KU LEUVEN

FACULTEIT PSYCHOLOGIE EN
PEDAGOGISCHE WETENSCHAPPEN

Emotional Mechanisms in the Relationship between Coastal Environments, Well-Being, and Pro-Environmental Attitudes

Masterproef aangeboden tot het
verkrijgen van de graad van Master
of Science in de psychologie
Door
Louis Pauwels

promotor: Filip Raes
m.m.v: Marine Severin

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Summary

Natural environments, and specifically *coastal environments*, have always been an important and unique part of the world around us. The relationship between exposure to the coast and well-being has been the subject of extensive research that has provided evidence that the coast can benefit *well-being*. There are several aspects of this relationship that we must further investigate. Various mechanisms that possibly underly this relationship have been proposed, though other potential mechanisms remain overlooked, such as emotional mechanisms. This study therefore explores the emotions of *awe* and *nostalgia*, in addition to *nature connectedness*, as possible mechanisms. Considering the benefits the coast can provide us and the rising impacts of climate change, we must further investigate how we can protect our planet and the coastlines. Therefore, this study explores how coastal environments can affect *pro-environmental attitudes* as well. Additionally, this study looked at possible differential effects of different types of coastal landscapes on well-being and pro-environmental attitudes, as coastlines can be substantially different across the globe. Finally, this study evaluated the possible effects that *plastic litter* in coastal environments may have on the coast's capacity to foster well-being and influence pro-environmental attitudes.

The study consisted of an online experiment of which a total of 251 participants participated. In this study, stress was induced in participants through a mental visualization task after which they watched a video of either an urban environment, coastal dunes, or a beach with a sunset. Participants rated their stress levels before and after watching the video. Well-being was measured in terms of *stress reduction* and *meaning-focused coping*. We also measured participants' level of pro-environmental attitudes. Finally, we looked at the potential mediating role of awe with *feelings of small self*, nostalgia and nature connectedness.

Results showed that stress reduction was greater after being exposed to the coastal sunset, compared to the urban environment. The coastal sunset was more effective in reducing stress than the coastal dunes. The type of environment did not affect meaning-focused coping or pro-environmental attitudes. Levels of all the potential mediators were higher in both coastal environments, compared to the urban environment. Stress reduction was positively correlated with nostalgia and feelings of small self. Nature connectedness was positively correlated with meaning-focused coping and pro-environmental attitudes. Feelings of small self were a significant mediator in the relationship between exposure to both coastal environments and stress reduction.

We conclude that the coast possesses therapeutic value, especially in the sense that it has the capacity to elicit emotions of awe, small self, and nostalgia, which have been proved to be beneficial to well-being. Additionally, the mediating role of feelings of small self further justifies the therapeutic value of the coast, as this emotional mechanism can foster well-being by reducing stress when being exposed to coastal environments.

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I honestly could not imagine how I could have done this without both of them and I am very grateful for such great guidance and support.

Next, I would like to thank the participants for taking part in our online study and providing us with all the data that we used to answer our research questions. Conducting the study would not have been possible without them.

Lastly, I would like to thank my family and my boyfriend Arnaud for always believing in me, not only during the last two years, but throughout all of my studies, especially at times where it was hard for me to believe in myself.

Clarification of Approach and own Contribution

I wrote this thesis with the help of my promotor, Filip Raes, and my daily supervisor, Marine Severin. I was assigned to the subject of this thesis and my promotor at the start of the academic year in 2020-2021. The study's aim, hypotheses, design, and analysis plan were already pre-registered in the Open Science Framework (OSF) before I entered the study. Marine provided me with some starting literature to gain some more insight into the subject of the study, after which I conducted a literature review on our research questions and started writing on the introduction and the method section, with guidance and regular feedback from both my daily supervisor and promotor.

Marine and I went to the beach of De Haan in Belgium, where we searched for the locations to record the coastal dunes videos and the videos at the beach with a sunset and recorded the videos that we used in the study. Afterwards, I helped with translating some of the scales of the questionnaire to Dutch.

When the construction of the survey was finished, I advertised the study on social media. Participants were recruited through the SONA system of KU Leuven and Ghent University and completed the online survey on the Limesurvey platform from May 21st through November 4th, 2021.

After the data was collected, I helped with a large part of the data analysis using SPSS. When the data analysis was finished, I started writing on the results and the discussion and completed it after several different versions, with the help, feedback and advice from my promotor and daily supervisor.

Table of Contents

List of Tables

List of Figures

Introduction

The relationship between nature, specifically coastal environments, well-being, and pro-environmental attitudes has been investigated extensively and literature has provided us with evidence of the existence of this relationship. However, there are still some aspects left to be explored. For example, it is still unclear what the most important mechanisms are behind this relationship. There has been more interest in literature in the role of emotions as a mechanism through which exposure to coastal environments can foster well-being and affect pro-environmental attitudes, but the role of emotions has not been fully explored yet. Furthermore, the potential differential effects of different types of coastal landscapes on both well-being and pro-environmental attitudes and how the presence of litter in these landscapes may affect its ability to foster well-being and affect pro-environmental attitudes are additional aspects that we must further investigate.

Therefore, in the next sections, the relationship between natural environments, specifically coastal environments, and well-being will be further explored, while also taking a look at how coastal environments can influence pro-environmental attitudes. We will further investigate proposed mechanisms behind this relationship, specifically the emotions of awe and nostalgia, in addition to nature connectedness, experienced in coastal environments.

Well-being

Well-being is a broad construct that entails many different concepts and can be measured several different ways. Two main perspectives have been suggested to measure well-being: objective well-being and subjective well-being (Voukelatou, 2020). Objective well-being entails objective parameters of a pleasurable life (i.e., physical health, job opportunities, safety), while subjective well-being entails people's perceived well-being (Voukelatou, 2020). Three approaches within subjective well-being have been described: evaluative well-being (how people evaluate their lives), hedonic well-being (positive and negative feelings; Kahneman, 1999), and eudaimonic well-being (Steptoe et al., 2014). Eudaimonic well-being can be conceptualized in terms of six dimensions of positive psychological functioning or well-being, described in the model of Ryff (1989, 2018). According to the model, the six dimensions of psychological well-being are self- acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth (Ryff, 1989; Ryff & Keyes, 1995).

Well-being seems to be closely related to both mental health and physical health. Therefore, we need better understanding about how to promote and preserve well-being. One possible contributor to well-being that has gained more attention is nature. For example, White et al. (2017) found a positive relationship between nature visit frequency and eudaimonic well-being and an association between visiting nature the previous day and positive experiential or hedonic well-being.

Nonetheless, research shows that people are getting more disconnected from nature (Kesebir & Kesebir, 2017; Pergams & Zaradic, 2008; Prévot-Julliard et al., 2015). Consequently, we need to further investigate how nature influences well-being, as well as pro-environmental behaviours and attitudes, to both reinforce connection and interest in nature and to benefit the conservation of nature, which is an important contributor to our well-being.

The Influence of Nature on Well-being and Pro-environmental Attitudes

Natural environments have been considered to be restorative environments that can benefit well-being in several different ways (Joye & van den Berg, 2018). A restorative environment is defined in the APA Dictionary of Psychology as "an environment that rejuvenates a person and can help restore depleted attention resources or reduce emotional and psychophysiological stress" (American Psychological Association, n.d.). For example, natural environments have been found to restore the stress that occurs after being exposed to circumstances that are demanding or threatening to well-being (Joye & van den Berg, 2018). In the study by Ulrich et al. (1991), participants were exposed to videotapes of different kinds of natural and urban environments after a manipulation of stress. The authors measured several physiological parameters and self-reported state affect. They found that the physiological stress indices recovered faster and to a greater extent after exposure to a natural environment compared to the different urban environments. The authors concluded that people recover more and faster from stress in terms of the physiological stress measures after exposure to natural environments as opposed to the urban environments. Participants also reported lower levels of anger, aggression, and fear and higher levels of positive affect following exposure to natural environments. Similarly, Alvarsson et al. (2010) looked at the influence of nature sounds on stress recovery. Stress was induced in participants through a mental arithmetic task, followed by recovery periods where participants were exposed to either nature sounds or noises. Several physiological measures were evaluated, and participants had to rate the perceptual attributes of the nature sounds and the noise. It was found that psychological stress recovery was faster when exposed to nature sounds compared to noises and the nature sounds were also rated more pleasant than the noises.

These studies have been conducted on the basis of a central theory in restorative environments research that tries to explain these restorative effects, i.e., the Stress Reduction Theory (SRT; Ulrich, 1983). The SRT is concerned with how exposure to natural environments can help people recover from stressors and strains from everyday life in an urban environment (White et al., 2013). More specifically, the theory states that when people are initially exposed to a natural environment, their initial generalized affective response is rather general; they either like or dislike the environment (Joye & van den Berg, 2018; Ulrich, 1983). These responses happen without

conscious processing of the environment. Positive affective responses occur if there are certain elements present in the environment. These elements include natural features, structural features (complexity, depth, ground surface texture), and the absence of threats (Joye & van den Berg, 2018; Ulrich, 1983). According to the SRT, these quick, initial positive affective responses bring about a restorative process by reducing stress, arousal, and negative emotions (Joye & van den Berg, 2018). A literature review of Berto (2014) suggests that there is evidence for stress reduction through exposure to natural environments and provides overall support for the SRT.

There is also some evidence of restoration of cognitive resources and attention through exposure to natural environments. For example, Gidlow et al. (2016) tested whether a 30-minute walk in a natural environment or an urban environment affected cognitive function (measured with the Backward Digit Span). Results indicated that cognitive function improved in natural environments, and that the effects persisted for at least 30 minutes after leaving the environment. Conversely, in a study of Emfield and Neider (2014), participants first completed a cognitive battery and affect measures and were then exposed to natural or urban sounds, pictures, or a combination of the two. In the nature condition, the researchers used pictures and sounds of coastal environments. The urban condition contained pictures of major cities in the United States or Europe and a recorded sound of Times Square in New York City. After being exposed to the sounds and/or pictures, participants completed the cognitive battery and affect measures again. Participants rated the nature conditions as more relaxing than the urban conditions. However, participants scored higher on negative affect and lower on positive affect at post-test compared to pre-test, regardless of the condition. The authors believe that this effect was due to fatigue, resulting from the cognitive tasks, and that the restoration period was not long enough to overcome this. Finally, no effect was found of the conditions on the cognitive tasks, exposure to images and sounds of nature did not benefit cognitive performance more than exposure to urban environments did. It was concluded that exposure to pictures and/or sounds of a coastal environment was insufficient to improve cognitive performance on this cognitive battery.

These studies were conducted on the basis of a second central theory in restorative environments research, i.e., the Attention Restoration Theory (ART; Kaplan & Kaplan, 1989). ART is centred around the idea that natural environments can restore depleted cognitive resources (White et al. 2013). ART argues that people's capacity to direct attention is susceptible to fatigue after any extended use (Kaplan, 1995). According to ART, there are four features that make an experience or environment restorative and that can reduce directed attention fatigue, i.e., fascination, being away, extent of the environment, and compatibility to people's purposes (Kaplan, 1995). Natural environments often contain these components; Therefore, these types of environments are thought

to be especially effective in countering directed attention fatigue (Joye & van den Berg, 2018; Kaplan, 1995).

In conclusion, to support ART, a systematic review from Ohly et al. (2016) looked at what the relative attention restoration potential of natural settings was compared to other settings. They looked at 31 studies with a variety of study designs. Evidence was found that supported ART for several cognitive measures (DSF, DSB, and TMTB), but the authors couldn't find any effects for 10 other attention outcomes. Considering these studies, we can conclude that it is still unclear what aspects of attention are affected by nature exposure, and which aspects of natural environments are most important in this regard. Due to the inconclusive evidence regarding ART, we preferred to base our study on the SRT and focus on stress reduction as a means of restoration of well-being.

