Psychological restoration and environment meaning attribution: pathways approach

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Abstract

Nature has become an object of interest due to its restorative properties. To explain this phenomenon, research has identified various variables that potentially act as mediating mechanisms in perceiving its restorativeness. Traditionally, this effect has been attributed to the properties of these environments while little attention has been paid to the meaning attributed by people and how it might change the way these environments are perceived. The present study (n = 562) aims to analyze the mediating mechanisms in the relationship between natural environments and restoration. Secondly, it investigates the impact of the meaning assigned to a specific environment on the perception of its restorative outcome. The results indicate that certain pathways play a mediating role in explaining the restorativeness perceived by individuals (such as social relationships, stress, contact, meaning, and emotion). Additionally, the study reveals that the restorative outcomes of natural environments diminish when they are associated with negative messages. Therefore, the importance of considering the conceptions of environments when trying to promote the restoration of people based on them is highlighted.

Keywords

nature environment; psychological restoration; environment attribution; meaning; restoration pathways.

Introduction

Nature's contributions to people can be highly diverse (Pascual et al., 2017), including the psychological benefits it provides (Pedersen et al., 2019). Research has consistently demonstrated that contact with nature, in contrast to urban settings, leads to higher levels of well-being (e.g., Marselle et al., 2014), reduced stress (e.g., Tyrväinen et al., 2014), and improved cognition (e.g., Berman et al., 2008). This process has widely been referred to as

restoration or restorativeness, defined as the recovery or renewal of physical and psychological diminished daily functions and capabilities (Han, 2018), involving a nature-human relationship. As Han (2018, p.3) pointed out, "the measurement of restoration tends to focus on the perceived change in recovery, while measurement of restorativeness tends to emphasize the restorative quality perceived in the environment as a mediating variable."

The two most influential models in Environmental Psychology are Stress Recovery Theory (SRT; Ulrich, 1979) and Attention Restoration Theory (ART; Kaplan & Kaplan, 1989; 1995). SRT focuses on the emotional response to natural environments, which are argued to reduce stress and that restorative influences of nature involve "a shift in feelings towards a more positively-toned emotional state," (Ulrich et al., 1991). On the other hand, ART proposes a cognitive approach that delineates two types of attention based on the effort involved (Kaplan, 1995). The first is voluntary attention, also known as Top-Down process, which relies on the ability to sustain focused attention. This process demands cognitive effort and, if prolonged, can lead to mental fatigue. Second, we find involuntary attention -the Bottom Up process-, which, according to Kaplan, does not involve effort and allows us to recover cognitive resources promoting psychological restoration. According to this theory, it would be the features of the environment (usually natural) that would attract involuntary attention.

In the exploration of the processes underlying these psychological changes, various mechanisms through which restoration can be explained have been examined. These mechanisms encompass pathways collected by Hartig et al. (2014) such as air quality in the environment (Li et al., 2018), the availability of spaces for physical activity (Legrand et al., 2018), the promotion of social cohesion (Maas et al., 2009), and the capacity to reduce stress (Ojala et al., 2022).

In the same way, Lumber et al. (2017) introduced five pathways that could elucidate the increase in connectedness to nature, subsequently leading to psychological well-being (Martin et al., 2020; McMahan & Estes, 2015; Pasca et al., 2022; Pritchard et al., 2020). The authors identified five pathways grounded in the intrinsic value of nature: contact (the act of engaging with nature through the senses); emotional responses (an affective state or sensation that occur as a result of engaging with nature); appreciation of its beauty (the perception of aesthetic qualities that please the senses); meaning (using nature or natural symbolism to communicate a concept that is not directly expressed); and compassion (which involves caring for and taking action on behalf of nature). The first objective of the present study was to empirically analyze these theoretical pathways proposed by Hartig et al. (2014) and Lumber et al (2017) as mediating mechanisms in the relationship between natural environments and restoration.

Top-Down processes

Despite the multitude of studies conducted to explore the positive effects of natural environments, most of them have assumed that the physical characteristics of these environments are the primary contributors to the beneficial psychological effects. However it has been suggested that the differences in restoration can also be attributed to the association processes between the environment and positive experiences (Egner, 2016; Egner et al., 2020), as well as individual factors such as personality (Felsten, 2014). A neutral sound is perceived as more restorative when participants believe it comes from a natural environment compared to when participants believe the same sound comes from an industrial environment (Haga et al., 2016). Similarly, studies have demonstrated differences in neuronal connectivity when presenting the same auditory stimulus associated with different environments (Hunter et al., 2010). Equally, a sound is perceived as more bothersome when participants believe it originates from a factory, compared to when they believe the same sound comes from a natural

environment (Bergman et al., 2008). Moreover, Karmanov and Hamel (2008) have demonstrated that cultural and historical information can enhance the experiential qualities of spaces, thereby increasing their restorativeness. Rostami et al. (2014, 2015) have highlighted the importance of historical gardens, suggesting that the historical aspect can influence restoration. These findings indicate that not only the sensory attributes of the environments are important, but also the meaning attributed to the environment can influence how it is perceived (Haga et al., 2016).

