artwork, and therefore possibly their reflection and

intentions. As with gender, the effect of experience with art was no longer significant when our cognitive variables were included in the model suggesting that the effect of experiences was because those with more experience think differently about the environment than those with less experience. We interpret these findings as suggesting that efforts to communicate the urgency of addressing climate change should be exhibited outside of the traditional museum and gallery setting, to reach people less experienced with art, as happened in our Trondheim venue, and when doing so should address thoughts, perhaps especially those regarding environmental consequences and ascription of responsibility.

Last, more education, and more concern about ease of breathing were associated with an increase in intentions. These results are as expected and in alignment with previous findings (Jones & Dunlap, 1992). We also found that intentions was associated with visiting in London more so than Trondheim. In London, air pollution is a bigger problem than in Trondheim, possibly leading to a higher sensitivity to the issues presented (air pollution indices were taken from the website: https://plumelabs.com/en/air/).

### 4.4. Emotions predicting change in intentions

Both negative (sadness, helpless and anger; guilt and shame) and positive emotions (sense of awe, inspiration and surprise; happiness and pride) were associated with changes in intentions. All associations were positive, except for happiness and pride. Thus, a mixture of emotions is important to predicting change in intentions perhaps suggesting that it is the strength rather than the valence of the emotional reaction to the art that predicts changes in intentions. The exception was that visitors who experienced happiness and pride while viewing the artwork were less likely to increase their intentions. Perhaps participants who felt happy and proud about the fact that the air in Trondheim and London was still much better than the air in New Delhi, Beijing or Sao Paulo also felt that there was no need for them to do something about conditions somewhere else in the world. This happiness about not being

affected was found by XXX and XXX (under review) qualitative study of the same exhibit and they described it as a defense mechanism which allowed people to distance themselves from the harsh reality. According to them, participants experienced mostly shock, but also grief, sadness, surprise, fear but also gratitude to live in a place that is not that affected by environmental pollution and climate change.

In the present study, only sadness, helpless and anger, were significant predictors of changes in intention after controlling for cognitions. This suggests that there is a connection between the remaining emotions and changed thoughts about the environment. For example, guilt and shame are likely prompted by feelings of responsibility and the findings suggest that the latter may be important for explaining the effects of guilt and shame on changing behaviors. The positive emotions may also be tightly related to cognitions, for example, perhaps their intensity is closely connected to being experientially close to the consequences.

### 4.5. Cognitions predicting changes in intention

Adding cognitive predictors to the base model resulted in a considerable increase in explained variance. All cognitive predictors were positively related to changes in intentions, suggesting that environmental art should encourage reflection on one's personal place in an environmental system, social connections, temporally removed effects, and the general connection between one's actions and environmental effects. Further, as noted above, it appears that cognitions account for many of the effects of emotions on changes in intentions. Based on these results, we recommend that an artwork communicating an environmental issue to its spectators should feature an aspect that highlights personal responsibility, as well as personal consequences of climate change. XXX and XXX (under review) qualitative study similarly indicated that the PP have achieved to highlight personal responsibility and awareness of consequences.

Importantly, however, it is not necessarily the case that a small increase in the adjusted $R^2$ between the baseline socio-demographic and the model including emotions, in comparison to the increase in $R^2$ including cognitions, indicates that cognitions are more important. An alternative explanation could be, that emotions function as a first "relevance detector", while the cognitions fit this arousal into a context (Öhman, Flykt & Esteves, 2001; Grandjean & Scherer, 2008). Alternatively, measurement similarity could explain the difference: because cognitions and intentions are both thoughts, cognitions may better explain changes in intentions than emotions. Therefore, future research should investigate which of the different options is more likely, since emotions and cognitions are generally playing a big role in the field of art perception (Pelowski et al., 2016).

### 4.6. Limitations and Future Directions

As we note above, there may be an effect of the PPs prior to even entering them. In other words, the anticipation of the event – especially after having received the instructions – might have already triggered the reaction. Thus, future research should control the anticipation of seeing an environmental artwork, either by visually shielding the art, including participants who unexpectedly visit an artwork, or by triggering a similar anticipation in a comparison group. Even though visually shielding the PPs would not have worked, since Pinsky reckoned the surroundings to be an essential part of the installation, it could be applied with another form of artwork. Also, the location of the PPs in a public park in Trondheim led to people encountering the artwork by chance, however, the research assistants could welcome visitors without mentioning the work 'art'.

The measurement of intentions before and after the PPs was limited in its success. One possible explanation is that participants were unable to express a possible increase due to the constraint of the measurement scale. In interviews as reported by Roosen & Klöckner (under review), visitors reported that they were touched by the experience and subjectively

indicated an increased intention to act. These results suggest that visitors increased their intentions but our measure may not have captured the strength of the impact on intentions, which underlines the importance of a functioning behavior measure.

We cannot tell how long the impact of the experience will last, although the very weak response to our behavior measure seems to indicate that the effect might be rather limited in time. The importance of intensity of emotional experience, as we interpret the impact of a range of positive and negative emotions on changes in intentions, suggest that the more people felt the experience was immersive, the more impact it had on them. This is echoed in the results of the qualitative study of the same event (Roosen & Klöckner, under review), which found that participants felt that experiencing the conditions in the pods was much more powerful than reading information about it. Thus, future research should test long term impacts of experiences with highly experiential art such as the PPs. They might also explore if labelling an experience as "art" might even make it easier for people to distance themselves from it when stepping back into their everyday life. In a similar vein, an important avenue to follow up on in future research might be to look further into the connection between appraisal – whether people personally liked the artwork – and its potential behavioral impact.

Another limitation of the study is that our study with the focus on emotional and cognitive reactions to art does not take into account different sensual experiences that visitors must have made in the PPs. A strand of research called "sensory ethnography" would be especially useful for following up with the impact of perceptual aspects such as smell and touch (Pink, 2015).

Moreover, only one art installation – the PPs – and not a range of different environmental artworks was evaluated. Art perception and art appreciation is very subjective, and as we could see in our data, influenced by socio-demographics such as experience with

art, age and education, as well as psychological factors. This is congruent with findings from Leder et al. (2004) and Silvia (2006). However, though the generalizability of these results is of course limited by the single artwork under study, more evidence from studies on single exhibitions (e.g. Pelowski et al., 2018) will present important conclusions.

## 5. Conclusion

Our work points to the value of large scale immersive art for communicating the perceptually linked concerns about air pollution and climate change. Even though the main questions whether environmental behavior can be triggered by the experience of environmental art remains open, we can shed light on how environmental art influences environmental intentions. Recommendations for environmental communicators can be deducted on how they can benefit from art as means of communication:

Environmental art can reach people outside of the circle of usual suspects, such as men, older people and people less experienced with art, when it is exhibited outside of the traditional museum and gallery setting. The artwork is especially impactful for these groups of people and may be most effective if it elicits reflections, systems thinking and thoughts about awareness of negative consequences of climate impacts, relevance to oneself personally, and ascription of responsibility. It seems particularly important to encourage personal responsibility. Moreover, sadness, helplessness and anger seemed to be the emotions that had the most impact on changes in intentions, so artists and communicators should not be afraid to trigger them with their messages.

There are many barriers to environmental communication, and it is difficult to increase awareness for climate change and air pollution, especially in a world filled with a multitude of information and many distractions. However, as Pelowski et al. (2017) describe art – classifying an object as piece of art gives the experience an extra meaning and as such could garner attention in the midst of other distractions.

Future research and practice will further clarify the role that immersive art installations can play in pro-environmental communication, and lead to interesting and effective avenues for the promotion of positive global change.

## 6. References


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