Besides these restorative effects, natural environments can also benefit well-being by promoting more efficient coping processes (Mayer et al. 2009). Well-being has been found to be associated with different types of adaptive coping strategies. Lazarus and Folkman (1984) distinguished two coping strategies, i.e., problem-focused coping (altering the source of the problem) and emotion-focused coping (reducing emotional stress associated with the problem) (Carver et al., 1989). Problem-focused coping, for example, positively predicts well-being, while emotion-focused coping is negatively associated with well-being (Mayordomo-Rodríguez et al., 2015). There is some research regarding contact with nature and coping strategies. For instance, Mayer et al. (2009) found that people had a greater ability to reflect on a life problem and experienced an increase in positive affect when they were in contact with nature. The increase in positive affect when being exposed to nature might also play an important role in coping with difficult or stressful situations. Folkman (2008) demonstrated the role of positive emotions in the stress process when the outcome of the problem is unfavourable. The author described this type of coping as meaning-focused coping:

> An appraisal-based coping in which the person draws on his or her beliefs (e.g., religious, spiritual, or beliefs about justice), values (e.g., ''mattering''), and existential goals (e.g., purpose in life or guiding principles) to motivate and sustain coping and well-being during a difficult time. (Park & Folkman, 1997, as cited in Folkman, 2008, p.7)

Meaning-focused coping is typically operationalized as acceptance and positive reframing coping strategies (Gan et al., 2013). In this study, we conceptualized hedonic and eudaimonic well-being in terms of stress reduction and meaning-focused coping, in order to encompass part of the broad construct of well-being.

Besides benefits to well-being, there has been some research exploring the positive relationship between exposure to natural environments and pro-environmental behaviours and attitudes. For example, Zelenski et al. (2015) showed participants nature (vs. architecture) videos before they were asked to play a fishing game. The fishing game was a measure of sustainable

behaviours. After watching a nature video, people exhibited more sustainable and cooperative behaviours compared to an architecture video. Furthermore, frequent participation in leisure activities in natural environments seem to have a positive effect on self-reported levels of pro-environmental behaviours (Rosa et al., 2018). In a literature review, DeVille et al. (2021) concluded that there is evidence for a positive association between time spent in nature and pro-environmental behaviours and attitudes. Initial research therefore provides support for the idea that contact with or exposure to natural environments can lead to more pro-environmental attitudes and behaviours, thereby increasing interest and connection to nature and providing benefits to the conservation of natural environments which are an important contributor to our well-being.

The Influence of the Coast on Well-being and Pro-environmental Attitudes

As noted above, natural environments can have a restorative effect on well-being by reducing stress. Natural environments can be green spaces, including parks, woodlands, gardens and forests (World Health Organization, 2016), or blue spaces. Blue spaces are defined by the BlueHealth project as "outdoor environments—either natural or manmade— that prominently feature water and are accessible to humans either proximally (being in, on or near water) or distally/virtually (being able to see, hear or otherwise sense water)" (Grellier et al., 2017, p.3). Blue spaces in particular have been considered to be restorative environments (White et al., 2020). The coast is considered to be a type of blue space that has gained more attention in research, with an increasing number of studies demonstrating a positive effect of the coast on well-being. For instance, when looking at self-reported feelings of restoration in different natural environments, White et al. (2013) found that coastal environments were the most restorative, followed by rural/countryside and urban greenspaces, respectively. In England, MacKerron and Mourato (2013) used a smartphone app to send out surveys to measure subjective well-being while also taking into account participants' location, the weather, whom they were with, and what they were doing at the time of questioning. It was found that participants' subjective well-being was higher when they were outdoors compared to being indoors or in a vehicle and was highest in coastal and marine margins. Additionally, proximity to the coast in England is associated with better self-reported health, and this effect was stronger for people living in more deprived areas (Garrett et al., 2019; Wheeler et al., 2012). These findings were recently replicated for the Flemish coast in Belgium. According to Hooyberg et al. (2020), people that lived close to the coast (<5km) reported better general health compared to people living more than 50km away. Along the same line, Severin et al. (2021) looked at access and visits to the coast in relation to well-being during the first national lockdown that was enforced between March and June 2020 to restrict further spread of the COVID-19 virus. Restrictions in circulation made the coast inaccessible for a large part of the Belgian population. The study therefore shows that people who

had access to the coast reported higher well-being compared to those that did not. More specifically, coastal residents experienced less boredom and worry, and higher happiness than inland residents.

In addition to benefits to well-being, there are also indications that exposure to coastal environments can influence the level of pro-environmental behaviours and attitudes (White et al., 2020). Alcock et al. (2020) found a direct positive effect of living near the coast (<5km) compared to living in inland areas (>20km) on pro-environmental behaviours in England. This relationship was only partially mediated by nature visit frequency and nature appreciation, which suggests there might be something else to the coast that can influence these behaviours aside from nature appreciation and nature visit frequency. In New Zealand, similar results were found where people who live <10km from the coast had a higher belief in climate change and were more supportive of government regulations regarding carbon emissions compared to people living further away (>100km) (Milfont et al., 2014).

Limitations

Despite the positive findings regarding the relationship between the coast, well-being, and pro-environmental attitudes, there are still some aspects that are left to be explored. For example, the study of Hooyberg et al. (2020) looked at four mechanisms that could potentially explain the positive association between coastal proximity and general health (i.e., physical activity, mental health, social appreciation, and air pollution) but did not find any significant mediating effects. According to the authors, the reason no mediating effects were found, in contrast to similar studies from other countries, is because of the heterogeneous character of the Belgian coast. The majority of the literature focuses solely on the effects of exposure to beaches and seawater. The Belgian coastline however consists of a heterogeneous landscape with urban, rural, and natural areas. Therefore, the mediating effects typically found in the literature are perhaps different according to the different types of landscapes present at the Belgian coast.

The difference between different coastal features in terms of their effect on well-being is still unclear. Litter, for example, can also influence the restorative effects of coastal environments. A study by Wyles et al. (2016) showed participants pictures of coastal environments and manipulated the presence of litter and the tides in these pictures. It appeared that if litter was present, the restorative properties of the coastal environment were reduced. Public litter had a stronger negative effect than fishing litter, mainly because public litter was perceived as intentionally left there by other people. Interestingly, the presence of litter also elicited a behavioural intention to actively deal with the litter and remove it. The litter therefore seemed to encourage pro-environmental attitudes in the participants, despite having a disruptive effect on the restorativeness of the coast. In another study, participants were exposed to pictures of different kinds of rural and urban settings while they were exercising on a treadmill (Pretty et al., 2005). Some of the photographs contained unpleasant

elements, such as broken machinery, damaged trees, rubbish, and graffiti. Exercise alone was found to reduce blood pressure, increase self-esteem, and have a positive effect on mood. Pleasant urban and rural scenes increased these benefits; However, unpleasant scenes reduced these positive effects of exercise, with the rural unpleasant scenes having the most detrimental effect. Moreover, Wilson et al. (1995) found that pictures of waterscapes that include litter were less liked and less appealing for recreational activities. Litter, a posted health warning, aquatic vegetation, and surface foam resulted in reduced liking of the scene. The presence of litter therefore potentially plays an important role in the positive effects the coast has on well-being.

Despite the increasing number of studies showing a beneficial effect of coastal environments on well-being, a systematic review by Gascon et al. (2017) of quantitative studies investigating the benefits of blue spaces on well-being found mixed results. The evidence for an association between blue spaces and general health was insufficient to make any firm conclusion. For mental health, there was some evidence suggesting that blue spaces can benefit mental health and well-being, but there was a substantial heterogeneity between the studies and the number of studies remained limited. In the context of these limitations, we wanted to evaluate, in the present study, the effect of different coastal environments and the effect that the presence of plastic litter may have on the benefits experienced at the coast. To fully understand the effect of the coast on well-being, it is important to consider the possible mechanisms that explain this effect.

Emotional Mechanisms Explaining the Relationship Between Coastal Environments, Well-Being, and Pro-environmental Attitudes

A range of possible mechanisms have been proposed that potentially underly the relationship between blue spaces, well-being and pro-environmental behaviours and attitudes, but there is no consensus yet as to the importance of each mechanism. White et al. (2020) proposed a framework with three potential pathways, namely, mitigation (harm reduction), instoration (promotion of positive effects), and restoration. Additionally, Willis (2015) looked at the human needs approach in terms of explaining the relationship between coastal environments and psychological well-being and found that nature can fulfil a range of human needs (e.g., aesthetic appreciation, leisure and recreation, need to know and understand, freedom and escapism) that are essential in order to achieve a high level of psychological well-being. Finally, Bell et al. (2015) described the relationship between exposure to the coast and well-being in terms of therapeutic landscape experiences. In this study, the authors interviewed residents of two coastal towns and asked about their experience of the coast and how these experiences contributed to their well-being. The narratives of the participants contained symbolic experiences, both cultural and personal symbolism, including emotional attachment to the coast. Furthermore, coastal environments were

experienced as landscapes that could foster feelings of competence, purpose, and achievement. Moreover, participants described immersive experiences at the coast, where they were able to clear their mind and focus, which is in line with ART (Kaplan & Kaplan, 1989), mentioned above. Finally, there seemed to be an important social dimension to participants' experiences at the coast as well.

Several mechanisms have been investigated as to what can explain the relationship between exposure to natural environments and pro-environmental behaviours. Examples are an attention restoration pathway, whereby perceiving nature as being restorative can influence the promotion of pro-environmental behaviours (Berto & Barbiero, 2017) and promotion of pro-environmental behaviours through feeling connected to nature (Rosa & Callado, 2018). In conclusion, a literature review of DeVille et al. (2021) indicated that the mechanisms underlying the relationship between nature contact, pro-environmental attitudes and pro-environmental behaviours are still unclear.

In our study, we wanted to focus on specific emotions experienced while being exposed to coastal environments, as the role of emotions has not yet been fully explored. We focused on two emotions in particular, namely awe and nostalgia. Additionally, we also studied the role of nature connectedness, as another mechanism through which coastal environments may benefit well-being and affect pro-environmental attitudes. The following section, thus, explores how the emotional states of awe, nostalgia, and nature connectedness could be potential mediators of the relationship between coastal environments, well-being, and pro-environmental attitudes.

Awe

Keltner and Haidt (2003) describe awe as an emotion that contains two characteristics, namely a perception of vastness and a need for accommodation. This perception of vastness entails everything that is perceived to be much larger than the self (Keltner & Haidt, 2003). This can be either physically larger, but also 'larger' in social size (i.e., authority, fame), or intense sensory experiences (Keltner & Haidt, 2003). Accommodation relates to how the mind is challenged as it tries to make sense of the stimulus that is perceived as vast (Keltner & Haidt, 2003).

There has been some research regarding the relationship between awe and well-being. Zhao et al. (2019) demonstrated that dispositional awe was positively correlated with subjective well-being, and this relationship was mediated by both meaning in life and materialism. People high in dispositional awe seemed to perceive their lives as more meaningful, which consequently increased their subjective well-being. Additionally, Gordon et al. (2017) looked at daily awe experiences of participants in a 14-day diary study, in which they reported awe-inducing experiences, experienced emotions, and completed a measure of well-being. Well-being was measured using two measures, i.e., daily ratings of "happiness" and daily ratings of life satisfaction, which were combined to a single measure of daily well-being. The authors investigated both threat-based awe experiences (where awe was elicited by something threatening or dangerous) and positive awe experiences. Positive awe

experiences seemed to be associated with higher levels of well-being, compared to experiences without feelings of awe. Threat-based awe experiences were not found to be related to higher well-being compared to no-awe experiences. Feelings of awe therefore seem to be an important contributor to well-being.

Recent research demonstrates that awe, specifically induced by nature, also has a positive effect on well-being. For example, Anderson et al. (2018) looked at the role of emotions, and specifically awe, in explaining the positive effects of nature on well-being. The authors found an improvement in well-being and stress-related symptoms in veterans and at-risk youth one week after a white-water rafting trip. Interestingly, feelings of awe experienced during the trip seemed to be related to these improvements, after controlling for five other positive emotions that are triggered by nature (joy, amusement, gratitude, contentment, and pride). In a second study, Anderson et al. (2018) investigated feelings of awe in nature experiences in daily life, with the use of dairies. The results suggest that nature experiences were related to a higher satisfaction with life. Moreover, feelings of awe were related to these nature experiences and this relationship was stronger for awe than for the other emotions mentioned beforehand. When looking at longitudinal well-being as the outcome, the authors found that the relationship between daily nature experiences and longitudinal well-being was mediated by a sequence of daily awe and daily life satisfaction. These findings suggest that awe might be an important element in the restorative effects of nature exposure and may be beneficial to hedonic well-being.

Additionally, Joye and Bolderdijk (2015) looked at the effects of awe-inspiring or awesome nature on several outcomes. Awesome nature is described as scenes including grand mountain scenery, tornadoes, deep canyons, and lighting storms. Participants were shown a slideshow of pictures of awesome nature, mundane nature, or neutral objects. The authors measured the type and strength of emotions experienced during the slideshow, as well as evaluation of the pictures, the participants' mood, and two prosociality measures. It was found that participants experienced more awe when they had watched the awesome nature slideshow compared to mundane nature or neutral objects. Participants also evaluated it as more beautiful. Awesome nature made participants feel significantly smaller and elicited more feelings of interest compared to the mundane nature and neutral condition. Being exposed to awesome nature improved mood in participants above and beyond the effect of the mundane nature condition, arguing for a unique influence of awesome nature on mood. This unique influence on mood stemmed from the feeling of awe experienced by participants during the slideshow.

More specifically to the coast, in a qualitative study by Jarratt and Sharpley (2017), the authors investigated the emotional influence of the coast on tourists visiting a coastal environment in England. Respondents referred to the coast as awe-inspiring, linking the awesome nature to

creation and their place in the world. Visitors experienced the coast as a place to which they felt an emotional and spiritual connection to nature, because they felt like they could reconnect with something bigger. The coast was considered to be a place of beauty and a place that provided the opportunity to contemplate and reflect. The coast also had the capacity to put visitors' concept of time into perspective and remove them from the busy modern world, providing them with an opportunity to restore. Similarly, Pearce et al. (2017) looked at participants' awe-inspiring experiences in the Kimberley region, a coastal region in far North Western Australia. Participants were interviewed about their most awe-inspiring experience and why that was. Five aspects that helped foster participants awe-inspiring experiences were identified. First, participants mentioned marine fauna as an important aspect, as seeing and interacting with marine animals was very exciting. Second, the aesthetics of the coastal region, including the unique landscape, the colours, and the sunsets all seemed to be awe-inspiring features of the area. Next, the ecological phenomena that were unique to the Kimberley area, namely, Montgomery Reef and the Horizontal Falls, contributed to the awe-inspiring experiences. These phenomena are a result of the extreme tidal fluctuations of the coastal area. Also, the vast geological landscape of the Kimberley area, with huge gorge cliff formations added to the awe-inspiring experiences. Finally, participants mentioned that having the opportunity to reflect and obtain a different perspective of the world through experiencing the Kimberley coasts, fostered awe-inspiring experiences as well. These studies suggest that feelings of awe and small self might play a role in the relationship between exposure to nature and aspects of eudaimonic well-being.

In addition to the role that awe plays in the relationship between nature exposure and well-being, there are also indications that awe might have an effect on pro-environmental behaviours and attitudes. Zhao et al. (2018) conducted several studies to investigate whether awe can influence environmentalism, operationalized as a combination of three indicators, i.e., ecological behaviour, environmental sacrifice, and pro-environmental intention. Participants higher in dispositional awe tended to exhibit more ecological behaviour than those who were lower in dispositional awe. In a second study, participants were asked to recall a narrative from a time they experienced awe. Feelings of awe were positively associated with environmental sacrifice. Finally, the authors induced awe in participants by exposing them to awe-inspiring video clips, i.e., extraordinary nature and childbirth, the authors included childbirth to also look at social elicitors of awe. Pro-environmental intention was compared to a mundane nature condition and a neutral condition, which the authors expected not to elicit awe. Pro-environmental intention was higher in the extraordinary nature condition compared to the mundane nature and neutral condition. The effect of awe was partially mediated by a decrease in participants' social dominance.

In conclusion, this overview of findings suggests that awe could play an important role in explaining the effect of coastal environments on well-being and pro-environmental attitudes. A second emotion that seems to play a role in this effect is nostalgia, which we will discuss in the following section.

Nostalgia

Wildschut et al. (2006) conducted several studies to unravel the content, triggers, and functions of nostalgia. In regard to the content, nostalgic experiences appeared to mainly revolve around one's self, the self in relation to others, and momentous events. Nostalgic narratives often contained both negative and positive aspects, but frequently progressed from a negative to a positive life scene, forming a redemption sequence. These narratives also seemed to contain more positive than negative affect. In terms of triggers, it was found that the most common triggers for nostalgia were negative mood and loneliness. By feeling lonely, one is therefore inclined to feel nostalgic and reflect on narratives that include the self in relation to others. This appears to have a positive effect as nostalgia was found to bolster social bonds, increase self-regard, and generate positive affect. Nostalgia can thus be conceptualized as a psychological resource that buffers negative indicators of well-being (Sedikides & Wildschut, 2016; Wildschut et al., 2006).

More specifically, Sedikides and Wildschut (2016) described several health benefits associated with nostalgia, reported in three different categories. First, nostalgia seemed to advance certain social health benefits, including promotion of social connectedness, perceptions of social support, and decreasing attachment anxiety through a promotion of the attachment system. Second, there seemed to be several benefits related to the self. Nostalgia was found to reinforce self-esteem and boost optimism. Finally, the authors described several existential benefits of nostalgia. Nostalgia appeared to amplify feelings of meaning in life, and this connection to meaning in life seemed to be mediated by the social aspects of nostalgia.

Nostalgia has also been suggested to be an important element of nature experiences. Jarratt and Gammon (2016) investigated the nostalgic feelings of people at the seaside in a qualitative study. The seaside elicited feelings of nostalgia because it was associated with a reconnection to one's own past, childhood and loved ones who have passed. The seaside-induced nostalgia also encouraged people to find meaning and reconnect to the past. Finally, it encouraged supporting family narratives and had a clear social dimension. Considering that nostalgia can generate positive affect (Wildschut et al., 2006), increase meaning in life, and its connection with coastal environments (Jarratt & Gammon, 2016; Sedikides & Wildschut, 2016), suggests that nostalgic experiences at the coast might play a role in the restorative effects of the coast and may be beneficial to both hedonic and eudaimonic well-being.

Additionally, nostalgia has been found to influence pro-environmental behaviours. Nostalgia seemed to increase recycling behaviour in participants when feelings of nostalgia were induced by either nostalgic music, nostalgic products, and through a recall task (Zhang et al., 2021). The authors also found a mediating effect of sense of meaning. They state that nostalgia can induce a sense of meaning and that participants subsequently engaged in meaningful behaviours, like recycling, to maintain this sense of meaning. Recycling behaviour can be considered a specific type of pro-environmental behaviour and was measured by real recycling behaviour in a cafeteria and self-reported recycling intentions (Zhang et al., 2021).

These studies suggest that nostalgia might play an important role in the relationship between the coast, well-being, and pro-environmental attitudes. Besides these two emotions, we explore nature connectedness as a potential mediator in the following section.

Nature Connectedness

Nature connectedness has been described by Mayer and Frantz (2004) as "a measure of an individual's trait level of feeling emotionally connected to the natural world" (p. 503). One's nature connectedness can be measured at the trait and state level, as it can fluctuate depending on context (Capaldi et al., 2014). There is evidence that nature connectedness, measured with the NR scale and the CNS, is positively correlated with several different aspects of well-being (Olivos & Clayton, 2016). Additionally, Pritchard et al. (2019) concluded in their meta-analysis that there is evidence for a small positive association between nature connectedness and eudaimonic well-being.

Feeling connected to nature has been considered as a possible mechanism through which nature can influence well-being. For example, Martin et al. (2020) found that trait nature connectedness was positively associated with both eudaimonic well-being and pro-environmental behaviours over and above contact with nature and socio-demographic factors. According to the authors, trait nature connectedness modifies the way in which people respond to contact with nature. Specifically, visiting natural spaces only benefited eudaimonic well-being for people with lower levels of trait nature connectedness, which suggests that people who are less connected to nature benefit most from contact with natural environments. More specifically to the coast, Wyles et al. (2019) investigated whether levels of nature connectedness would differ depending on environment type, comparing coastal, urban-green, and rural-green environments. Additionally, the authors looked at how this was associated with psychological restoration. The authors concluded that nature visits were positively associated with both nature connectedness and psychological restoration. Furthermore, the study showed that visits to the coast were related to greater nature connectedness and psychological restoration than urban-green environments.

There are also studies that examined the link between nature connectedness and pro-environmental behaviours. Alcock et al. (2020) for example, found a positive association between

appreciation for nature and pro-environmental behaviour. Appreciation for nature was expressed by several measures of feeling a personal connection with nature, so it was considered to be equivalent to nature connectedness. Additionally, Gosling and Williams (2010) looked at the relationship between pro-environmental behaviour and nature connectedness. A postal survey was conducted with Australian farmers in which the authors asked the participants about their behaviour and behavioural intentions towards native vegetation on their farm and their concerns (or valued objects) associated with it. It was found that nature connectedness was associated with pro-environmental behaviours towards native vegetation, namely remnant vegetation protection and intended replanting of native vegetation. A causal relationship between nature connectedness and pro-environmental behaviour was not found but the results did show that a feeling of nature connectedness can have an influence on how participants interacted with native vegetation and that it was mediated by environmental concern expressed by the farmers. Considering the findings above, we hypothesize that nature connectedness might mediate the relationship between exposure to nature and pro-environmental behaviour, just as for its relationship with well-being.

The Current Study

In the present study, we wanted to explore the role of emotions – awe and nostalgia – and nature connectedness in explaining the relationship between coastal environments, well-being, and pro-environmental attitudes. There is a body of evidence suggesting a positive relationship between coastal environments, well-being, and pro-environmental attitudes, although there is no consensus on the underlying mechanisms of this relationship. One of these mechanisms could involve the emotions of awe and nostalgia, in addition to nature connectedness. It is also still unclear how heterogeneity in coastal environments and the presence of litter affects the beneficial properties of the coast. In this study, we therefore had two aims. First, we wanted to look at nature connectedness and the emotions of awe with feelings of small self and nostalgia as potential mediators in explaining the relationship between coastal environments, well-being, and pro-environmental attitudes. A measure of small self was added, as feelings of a small self are considered to be an important characteristic of awe (Piff et al., 2015). Well-being was measured in terms of stress reduction and meaning-focused coping, in order to assess both hedonic and eudaimonic well-being. Second, we wanted to look into the differential effect of different coastal landscapes such as dunes or the beach and evaluate the effect of the presence of litter.

We conducted an online experimental study in which we asked participants to recall a stressful moment in their lives, measured their self-reported stress level, and exposed them to a video clip of either a coastal environment or an urban environment, each with or without plastic. The coastal environments were either a landscape containing dunes or the beach with a sunset. The

urban environment was an urban street. We then measured again their self-reported stress level, as well as self-reported emotions, meaning-focused coping, and pro-environmental attitudes.

Four hypotheses were tested. The first hypothesis was that exposure to the video clips would decrease the stress levels in all conditions, but that there would be a higher decrease in both coastal conditions compared to the urban conditions (main effect of environment type) and in the conditions without plastic compared to the conditions with plastic (main effect of plastic) (H1a). Within this hypothesis, we expected to see an interaction effect between the presence of plastic and environment type on stress reduction (H1b). We also expected that levels of meaning-focused coping and pro-environmental attitudes would differ between the conditions (H1c). The second hypothesis was that we expected exposure to the coastal conditions, compared to the urban conditions (main effect of environment type), and absence of plastic (main effect of plastic), would elicit higher levels of awe with feelings of small self, nostalgia, and nature connectedness (H2). The third hypothesis was that the levels of awe with feelings of small self, nostalgia, and nature connectedness would be positively correlated with the change in stress from pre- to post- video clip, meaning-focused coping and pro-environmental attitudes (H3). Finally, we hypothesized that awe with feelings of small self, nostalgia, and nature connectedness would mediate the relationship between exposure to the video clips and change in stress, meaning-focused coping, and pro-environmental attitudes (H4).

Method

Our study's aims, hypotheses, design, and the statistical analysis plan were pre-registered on the Open Science Framework (OSF) registry prior to the data collection (https://osf.io/qwkvc).

Participants

A total of 251 first-year psychology students completed the online survey on the Limesurvey platform (Limesurvey Project Team & Schmitz, 2020). To be included in the study, participants had to be older than 18 years old, Dutch-speaking, and live in Belgium. Of the 251 participants, three were excluded because they scored either 1 or 2 on a five-point Likert scale measuring honesty, indicating they did not follow the mental visualization exercise correctly. 205 participants (82.7%) identified as women, 41 (16.5%) as men, and two participants (0.8%) identified as other. Age ranged from 18 to 53 years old (M = 18.97, SD = 2.93), with more than half of the participants (65.7%) aged 18 years old. A large majority of the participants (91.1%) were educated on a general secondary school level (ASO).

Design

The study used an experimental and randomized mixed design with six conditions that differed on two factors: environment type and the presence of plastic. The environment type had three different conditions: a coastal environment with a sunset on the beach (see Figure 1), a coastal environment with dunes (see Figure 2) and an urban environment, specifically an urban street (see Figure 3). The presence of plastic had two conditions, namely the presence of plastic or the absence of plastic. This makes for a total of six different conditions with a different video clip for each condition. Three dependent variables were measured: stress reduction, meaning-focused coping, and pro-environmental attitudes. The potential mediators were also measured: awe with feelings of small self, nostalgia, and state nature connectedness. We manipulated the participants' stress level by asking them to recall a stressful moment. We also included a number of covariates, namely age, gender, level of education, subjective physical health, dispositional positive emotions (contentment, pride, compassion, amusement, joy, awe, and nostalgia), meaning in life, trait nature connectedness, and engagement with beauty.

Figure 1

Screenshot of the Video of the Coastal Environment with a Sunset and without Plastic

Figure 2

Screenshot of the Video of the Coastal Environment with Dunes including Plastic

Figure 3

Screenshot of the Video of the Urban Street without Plastic

Materials

This study was conducted in Dutch. All scales used in the current study were Dutch versions of the original scales, that which we either translated ourselves using independent back-translation or that were translated by other authors and empirically validated. The back-translation consisted of first translating the scales into Dutch and then having an external person (unaware of the aims of the scales) translate them back to English. The authors of each scale (except for the brief COPE) then verified and gave feedback on the back-translation. The subsequent Dutch-translated scales were adjusted according to this feedback. The complete questionnaire is included in the appendix.

Control Variables

A number of potential covariates were included. Participants reported several demographic variables, namely their age, gender and level of education. They also rated their subjective health on a five-point Likert scale from ranging from 1 (*very good*) to 5 (*very bad*).

Next, we measured the dispositional or trait level of every potential mediator, as well as other positive emotions, as possible covariates. We first used the Dispositional Positive Emotion Scale (DPES; Shiota et al., 2006), without the Love subscale. The scale consists of 32 items that were rated on a Likert scale ranging from 1 (*do not agree at all*) to 7 (*fully agree*). There were subscales for positive emotions of contentment, pride, compassion, amusement, joy, and awe. Each subscale consists of five to six statements. In the awe subscale, one item was removed (i.e., "I often look for patterns in the objects around me."), due to studies showing low reliability for said item (Dixson et al., 2018). Cronbach's alpha in this sample was $\alpha = .90$ for the contentment subscale, $\alpha = .75$ for the pride subscale, $\alpha = .79$ for the compassion subscale, $\alpha = .70$ for the awe subscale, $\alpha = .78$ for the amusement subscale, and $\alpha = .82$ for the joy subscale, which shows good to excellent reliability of the DPES.

Additionally, we also measured participants' dispositional level of nostalgia with the Southampton Nostalgia Scale (SNS; Barrett et al., 2010), which consists of four questions about their perceived value of nostalgia that participants rated on a seven-point Likert scale (1 = *not at all*, 7 = *very much*). Example items are: "How valuable is nostalgia to you?" and "How important is it for you to bring to mind nostalgic experiences?" Next, there were two questions about how often participants experience nostalgia, rated on a seven-point Likert scale ranging from 1 (*very rarely*) to 7 (*very frequently*). Participants also had to specify how many times they thought about nostalgic experiences specifically, either "*at least daily*", "*three to four times a week*", "*twice a week*", "*once a week*", "*once or twice a month*", "*every few months*", "*once or twice a year*". Reliability for the SNS was excellent as Cronbach's alpha in this sample was $\alpha = .91$.

Finally, trait nature connectedness was measured using the shortened version of the Nature Relatedness Scale (NR-6; Nisbet & Zelenski, 2013). Participants rated six statements on a five-point

Likert scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*). Cronbach's alpha was α = .83, which shows good reliability for the NR-6 for this sample. Examples of items are: "My ideal vacation spot would be a remote, wilderness area." and "My relationship with nature is an important part of who I am.".

Meaning in life was measured using the Meaning in Life Questionnaire (MLQ; Steger et al., 2006), translated into Dutch by van den Heuvel from Utrecht University. Participants rated 10 statements on a 7-point Likert scale ranging from 1 (*absolutely untrue*) to 7 (*absolutely true*). Cronbach's alpha in this sample was α = .75, which shows acceptable reliability. There were two subscales, the presence subscale (α = .85) and the search subscale (α = .88), each consisting of five items. Reliability for the two subscales was good. Examples of items are: "I understand my life's meaning." and "I am always looking to find my life's purpose.". Meaning in life was included as a potential covariate due to its associations with the mediators (Sedikides & Wildschut, 2016; Zhao et al., 2019), and the dependent variables (Zhang et al.,2021).

The participants' tendency to engage with or perceive beauty in nature was measured using the beauty in nature subscale of the Engagement with Beauty Scale (EBS; Diessner et al., 2008). Participants rated four statements on a seven-point Likert scale ranging from 1 (*very unlike me*) to 7 (*very much like me*). Examples of items are: "I notice beauty in one or more aspects of nature." and "When perceiving beaty in nature I feel changes in my body, such as a lump in my throat, an expansion in my chest, faster heartbeat, or other bodily responses." Reliability for the EBS was good, with a Cronbach's alpha of α = .80 for this sample. Engagement with beauty has been found to moderate the relationship between nature connectedness and well-being. Specifically, people who tend to perceive beauty in nature experience more beneficial effects of being connected to nature (Zhang et al., 2014). For these reasons we thought it would be appropriate to include participants' tendency to engage with or perceive beauty in nature as a potential covariate.

Stress Recall and Self-Reported Stress

Stress was manipulated by asking the participants to recall a recent stressful moment from their lives and mentally visualize it for one minute. During this mental visualization, participants were asked to concentrate on the feelings of stress they experienced in their body and mind. Afterwards, we assessed the extent of the mental visualization in participants by using three statements that participants rated on a five-point Likert scale ranging from 1 (*do not agree at all)* to 5 (*fully agree*). The following statements were used: "I had the feeling I was mentally reliving this moment.", "I visualized the moment in great detail." and "I saw the moment like it truly happened.". To gather more detail regarding the stress recall, we also asked participants how long ago the stressful moment had happened and to rate how stressful the moment was for them at the time it happened on a 10-point Likert scale, ranging from 1 (*not stressed at all*) to 10 (*very stressed*). Next, we asked them to

explain the main cause of the stressful moment they had visualized. Finally, participants rated their current stress level on a 10-point Likert scale ranging from 1 (*not stressed at all*) to 10 (*very stressed*), hereby referred to as "pre-stress". After watching the video clip, we asked participants to rate their stress level again on the same scale, hereby referred to as "post-stress".

Video Clips

The video clips of the coastal conditions, either containing dunes or a sunset, were recorded on the beach of De Haan in Belgium. The video clips were recorded using a Canon EOS60D in automatic settings, set on a tripod. For the conditions where plastic was present, plastic litter (e.g., plastic bottles, beer cans, industrial packaging) was added to the scenes. The exact same locations, camera settings, and tripod positions were used for each environment type in the plastic and non-plastic conditions. The video clips of the urban conditions were recorded on a street in Ghent, Belgium. The condition where plastic was present was also recorded at the exact same location, using the same camera settings and tripod position. The videos were approximately two minutes long and contained audio as well.

Emotions

After watching the video, we asked participants to what extent they experienced amusement, awe, fear, nostalgia, gratitude, compassion, sadness, contentment, pride, and relaxation while watching the video. We asked them to rate the experience of each emotion on a seven-point Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*).

As an additional measure of awe, we asked participants about feelings of a small self, which characterizes awe (Piff et al., 2015). We used 10 items, taken from a study of Piff et al. (2015), that make up a reliable measure of feelings of small self. Participants rated these items on a seven-point Likert scale, ranging from 1 (*completely disagree*) to 7 (*completely agree*). Examples of items are: "I feel the presence of something greater than myself." and "I feel insignificant in the grand scheme of things.". Cronbach's alpha was $\alpha = .93$ in this sample, which shows excellent reliability for the scale measuring feelings of small self.

Nature Connectedness

We measured participants' level of state nature connectedness using the state version of the Connectedness to Nature Scale (CNS; state version; Mayer et al., 2009). Participants were asked to rate 13 statements based on how they felt at the time of questioning. They rated the statements on a seven-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Examples of items are: "Right now, I'm feeling a sense of oneness with the natural world around me." and "At this moment, I'm feeling a kinship with animals and plants.". Cronbach's alpha was $\alpha = .87$ in this sample, which shows good reliability for the CNS.

Meaning-focused Coping

In order to see to what extent the environment type and presence of plastic influenced the tendency to adopt a meaning-focused coping style, we asked participants how they would cope if they were again confronted with the stressful moment they recalled earlier, after being exposed to the video clip. We used the brief COPE (COPE inventory; Carver, 1997) to assess their coping style. Participants had to rate 14 items on a four-point Likert scale, ranging from 1 (*I haven't been doing this at all*) to 4 (*I've been doing this a lot*).

We aggregated the means of the items related to positive reframing and acceptance subscales to make a single measure of "meaning-focused coping" (α = .66). Reliability was questionable for the meaning-focused coping measure in this sample. Specifically, four items were aggregated. An example of an item of the positive reframing subscale is: "I've been trying to see things in a different light, to make it seem more positive.". An example of an item of the acceptance subscale is: "When I am confronted with a difficult or stressful event, I usually learn to live with it.".

Pro-environmental Attitudes

Finally, to measure participants' level of pro-environmental attitudes, we used the abbreviated New Ecological paradigm Scale (NEP; Cordano et al. 2003; Dunlap et al., 2002). Participants rated eight statements on a seven-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Examples of items are: "The balance of nature is very delicate and easily upset." and "If things continue on their present course, we will soon experience a major ecological catastrophe.". Cronbach's alpha was α = .79 in this sample, which shows acceptable reliability for the NEP.

Procedure

The study was completed by participants through an online survey on the Limesurvey platform (Limesurvey Project Team & Schmitz, 2020) from May 21st through November 4th, 2021. Participants were recruited through the Sona System (Sona Systems, https://psykuleuven.sona-systems.com/) of the Faculties of Psychology and Educational Sciences of KU Leuven and Ghent University. The survey was advertised on social media as well, and the study's aim was portrayed as investigating individual reactions to the environment. Participants that signed up for the study on the Sona System received an e-mail with a link to the study. Participants were randomly assigned to one of the six conditions using the token system on the Limesurvey platform. They were given a token that referred to a specific group (A, B, C, D, E, or F), with every token group representing one of the six conditions.

After receiving the link to the study, participants had to sign their informed consent in order to start the survey. The survey typically took 24 minutes to complete. Compensation for participants

was provided through Sona credits and participants were informed of the possibility to be debriefed. The study was approved by the Ethical Committee of the faculty of Psychology and Educational Sciences from Ghent University.

Statistical Analysis

To test the effect of the condition variable on stress (H1a), a three-way mixed ANCOVA model was used. The within-subject factor was time, the between-subject factors were environment type and plastic and the dependent variable was self-reported stress. There were two different time points, i.e., before watching the video clip and after watching the video clip. An interaction or additive effect between the factors environment type and plastic on stress (H1b) was assessed using the same ANCOVA model. The effect of the condition variable on dependent variables meaning-focused coping and pro-environmental attitudes (H1c) was tested with two-way ANCOVA models with environment type and plastic as between-subject factors. The effect of exposure to the different conditions on the potential mediators (H2) was assessed using two-way ANCOVA models with awe, feelings of small self, nostalgia, and nature connectedness as dependent variables and environment type and plastic as between-subject factors.

In the ANCOVA models, only covariates that were linearly related to the dependent variable, theoretically relevant, and that did not violate the homogeneity of regression slopes assumption were included in the analysis of each hypothesis. Outliers were identified by looking at the studentized residuals of the dependent variable. If they exceeded an absolute value of 3 standard deviations, these data points were identified as outliers. In these cases, results were compared with and without the outliers. Assumptions of normality, homogeneity of variances, and homoscedasticity were tested for. The assumption of homoscedasticity was assessed by visual inspection of scatterplots of the studentized residuals against the predicted values of the dependent variable for each combination of the independent variables (i.e., environment type and plastic) in every model. In each of the models, there was homoscedasticity within the conditions. Homogeneity of variances was tested using Levene's test of homogeneity of variances in every model. The assumption of homogeneity of variances was not violated for any of the models. There were no serious violations of the assumption of normality in any of the models either, as assessed by Shapiro-Wilk's test and inspecting the skewness and kurtosis values.

To test the effect of the potential mediators on the dependent variables (H3), Pearson correlations between awe, feelings of small self, nostalgia, nature connectedness, and the dependent variables were assessed. Finally, to test whether awe, feelings of small self, nostalgia, or nature connectedness mediated the relationship between exposure to coastal environments and stress reduction, meaning-focused coping, and pro-environmental attitudes, Model 4 of PROCESS macro

(Hayes, 2012) was used. Stress reduction was assessed by the difference between post-stress and pre-stress levels. As our main objective was to test for a mediation effect, the presence of a total effect of exposure to coastal environments on the outcome variables was not a necessity in order to test for indirect effects of the predictor variable on the outcomes (Loeys et al. 2015).

Results

Manipulation Check of Stress Recall

To check for correct manipulation of the stress recall, we first looked at the item mean of the mental visualization items (M = 3.52, out of a scale from 1 to 5), which indicated a high level of mental visualization. The mean level of pre-stress was 5.94 (out of a scale from 1 to 10) and there was a positive correlation between mental visualization and pre-stress levels (r = 0.45, p < .001). We therefore considered to have successfully manipulated stress with the use of the mental visualization task.

Effect of Environment Type and Plastic on the Dependent Variables

Stress Reduction

When controlling for the covariates physical health and search of meaning in life, no statistically significant three-way interaction was found between time, environment type and plastic $F(2, 240) = 0.272$, $p = .762$. A statistically significant two-way interaction was found only between time and environment type, $F(2, 240) = 6.49$, $p = .002$, partial $\eta^2 = .051$. In the pairwise comparisons, there was a statistically significant simple main effect of environment type at the post-stress level, $F(2, 240) = 5.86$, $p = .003$, partial $\eta^2 = 0.047$, but not at the pre-stress level (Table 1). Statistical significance of a simple main effect was accepted at a Bonferroni-adjusted alpha level of .016. The adjusted marginal mean post-stress score was higher in the urban conditions (M = 4.378, SE = 0.216), compared to the sunset conditions (M = 3.329, SE = 0.215), with a mean difference of 1.049, $p = .002$. The two-way interaction between plastic and time was not significant, $F(1, 240) = 0.27$, $p = .603$. Excluding the three outliers did not change the interpretation of the results.

In conclusion, the model provided partial support for hypothesis 1a, with a significant simple main effect for environment type. A graphic representation of the pre-stress and post-stress levels in each condition is provided in Figure 4. The post-stress score was higher in the urban conditions compared to the sunset conditions, with a small to medium effect size. There was no simple main effect for the presence of plastic. Hypothesis 1b was not supported, since the three-way interaction effect between time, environment type and plastic was not significant.

Table 1

Estimated Marginal Means, Standard Errors, and Univariate Analysis of Variance of Stress in the Urban, Dunes and Sunset Conditions

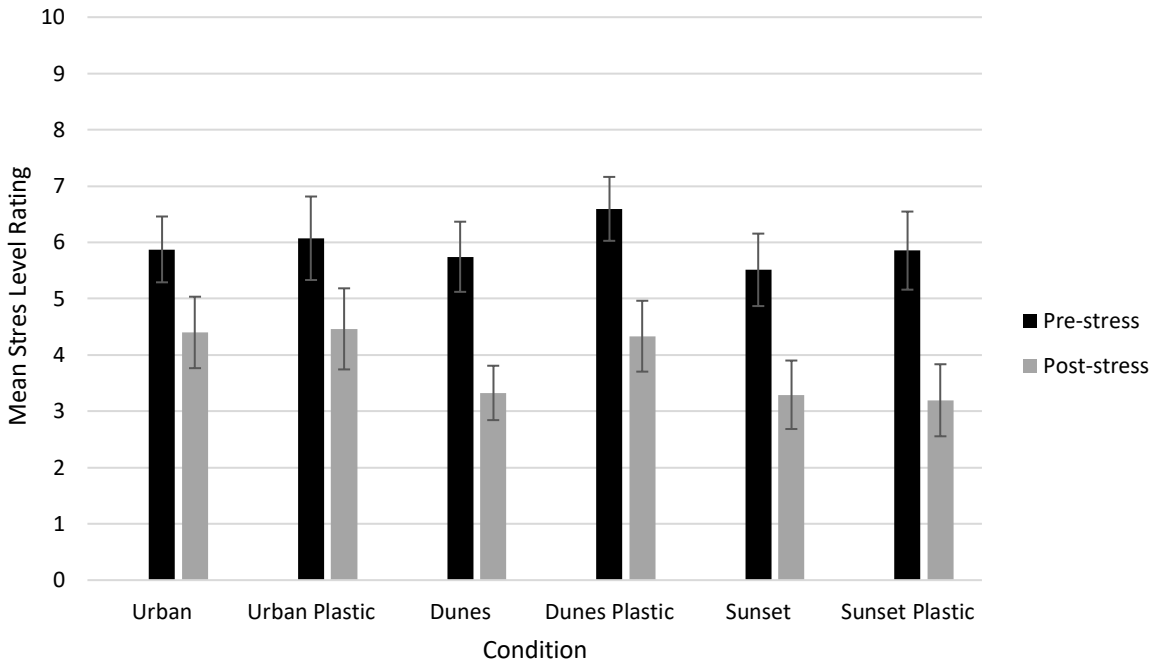
Variable	Urban		Dunes		Sunset		*F*	η_p^2
	M	*SE*	*M*	*SE*	*M*	*SE*		
Pre-stress	5.85[a]	0.22	6.15[a]	0.21	5.83[a]	0.22	0.68	.006
Post-stress	4.38[a]	0.22	3.8[a]	0.21	3.33[a]	0.22	5.86**	.047

Note. $^{**}p < .005$

[a] Covariates that were included in the model were evaluated at the following values: physical health = 3.77, search of meaning in life = 4.76.

Figure 4

Clustered Bar Graph with Pre-stress and Post-stress Levels for Each Condition



Meaning-focused Coping and Pro-environmental Attitudes

For meaning-focused coping, when controlling for covariates dispositional amusement, awe, contentment, joy, pride, and presence of meaning in life, no significant effects were found. There was no statistically significant interaction effect between environment type, plastic and meaning-focused coping, $F(2, 236) = 0.62$, $p = .538$. There were also no significant main effects for either

environment type, $F(2, 236) = 1.53$, $p = .219$, or plastic, $F(1,236)$, $p = .377$. Regarding pro-environmental attitudes, when looking at the adjusted model controlling for covariates dispositional awe and compassion, presence of meaning in life, trait nature connectedness, and participant's tendency to engage with beauty in nature, no significant effects were found. There was no significant interaction effect between environment type, plastic and pro-environmental attitudes, $F(2, 239) = 0.71$, $p = .495$. No significant main effects were found for either environment type, $F(2, 239) = 0.97$, $p = .38$, or plastic, $F(1, 239) = 1.24$, $p = .267$. In conclusion, we did not find support for Hypothesis 1c; there was no significant effect of the environment type or the presence of plastic on meaning-focused coping and pro-environmental attitudes.

Effect of Environment Type and Plastic on Potential Mediators

Awe with Feelings of Small Self

Looking at the adjusted model, controlling for dispositional awe and meaning in life, there was no statistically significant interaction between environment type and plastic on awe, $p = .70$. There was a significant main effect of environment type, $F(2, 240) = 31.69$, $p < .001$, partial $\eta^2 = .21$. The adjusted marginal mean awe in the urban conditions ($M = 2.44$, $SE = 0.15$) was lower than the dunes conditions ($M = 3.61$, $SE = 0.15$), with a significant mean difference of 1.17, $p < .001$, and the sunset conditions ($M = 4.11$, $SE = 0.15$), with a mean difference of 1.67, $p < .001$. The dunes and sunset conditions did not differ significantly (Table 2). When an outlier is excluded from the model, the dunes ($M = 3.61$, SE = 0.15) and sunset ($M = 4.11$, $SE = 0.15$) conditions do significantly differ, with a mean difference of 0.5, $p = .049$. No significant main effect was found for plastic, $F(1, 240) = 0.356$, $p = .114$.

In regard to small self, when controlling for dispositional awe, meaning in life, participants' tendency to engage with beauty in nature, and trait nature connectedness, no significant interaction effect was found between environment type and plastic on small self, $p = .516$. A significant main effect of environment type, $F(2, 237) = 14.31$, $p < .001$, partial $\eta^2 = .108$, was found. The adjusted marginal mean of small self was lower in the urban conditions ($M = 2.51$, $SE = 0.13$) compared to the dunes conditions ($M = 3.30$, $SE = 0.12$), with a mean difference of 0.79, $p < .001$, and the sunset conditions ($M = 3.39$, $SE = 0.13$), with a mean difference of 0.88, $p < .001$. The dunes and sunset conditions did not differ significantly (Table 2). There was no significant main effect of plastic on small self, $F(1, 238) = 0.07$, $p = .791$.

In conclusion, hypothesis 2 was partially supported for awe with feelings of small self, as there was a significant main effect of environment type on both awe, with a large effect size and small self, with a medium to large effect size. Both feelings of awe and small self were higher in both the coastal environments, dunes and sunset, compared to the urban environments. Presence of

plastic in the scenes did not seem to have a significant effect on levels of awe and feelings of small self.

Nostalgia

In the adjusted model, controlling for dispositional nostalgia and meaning in life, there was no significant interaction between environment type and plastic on nostalgia, p =.326. A statistically significant main effect for environment type was found, $F(2, 240) = 52.41$, $p < .001$, partial $\eta^2 = .30$. The adjusted marginal mean of nostalgia was lower in the urban conditions (M = 2.43, SE = 0.19) compared to the dunes conditions (M = 4.53, SE = 0.18), with a statistically significant mean difference of 2.21, p <.001, and the sunset conditions (M = 4.45, SE = 0.19), with a mean difference of 2.18, p <.001. The dunes and sunset conditions did not differ significantly (Table 2). There was no significant main effect of plastic on nostalgia, $F(1, 240) = 0.051$, p = .821. In conclusion, there was partial support for hypothesis 2 for nostalgia, as there was a significant main effect for environment type, with a large effect size. Nostalgia was higher in both coastal conditions compared to the urban conditions. Whether plastic was present or not, did not seem to have a significant effect on the level of nostalgia.

Nature Connectedness

In the unadjusted model, there was a significant interaction between environment type and plastic on nature connectedness, $F(2, 242) = 4.59$, p = .011, partial η^2 = .037. A statistically significant simple main effect of plastic was found in the sunset conditions, $F(1, 242) = 6.21$, p = .013, partial η^2 = .025. Statistical significance was accepted at the Bonferroni-adjusted alpha level of .016. Mean nature connectedness in the no plastic conditions (M = 3.75, SE = 0.15) was significantly lower compared to the plastic conditions (M = 4.28, SE = 0.15) when exposed to the beach with a sunset, with a statistically significant mean difference of 0.53, p = .013. However, the simple main effect of plastic was not statistically significant in the urban, p = .389, and dunes, p = .082, conditions. There was a significant simple main effect of environment type as well, however, the simple main effect was only significant in the no plastic conditions, $F(2, 242) = 3.86$, p = .022, partial η^2 = .031. Statistical significance was accepted at the Bonferroni-adjusted alpha level of .025. Mean nature connectedness was lower in the urban condition (M = 3.69, SE = 0.15) compared to the dunes condition (M = 4.23, SE = 0.15), when there is no plastic present, with a significant difference of 0.53, p = .039. In the plastic conditions, no significant simple main effect of environment type was found, $F(2,242) = 2.48$, p = .086.

When controlling for the covariates meaning in life, participant's tendency to engage with beauty in nature, and trait nature connectedness, there was no statistically significant interaction effect between environment type and plastic on nature connectedness, p =.104. There was a statistically significant main effect of environment type, $F(2, 239) = 8.78$, $p < .001$, partial η^2= .068.

Adjusted marginal mean nature connectedness in the urban conditions (*M* = 3.65, *SE* = 0.09) was significantly lower than the dunes conditions (*M* = 4,1, *SE* = 0.84), with a difference of 0.45, *p* < .001, and the sunset conditions (*M* = 4.09, *SE* = 0.09), with a difference of 0.44, *p* = .001. The dunes and sunset conditions did not differ significantly (Table 2). There was no significant main effect of plastic on nature connectedness, *F*(1,239) = 0.112, *p* = .727. When taking out two outliers, interpretation of the results remains the same. In conclusion, as to hypothesis 2 for nature connectedness, there seems to be partial support. Nature connectedness was higher in both of the coastal conditions compared to the urban conditions, with a medium effect size. In the adjusted model, there was no significant effect of plastic on nature connectedness, while there was a small significant effect of plastic when looking at the unadjusted model.

Table 2

Estimated Marginal Means, Standard Errors, and Univariate Analysis of Variance of the Potential Mediators in the Urban, Dunes and Sunset Conditions

Variable	Urban		Dunes		Sunset		*F*	η_p^2
	M	*SE*	*M*	*SE*	*M*	*SE*		
Awe	2.44 [a]	0.15	3.61 [a]	0.15	4.11 [a]	0.15	31.61***	.21
Small Self	2.51 [b]	0.13	3.30 [b]	0.12	3.39 [b]	0.13	14.18***	.11
Nostalgia	2.43 [c]	0.19	4.53 [c]	0.18	4.45 [c]	0.19	40.65***	.25
Nature Connectedness	3.65 [d]	0.09	4.1 [d]	0.84	4.09 [d]	0.09	8.78***	.07

Note. ***p < .001

[a] Covariates that were included in the model of awe were evaluated at the following values: dispositional awe = 4.51, meaning in life = 4.38.
[b] Covariates that were included in the model of small self were evaluated at the following values: dispositional awe = 4.51, meaning in life = 4.39, tendency to engage with beauty in nature = 4.58, trait nature connectedness = 2.90.
[c] Covariates that were included in the model of nostalgia were evaluated at the following values: dispositional nostalgia = 4.82, meaning in life = 4.39.
[d] Covariates that were included in the model of nature connectedness were evaluated at the following values: meaning in life = 4.39, tendency to engage with beauty in nature = 5.58, trait nature connectedness = 2.90.

Effect of Potential Mediators on Dependent Variables

Stress reduction was significantly positively correlated with nostalgia, $r = .215$, $p < .001$, and feelings of small self, $r = .208$, $p < .001$ (Table 3). Awe significantly interacted with the condition variable on stress reduction, $F (5, 236) = 3.23$, $p = .008$. More specifically, within the urban plastic condition, awe was found to be negatively correlated with stress reduction, $r = -.43$, $p = .005$, but no other significant correlations were found for the other conditions. The correlation between awe and stress reduction therefore depends on the condition.

Nature connectedness was found to be significantly positively correlated to meaning-focused coping, $r = .205$, $p < .001$. No other significant correlations were found between meaning-focused coping and the other potential mediators. Finally, a significant positive correlation was also found between pro-environmental attitudes and nature connectedness, $r = .172$, $p = .007$.

Additionally, significant intercorrelations between the mediators were found as well. Awe significantly correlated positively with nostalgia, $r = .337$, $p < .001$, nature connectedness, $r = .295$, $p < .001$, and small self, $r = .42$, $p < .001$. Further, nostalgia was significantly positively correlated with nature connectedness, $r = .227$, $p < .001$, and small self, $r = .385$, $p < 001$. Finally, small self was significantly positively correlated with nature connectedness, $r = .581$, $p < .001$.

Table 3

Pearson Correlations Between the Potential Mediators and Dependent Variables

Variable	1	2	3	4	5	6	7
1. Awe	-						
2. Nostalgia	.377**	-					
3. Nature Connectedness	.295**	.277**	-				
4. Small Self	.420**	.385**	.581**	-			
5. Stress Reduction	.031	.215**	.101	.208**	-		
6. Meaning Focused Coping	.105	.064	.205**	.115	.052	-	
7. Pro-environmental attitudes	.011	.075	.172**	.040	.089	-.093	-

Note. ** Correlation is significant at the 0.01 level (2-tailed).

Mediation of Awe, Small Self, Nostalgia and Nature Connectedness

Only the predictor variable environment type was included in the models, as there was no significant main effect or interaction effect of the presence of plastic on stress reduction, meaning-focused coping, or pro-environmental attitudes. We therefore did not include plastic as a predictor variable. The predictor variable environment type was dummy coded with the urban condition as

reference category, X1 representing the dunes condition and X2 representing the sunset condition. When looking at stress reduction as the outcome, we looked at potential mediators of awe, nostalgia, and small self, considering the significant correlations between these variables and stress reduction. As there was no significant correlation between nature connectedness and stress reduction, we did not include nature connectedness in the model. We included covariates dispositional awe, dispositional nostalgia, meaning in life, participants' tendency to engage with beauty in nature, trait nature connectedness, and subjective physical health. These covariates were related to either the potential mediators or the outcome variable.

Results show that feelings of small self are a significant mediator in the relationship between exposure to both coastal dunes (*Effect* = 0.199, *BootCI* = 0.016 to 0.429) and coastal sunset (*Effect* = 0.214, *BootCI* = 0.018 to 0.464) and stress reduction, compared to the urban condition, as their bias-corrected bootstrap 95% confidence intervals, based on 5,000 bootstrap samples, are above zero (Table 4). Awe was not a significant mediator for stress reduction in either the coastal dunes (*Effect* = - 0.231, *BootCI* = -0.49 to 0.017) or the coastal sunset *(*Effect = -0.335, *BootCI* = -0.688 to 0.027), compared to the urban condition. Nostalgia was not a significant mediator for stress reduction either, in both the coastal dunes (*Effect* = 0.254, *BootCI* = -0.123 to 0.643) and coastal sunset (*Effect* = 0.249, *BootCI* = -0.119 to 0.642), compared to the urban condition.

When looking at meaning-focused coping as the outcome, we looked at nature connectedness as a potential mediator, as nature connectedness was significantly correlated with meaning-focused coping. We controlled for covariates meaning in life, participants' tendency to engage with beauty in nature, and trait nature connectedness as they were related to both the potential mediators and the outcome. Finally, when looking at pro-environmental attitudes as the outcome, nature connectedness was assessed as a potential mediator, as nature connectedness was significantly correlated with pro-environmental attitudes. We controlled for covariates meaning in life, participants' tendency to engage with beauty in nature and trait nature connectedness.

We did not find nature connectedness to be a significant mediator in the relationship between exposure to coastal dunes (*Effect* = 0.028, *BootCI* = -0.017 to 0.078) and coastal sunset (*Effect* = 0.026, *BootCI* = -0.017 to 0.068) and meaning-focused coping, compared to the urban condition. Finally, nature connectedness was not a significant mediator between exposure to coastal dunes (*Effect* = 0.047, *BootCI* = -0.016 to 0.129) and coastal sunset (*Effect* = 0.042, *BootCI* = -0.015 to 0.12), and pro-environmental attitudes either, compared to the urban condition.

Table 4

Direct and Indirect Effects of Exposure to the Environments on Stress Reduction

Variable		Effect	*SE*	LLCI	ULCI
Direct Effects					
Dunes		0.652	0.364	-0.065	1.369
Sunset		0.857	0.381	0.116*	1.618*
Indirect Effects		Effect	*Boot SE*	BootLLCI	BootULCI
Awe	Dunes	-0.231	0.129	-0.49	0.017
	Sunset	-0.335	0.18	-0.688	0.027
Nostalgia	Dunes	0.254	0.196	-0.123	0.643
	Sunset	0.249	0.195	-0.119	0.642
Small Self	Dunes	0.199	0.104	0.016*	0.429*
	Sunset	0.214	0.114	0.018*	0.464*

*Note. *Bias-corrected bootstrap interval is above zero.*

In conclusion, the fourth hypothesis is therefore partially supported, as the model indicates that exposure to both coastal conditions led to higher feelings of small self, which, in turn, led to higher stress reduction, compared to the urban condition. The direct effect of exposure to the coastal dunes condition was not statistically significant, which implies full mediation of feelings of small self in the coastal dunes condition. In contrast, the direct effect of the coastal sunset condition remained statistically significant, which shows a partial mediation effect for feelings of small self.

Discussion

The aim of the current study was to gain more insight into the emotional mechanisms in the relationship between coastal environments, well-being, and pro-environmental attitudes. Additionally, we investigated the effect of the presence of litter in these environments on this relationship. Another aim was to look at the differential effect of the heterogeneity of the coast. Our study's findings demonstrate that being virtually exposed to a coastal environment led to a higher stress reduction and to a stronger experience of awe, feelings of small self, nostalgia, and nature connectedness, compared to being exposed to an urban environment. However, exposure to the coast did not have a significant effect on either meaning-focused coping and pro-environmental attitudes, compared to exposure to an urban environment. Furthermore, stress reduction was significantly positively correlated with both nostalgia and feelings of small self. A significant mediating effect was found for feelings of small self in the relationship between exposure to both

coastal conditions and stress reduction. The presence of plastic did not seem to affect the outcomes nor the mediators.

Environment Type

Stress Reduction

The results indicated that coastal environments led to more stress reduction compared to an urban environment. This finding is in line with previous research finding similar results. Videotapes of natural environments (Ulrich et al., 1991) and nature sounds (Alvarsson et al, 2010) have been found to be effective in reducing stress levels, however the authors used physiological measures to operationalize stress in these studies, while in this study we used self-reported stress levels. Our findings further support the Stress Reduction Theory (Ulrich, 1983), and are consistent with the claim that coastal environments have restorative properties. Several previous studies also found evidence for the claim that coastal environments can be restorative, such as the study of White et al. (2013), where the authors concluded that self-reported feelings of restoration were highest in coastal and marine margins. Along the same line, MacKerron and Mourato (2013) found that self-reported subjective well-being was highest in coastal environments.

The coastal sunset environment was more effective in reducing stress than the coastal dunes, as a significant effect was found for the former and not the latter. The reason for this could be that the coastal sunset environment is a more open landscape and represents the end of the day and the peacefulness of the evening, where people are able to leave their busy days behind.

Meaning-focused Coping

Results indicated that video clips of coastal or urban environments did not significantly affect the extent to which participants would adopt a meaning-focused coping style if confronted again with their stressful situation. The reason we did not find an effect of the environment type on meaning-focused coping could be that in our study we used video clips of coastal environments and thus participants were not actually at the coast. Mayer et al. (2009) investigated the influence of natural environments on people's ability to reflect and, importantly, compared the influence of actual nature contact and virtual nature contact on participants' ability to reflect. They concluded that participants' ability to reflect was better in actual nature compared to the virtual nature. This could have also been the case in our study, where the virtual exposure of the coastal environments was perhaps not sufficient to influence participants' coping style.

Pro-environmental Attitudes

Results indicated that exposure to the coastal environments did not influence participants' pro-environmental attitudes. Literature on the relationship between the coast and pro-environmental attitudes, such as the studies of Alcock et al. (2020) and Milfont et al. (2014), did find

an effect of exposure to coastal environments on pro-environmental attitudes, but these studies focused on whether participants lived close to or further away from the coast. It could be that in our study, the exposure to a short video clip of a coastal environment did not suffice in affecting the levels of pro-environmental attitudes in participants. Perhaps more long-term exposure and actually living close to the coast is necessary for altering peoples' pro-environmental attitudes. In our study, we did not control for whether participants lived close to the coast, which potentially could have given us a better view on this relationship.

Potential Mediators

Our results suggest that both the emotions of awe with feelings of small self and nostalgia were significantly higher in both the coastal dunes and coastal sunset environments, compared to the urban environments. These results support findings from qualitative studies that have brought forward the hypotheses that the coast elicits awe (Jarratt & Sharpley, 2017) and nostalgia (Jarratt & Gammon, 2016). To the best of our knowledge, our study is the first to have found a positive effect of the coast on awe, small self, and nostalgia within an experimental design. Awe and nostalgia thus seem to be an important part of the emotional experience at the coast.

As for nature connectedness, our findings suggest that both coastal dunes and a coastal sunset elicited higher levels of nature connectedness than an urban environment did. Our results are in line with findings in literature. Wyles et al. (2019) concluded that coastal environments were related to higher levels of nature connectedness compared to urban green environments.

When looking at the relationship between the mediators and dependent variables, results showed that both feelings of small self and nostalgia were positively correlated with stress reduction. The association between nostalgia and stress reduction is in line with previous findings. Routledge et al. (2011) found that nostalgia can play a buffering role in stress and can help people cope with stress. It is a novel finding in our study that small self is associated with stress reduction. Small self is however a component of awe (Piff et al., 2015), which has been found to be related to well-being and stress reduction (Anderson et al. 2018; Gordon et al., 2017; Zhao et al., 2019). However, results also indicated a negative correlation between awe and stress reduction in the urban plastic condition and no significant correlations in the other conditions. Awe significantly interacted with the condition variable, indicating that the correlation between awe and stress reduction depended on the type of environment. It could be, therefore, that the urban plastic video elicited a more negative type of awe that possibly reflects fear or anxiety towards the detrimental presence of plastic in that particular landscape, which ultimately does not help to reduce stress. Gordon et al. (2017) also argue for the existence of a negative type of awe. In their study, the authors distinguished a threat-based variant of awe, that is associated with feelings of fear and anxiety and does not positively affect well-being.

Finally, we found that nature connectedness was positively correlated with both meaning-

focused coping and pro-environmental attitudes. These results are consistent with what other researchers have found. Pritchard et al. (2019) concluded there was a small positive association between eudaimonic well-being and nature connectedness. Eudaimonic well-being does not refer to meaning-focused coping precisely, so the finding that nature connectedness is positively correlated with meaning-focused coping is a novel finding in our study. Nonetheless, meaning-focused coping can be considered as an important element within eudaimonic well-being. The work of Alcock et al. (2020) and Gosling and Williams (2010) provided support for a positive association between nature connectedness and pro-environmental attitudes.

Presence of Plastic

The presence of plastic litter did not seem to influence stress levels in participants or the extent to which participants adopted a meaning-focused coping style significantly. This finding is in contrast with earlier findings in literature that report a decline in restorative properties of natural environments when litter is present in the environment (Wyles et al., 2016). The reason we did not find a significant effect of plastic litter on stress reduction or meaning-focused coping could be that the plastic litter was not visible enough in our video of the coastal sunset environment. However, the plastic in the coastal dunes video was clearly visible and yet did not impact stress reduction or meaning-focused coping. Further research should therefore aim to assess the effect of plastic on the coast's restorative properties. The presence of plastic did not have a significant effect on pro-environmental attitudes either. Findings in literature suggest that the presence of litter in natural environments can actually encourage pro-environmental attitudes and behaviours in people. In the study of Wyles et al. (2016), the presence of litter in pictures of a coastal environment encouraged pro-environmental attitudes in participants. These findings are in contrast with our results.

The experiences of the potential mediators of awe, feelings of small self, nostalgia, or nature connectedness were also not significantly affected by the presence of plastic. This may be because the placement of the plastic did not seem realistic to some participants, or they saw the plastic but tried to ignore it because they wanted to focus on the nature. Further research should investigate the influence of presence of litter in natural environments on awe, feelings of small self, nostalgia, and nature connectedness.

Mediation

The results of our study provide support for a mediating effect of feelings of small self in the relationship between exposure to coastal environments and stress reduction. These findings are in line with previous research concerning the mediating role of awe in the relationship between nature exposure and hedonic well-being. Anderson et al. (2018) found a mediating role of awe in the

relationship between daily exposure to nature and daily life satisfaction. Joye and Bolderdijk (2015) also argue for a unique influence of awesome nature on mood. These studies, however, looked at awe induced by nature in general, while in our study we found similar effects for the coast in particular. Moreover, these studies investigated awe in its globality and not its component of feelings of small self. In our study, the emotion of awe per se did not mediate the relationship between the coast and stress reduction, but it seems that it is rather the effects of awe, namely its ability to elicit feelings of small self, that is a significant mediator. Nostalgia was not a significant mediator in the relationship between exposure to coastal environments and stress reduction either. Further research is needed to look into whether nostalgia can be a mediator in this relationship or whether it is more the effects of nostalgia that can play a mediating role, just like with awe.

We did not find any mediating effects of nature connectedness in the relationship between exposure to coastal environments and both meaning-focused coping and pro-environmental attitudes. The reason we did not find any mediating effects could be due to the same reason why exposure to the coast did not impact meaning-focused coping and pro-environmental attitudes, namely that perhaps more long term and real-life exposure to the coast is needed.

Limitations

There are certain limitations in the current study that could be addressed in future research. A first limitation concerns the homogeneity of the sample of participants. The sample consisted entirely out of first year psychology students. This implies that participants were mostly young women with a similar level of education. A more diverse sample may have provided us with different results. As previous research of Garrett et al. (2019) and Wheeler et al. (2012) indicates, sociodemographic indicators can influence the extent to which exposure to the coast benefits well-being. A second limitation concerning this study is that we used video clips of coastal environments. Exposing participants to actual coastal environments might have provided us with different results. As the findings of Mayer et al. (2009) indicate, exposure to actual nature can provide more benefits to well-being than being exposed to virtual nature. Furthermore, despite the fact that we included several covariates, it could be that other covariates that we did not account for influenced our findings. Past research indicates that living closer to the coast can influence well-being and pro-environmental attitudes (Alcock et al., 2020; Hooyberg et al., 2020; Milfont et al., 2014). Consequently, we suggest investigating whether people who live closer to the coast or further away from the coast respond differently to exposure to video clips of coastal environments in terms of well-being and pro-environmental attitudes. Finally, although the study followed an experimental design, it was not conducted within a controlled setting. Participants completed the study online, which means that we did not have control over the environment they were in when completing the

study and the level of attention they brought to it. Nonetheless, our study does have the advantage of an experimental design, which allows us to make a causal link between exposure to the coast, stress reduction, and the emotions of awe and nostalgia and nature connectedness.

Conclusion and Implications

The results of the current study provide support for the restorative properties of coastal environments. Stress reduction was evident in the coastal environment containing the beach with a sunset. The results also provided us with evidence of a mediating role of feelings of small self in the relationship between exposure to the coast and stress reduction. We gained more insight into the emotional mechanisms that underly the restorative properties of the coast, as well as the effect of different types of coastal environments on well-being, namely that the coastal sunset seemed to be more effective in reducing stress as opposed to coastal dunes, while the coastal dunes and sunset did not lead to a different emotional experience.

These findings therefore argue for conservation of coastal environments, since they have been found to effectively reduce stress and thereby foster well-being. The results also argue for the use of virtual nature in health care for example, which is in line with what White et al. (2018) conclude in their review. Considering the mediating role of small self in the relationship between exposure to virtual coastal environments and stress reduction and the finding that that coastal environments have the capability to elicit feelings of awe, nostalgia and nature connectedness, this allows us the possibility to optimize the therapeutic value of the coast. For example, utilizing coastal exposure and eliciting these emotions during therapy or in prevention programs could further support mental health.

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Appendix

Questionnaire

1. Control Variables

1.1 Wat is uw geboortejaar?

_____

1.2 Met welk geslacht identificeert u zich?
Man – Vrouw – Andere

1.3 Wat is het hoogste opleidingsniveau dat u heeft behaald?

Lagere school – Hoger beroeps onderwijs – Hoger technisch onderwijs – Hoger algemeen secundair onderwijs – Hoger niet-universitair onderwijs (bv. hogeschool) – Universitair onderwijs (incl. doctoraat)

1.4 Hoe zou u uw eigen gezondheid momenteel inschatten?

1 = *heel slecht*, 2 = *slecht*, 3 = *neutraal*, 4 = *goed*, 5 = *heel goed*

1.5 Dispositional Positive Emotion Scales

Geef voor elk van de onderstaande uitspraken aan hoe sterk u het er mee eens bent.

1 = *helemaal oneens*, 2 = *oneens*, 3 = *eerder oneens*, 4 = *evenveel eens dan oneens*, 5 = *eerder eens*, 6 = *eens*, 7 = *helemaal eens*

1.5.1 Contentement Subscale

Ik ben over het algemeen een tevreden persoon.

Ik heb vrede met mijn leven.

Als ik aan mijn leven denk, ervaar ik een diep gevoel van tevredenheid.

Ik voel me vaker tevreden dan de meeste mensen.

Mijn leven geeft me veel voldoening.

1.5.2 Pride Subscale

Ik voel me goed in mijn vel.

Ik ben trots op mezelf en mijn prestaties.

Veel mensen respecteren mij.

Ik kom altijd op voor wat ik geloof.

Mensen erkennen meestal mijn autoriteit.

1.5.3 Compassion Subscale

Het is belangrijk om te zorgen voor mensen die kwetsbaar zijn.

Als ik iemand gekwetst of in nood zie, voel ik een sterke drang om voor hem of haar te zorgen.

Voor anderen zorgen geeft me een warm gevoel van binnen.

Ik merk vaak mensen op die hulp nodig hebben.

Ik ben een erg meelevend persoon.

1.5.4 Amusement Subscale

Ik vind humor in bijna alles.

Ik vind het erg leuk om mensen waar ik om geef te plagen.

Ik vind dingen snel grappig

De mensen om me heen maken veel grapjes.

Ik maak grapjes over alles.

1.5.5 Awe Subscale

Ik voel vaak ontzag (ook wel verwondering genoemd)

Ik zie overal schoonheid om me heen.

Ik voel me verwonderd bijna elke dag.

Ik heb veel gelegenheden om de schoonheid van de natuur te zien.

Ik zoek ervaringen die mijn begrip van de wereld uitdagen.

1.5.6 Joy Subscale

Ik voel vaak uitbarstingen van vreugde.

Ik ben een intens opgewekt persoon.

Ik ben vaak helemaal in de wolken als er iets goeds gebeurt.

Op een doorsnee dag maken veel gebeurtenissen me gelukkig.

Er gebeuren de hele tijd goede dingen met mij.

Mijn leven wordt altijd beter.

1.6 Southampton Nostalgia Scale

1-4: 1 = *helemaal niet* – 7 = *zeer*

1. Hoe waardevol is nostalgie voor je?
2. Hoe belangrijk is het voor je om terug te denken aan nostalgische evaringen?
3. Hoe belangrijk is het voor je om nostalgie te ervaren?
4. Hoezeer ben je geneigd om nostalgische gevoelens te ervaren?

5-6: 1 = *helemaal nooit* – 7 = *zeer vaak*

5. Hoe vaak ervaar je nostalgie?
6. Over het algemeen, hoe vaak denk je terug aan nostalgische ervaringen?

7. Specifiek, hoe vaak denk je terug aan nostalgische ervaringen? (Kies ÉÉN antwoord)

_____ Één of twee keer per jaar

_____ Om de zoveel maanden een keer

_____ Één of twee keer per maand

_____ Ongeveer één keer per week

_____ Ongeveer twee keer per week

_____ Drie of vier keer per week

_____ Minstens één keer per dag

1.7 Meaning in Life Questionnaire

Neem even de tijd om na te denken over welke dingen u het gevoel geven dat uw leven belangrijk is en ertoe doet. Wilt u bij iedere uitspraak hieronder zo eerlijk mogelijk aangeven welk antwoord voor u het best passend is? Er zijn geen goede of foute antwoorden, het gaat om uw subjectieve ervaring. 1 = Geheel mee oneens, 2= Mee oneens, 3 = Enigszins mee oneens, 4 = Neutraal, 5 = Enigzins mee eens, 6 = Mee eens, 7 = Geheel mee eens

1. Ik begrijp de zin van mijn leven
2. Ik ben op zoek naar iets dat mijn leven zinvol maakt
3. Ik ben altijd op zoek naar de bedoeling van mijn leven
4. Mijn leven heeft een duidelijke betekenis
5. Ik heb een goed idee over wat mijn leven zinvol maakt
6. Ik heb een bevredigend levensdoel gevonden
7. Ik zoek altijd naar iets dat me het gevoel geeft dat mijn leven ertoe doet
8. Ik zoek naar een doel of een missie voor mijn leven
9. Mijn leven heeft geen duidelijk doel
10. Ik zoek naar zin in mijn leven

1.8 Engagement with Beauty Scale

Houd er rekening mee dat we alleen vragen naar uw ervaring met het waarnemen en voelen van iets moois. Over het algemeen kunnen we veel dingen leuk vinden of ze als belangrijk beschouwen zonder hun schoonheid echt op te merken. Daarom vragen we in de volgende vragen niet of je iets leuk vindt; we vragen niet of je iets belangrijk vindt; we vragen alleen of je het mooi vindt.

Deze uitspraken hieronder verwijzen naar ervaringen met de natuur en de fysieke wereld, inclusief bergen, rotsen, rivieren, meren, oceanen, woestijnen, planten, bloemen, bomen, dieren, enz. (Maar NIET het menselijk lichaam).

1 = *heel anders dan ik*, 2 = *anders dan ik*, 3 = *een beetje anders dan ik*, 4 = *neutraal*, 5 = *een beetje zoals ik*, 6 = *zoals ik*, 7 = *heel erg zoals ik*

1. Ik merk schoonheid op in één of meer aspecten van de natuur.
2. Wanneer ik schoonheid in de natuur waarneem, voel ik veranderingen in mijn lichaam, zoals een brok in mijn keel, een uitzetting van mijn borstkas, snellere hartslag of andere lichamelijke reacties.

3. Wanneer ik schoonheid in de natuur waarneem, voel ik me emotioneel, het 'ontroert me', zoals een gevoel van ontzag, of verwondering of opwinding of bewondering of verheffing.
4. Wanneer ik schoonheid in de natuur waarneem, voel ik zoiets als een spirituele ervaring, misschien een gevoel van eenheid, of verenigd zijn met het universum, of een liefde voor de hele wereld.

1.9 Nature Relatedness Scale

Geef voor elk van de onderstaande uitspraken aan hoe sterk u er mee eens bent, met behulp van de schaal van 1 tot 5 zoals hieronder weergegeven. Antwoord alsjeblieft zoals u u echt voelt, in plaats van hoe u denkt dat de meeste mensen zich voelen.

1 = *helemaal oneens*, 2 = *oneens*, 3 = n*eutraal*, 4 = *eens*, 5 = *helemaal eens*

1. Mijn ideale vakantieplek is een afgelegen wildernisgebied.
2. Ik denk er altijd aan hoe mijn acties de natuur beïnvloeden.
3. Mijn verbondenheid met de natuur en de omgeving is deel van mijn spiritualiteit.
4. Ik merk wilde planten en dieren op overal waar ik ben.
5. Mijn relatie met de natuur is een belangrijk deel van wie ik ben.
6. Ik voel me erg verbonden met alle levende dingen en onze planeet.

2. Independent Variables

2.1 Stress recall

We willen u vragen om mentaal een stressvol moment te visualiseren dat zich de afgelopen weken heeft voorgedaan. Kies eerst aan welk moment u wil terugdenken. Als u besloten heeft, kunt u op "volgende pagina" klikken.

Volgende pagina: Visualiseer alstublieft het stressvolle moment dat u hebt gekozen voor een minuut. Sluit uw ogen en concentreer u op de stress die u in uw lichaam en in uw geest ervaart. Gebruik de onderstaande timer om een minuut af te tellen. De timer maakt een geluid zodra er een minuut is verstreken dus zorg ervoor dat u het geluid aanzet.

Na aftellen:

1. Op een schaal van 1 tot 10, duid aan hoe gestresseerd u bent op dit moment.

1= helemaal niet gestresseerd, 5 = matig, 10 = zeer gestresseerd

2. Geef aan in hoeverre u het eens bent met deze volgende uitspraken met betrekking tot wat u zojuist hebt gevisualiseerd.

1 = helemaal oneens 5 = helemaal eens

Ik had het gevoel dat ik dit moment mentaal opnieuw beleefde.

Ik visualiseerde het moment in groot detail.

Ik zag het moment zoals het echt gebeurde.

3. Hoe lang terug in de tijd gebeurde het stressvolle moment?

_____

4. Op een schaal van 1 tot 10, duid aan hoe stresserend het toen was voor u, op dat moment.

1= helemaal niet gestresseerd, 5 = matig, 10 = zeer gestresseerd

5. Leg in een paar woorden uit wat de belangrijkste oorzaak was van het stressvolle moment dat u net heeft gevisualiseerd.

_____

2.1 Video clip

U wordt nu uitgenodigd om een video van twee en een halve minuut te bekijken. Zorg ervoor dat u het geluid aanzet.

Probeer u voor te stellen dat u in de omgeving bent die wordt getoond, en probeer aandacht te besteden aan de gevoelens en gedachten die u ervaart tijdens het kijken.

Zet de video op volledig scherm. Als het filmpje voorbij is, kun je op "volgende" klikken.

3. Mediators

3.1 Emotions

Bedankt om de video te bekijken. We zullen u nu enkele vragen stellen over de gevoelens die u mogelijk heeft ervaren tijdens het bekijken van de video.

Tijdens het kijken van de video, ervaarde ik...

1 = *helemaal oneens*, 2 = *oneens*, 3 = *eerder oneens*, 4 = *evenveel eens dan oneens*, 5 = *eerder eens*, 6 = *eens*, 7 = *helemaal eens*

1. Vermakelijkheid
2. Ontzag
3. Angst
4. Nostalgie
5. Dankbaarheid
6. Mededogen
7. Verdriet
8. Tevredenheid
9. Trots
10. Ontspanning

3.2 Feelings of small self

Tijdens het kijken van de video,

1 = *helemaal oneens*, 2 = *oneens*, 3 = *eerder oneens*, 4 = *evenveel eens dan oneens*, 5 = *eerder eens*, 6 = *eens*, 7 = *helemaal eens*

1. Ik voelde de aanwezigheid van iets groters dan mezelf.
2. Ik voelde me onderdeel van een grotere entiteit.
3. Ik voelde me alsof ik in de aanwezigheid was van iets groots.
4. Ik voelde me alsof ik deel uitmaakte van een groter geheel.
5. Ik voelde het bestaan van dingen krachtiger dan mezelf.
6. Ik voelde me klein of onbeduidend.
7. Ik had het gevoel dat mijn eigen dagelijkse zorgen relatief triviaal waren.
8. Ik had het gevoel dat mijn eigen problemen en zorgen niet zo belangrijk waren.
9. Ik voelde me onbeduidend in het grote geheel van de dingen.
10. Ik voelde me klein ten opzichte van iets krachtigers dan mezelf.

3.3 Connectedness to Nature Scale

Beoordeel elk van deze stellingen naargelang hoe u zich voelt op dit moment. Er zijn geen juiste of foute antwoorden. Gebruik de antwoordschaal in de ruimte naast elke vraag om zo eerlijk en openhartig mogelijk te omschrijven wat u momenteel ervaart.

1 = *helemaal oneens*, 2 = *oneens*, 3 = *eerder oneens*, 4 = *evenveel eens dan oneens*, 5 = *eerder eens*, 6 = *eens*, 7 = *helemaal eens*

1. Op dit ogenblik heb ik een gevoel van eenheid met de natuurlijke wereld rondom mij.
2. Op dit moment voel ik dat de natuurlijke wereld een gemeenschap is waartoe ik behoor.
3. Momenteel herken en apprecieer ik de intelligentie van andere levende organismen.
4. Op dit eigenlijke moment, voel ik me niet verbonden met de natuur.
5. Op dit moment kan ik me voorstellen dat ik deel uitmaak van het grotere cyclisch proces van het leven.
6. Op dit moment voel ik een verwantschap met dieren en planten.
7. Op dit ogenblik heb ik het gevoel dat ik net zo goed bij de aarde behoor als de aarde bij mij behoort.
8. Op dit ogenblik ben ik me diep bewust van hoe mijn acties de natuurlijke wereld beïnvloeden.
9. Momenteel voel ik me alsof ik deel ben van het web van het leven.
10. Op dit ogenblik heb ik het gevoel dat alle inwoners van de aarde, menselijk en niet-menselijk, een gemeenschappelijke levenskracht delen.
11. Op dit moment voel ik me ingebed in de bredere natuurlijke wereld, zoals een boom in een bos.

12. Wanneer ik denk aan mensen hun plaats op de aarde op dit moment, beschouw ik hen als de meest waardevolle soort in de natuur.
13. Op dit moment heb ik het gevoel dat ik slechts een deel ben van de natuurlijke wereld rondom mij en dat ik niet belangrijker ben dan het gras op de grond of de vogels in de bomen.

4. Dependent Variables

4.1 Stress After Exposure

Op een schaal van 1 tot 10, duid aan hoe gestresseerd u bent op dit moment.

1 = *helemaal niet gestresseerd*, 5 = *ma*tig, 10 = *zeer gestresseerd*

4.2 Brief COPE

Denk terug aan het stressvolle moment dat u zich herinnerde voordat u de video bekeek, en beoordeel hoe u zou reageren als u weer met dat moment geconfronteerd zou worden.

1 = *ik zou dit helemaal niet doen*, 2 = *ik zou dit een beetje doen*, 3 = *ik zou dit een gemiddelde hoeveelheid doen*, 4 = *ik zou dit vaak doen*

1. Ik concentreer mijn inspanningen om iets te doen aan de situatie waarin ik me bevind
2. Ik onderneem actie om te proberen de situatie te verbeteren
3. Ik probeer een strategie te bedenken over wat ik moet doen
4. Ik denk goed na over welke stappen ik moet nemen
5. Ik probeer het in een ander licht te zien, om het positiever te laten lijken
6. Ik zoek iets goeds in wat er gebeurt
7. Ik accepteer de realiteit van het feit dat het is gebeurd
8. Ik leer ermee te leven
9. Ik maak er grapjes over
10. Ik lach om de situatie
11. Ik probeer troost te vinden in mijn religie of mijn spirituele overtuigingen
12. Ik bid of mediteer
13. Ik krijg emotionele steun van anderen
14. Ik krijg troost en begrip van iemand

4.3 New Ecological Paradigm Scale

Hieronder staan uitspraken over de relatie tussen mens en milieu. Geef voor elk van de uitspraken aan hoe sterk u er mee eens bent.

1 = *helemaal oneens*, 2 = *oneens*, 3 = *eerder oneens*, 4 = *evenveel eens dan oneens*, 5 = *eerder eens*, 6 = *eens*, 7 = *helemaal eens*

1. Het evenwicht van de natuur is erg delicaat en snel verstoord.

2. Wanneer de mens ingrijpt in de natuur, heeft dat vaak desastreuze gevolgen.
3. De mens maakt ernstig misbruik van het milieu.
4. De zogenaamde ecologische crisis waarmee de mensheid wordt geconfronteerd, is sterk overdreven.
5. Als het zo doorgaat, zullen we binnenkort een grote ecologische catastrofe meemaken.
6. De mens heeft het recht om de natuurlijke omgeving aan te passen aan zijn behoeften.
7. De mens is voorbestemd om te heersen over de rest van de natuur.
8. Planten en dieren zijn er voornamelijk om door mensen te worden gebruikt.

5. Honesty Scale

Het moment van de waarheid!

Heeft u de instructies gevolgd toen u werd gevraagd uw ogen te sluiten en een stressvol moment te visualiseren?

1 = helemaal niet, 5 = absoluut

6. Debriefing

Dit is het einde van de vragenlijst. Heel erg bedankt voor uw deelname! Indien u meer informatie wenst of op de hoogte gebracht wilt worden van de resultaten van dit onderzoek, dan kunt u dit laten weten door een email te sturen naar marine.severin@vliz.be. Krijgt u het moeilijk in isolement? Heeft u nood aan een gesprek? Tele-Onthaal is elke dag 24u/24u bereikbaar op het telefoonnummer 106 of via chat op www.tele-onthaal.be.