Despite the emphasis on meaning attribution to environments when it comes with sounds, studies with messages and images are limited. Therefore, the second objective of this research is to explore the impact of the meaning ascribed to an environment. Specifically, it aims to investigate whether the same environment can elicit different effects on perceived restorativeness depending on the attribution (positive or negative) assigned to that environment. Furthermore, in an effort to further investigate the variables proposed above as mediators in the study of restorativeness, we analyze whether these variables can be influenced by the association of an environment with a positive or negative attribute.

Method

Participants

G*power software (Faul et al., 2007) was used to calculate the necessary sample size to carry out the analyses that will be mentioned below. To obtain a power of 0.85 ($f = 0.15$; $\alpha = .05$), approximately 500 participants were needed, therefore the sample consisted of 562 people from the general Spanish population. The mean age was 32.16 years (SD = 15.08), with 60.3% being women.

Design

An experimental design was implemented, involving six groups based on two factors (2x3): environment (nature/city) and message (positive/negative/no message), including a no message condition as the control group regarding this variable. Participants were randomly assigned to each group: natural environment with positive message (n = 92), natural environment with negative message (n = 94), natural environment without message (n = 94), urban environment with positive message (n = 90), urban environment with negative message (n = 96), and urban environment without message (n = 96).

Instrument and procedure

Six online questionnaires, each corresponding to one of the six experimental conditions, were developed and distributed via social media and email using a snowball sampling method, with the assistance of 42 Psychology degree students who also forwarded the questionnaire link to individuals across different age groups. Different links to each experimental group were randomly distributed, modifying at different times the group to which the link was directed, to ensure randomness in the formation of the groups.

In each questionnaire, a photograph of an environment, either natural or urban depending on the assigned condition, was included. The photograph used had been previously validated by Pasca et al. (2022), in such a way that they can be considered representative of environmental conditions under investigation. At the top of the photograph, a specific message was added according to the assigned condition. For the positive message condition, the message stated, "The following image corresponds to a place considered a paradise on earth as it is characterized by its historical episodes of tranquility and harmony. Look at it carefully and notice its elements." For the negative message condition, the message stated, "The following image corresponds to a place considered as hell on earth as it is characterized by bloody events

and murders. Look at it carefully and notice its elements." In the control condition, no message was included alongside the photograph. The messages were carefully formulated to avoid any specific ideological, historical-political, or religious references. While terms like "paradise on earth" and "hell on earth" were utilized, it is important to note that these phrases are commonly used in everyday language and do not inherently carry a religious connotation in the colloquial usage of the Spanish language spoken in Spain.

Following the presentation of the photograph and message, participants were presented with the Spanish adaptation of the Restoration Outcome Scale (ROS; $\alpha = .95$) (Subiza-Pérez et al., 2017). Since the scale focuses on the restoration experienced in the specific place depicted, adaptations were made to the six items to suit the design using photographs. For example, the item "After being here I feel calmer" was modified to "After being here I would feel calmer". Thus, throughout the article, we refer to “perceived restorativeness” as the restoration that a given environment would provide if they were in that environment and not to “experienced restoration” as they do not experience the environments directly. To calculate the total score on the scale, the scores for all the items were aggregated (range from 7 to 42).

On the second page of the questionnaire, the four pathways reported by Hartig et al. (2014) as explanations for restoration were assessed. Once again, the corresponding photograph of the environment was presented, accompanied by the instruction "To what extent do you consider the following environment..." followed by four items, created ad hoc, each corresponding to one of the variables: "It has good air quality", "It is suitable for sports", "It is suitable for meeting with close friends and family", and "It would cause me stress" (inverse item, following the approach from literature). Participants were asked to position themselves on a five-point continuum, ranging from "not at all" to "totally", to indicate the extent to which they agreed with each statement.

On the third page of the questionnaire, a measure of the pathways proposed by Lumber et al. (2017) was included. This measure, encompassing ten items, consisted of two indicators for each of the five pathways: contact, beauty, meaning, emotion, and compassion. The scale demonstrated good internal consistency for each pathway (α = .91 for contact, α = .85 for beauty, α = .86 for meaning, α = .63 for emotion, and α = .79 for compassion). Participants were asked to rate their agreement with each item using a Likert-type scale with a seven-point response range, ranging from "strongly disagree" to "strongly agree".

Finally, sociodemographic questions are included. The questionnaire and database can be found at https://osf.io/wjyh6/?view_only=745d9554fd5b41e8941d58fe3e75be1e.

Data analysis

In order to analyze the mediating mechanisms in the relationship between the kind of environment (urban vs nature) and the perceived restorativeness of the setting, two mediational analyses were carried out. The first one considers variables reported by Hartig et al. (2014), and the second considers the pathways approach. The SPSS macro Process was used (Hayes, 2013) with 5000 bootstrap samples to estimate 95% bias-corrected confidence intervals (BC 95% CI). A BC 95% CI that does not include zero provides evidence of a significant indirect effect (MacKinnon et al., 2000; Preacher & Hayes, 2008), indicating the changes in the “kind of environment” outcome a changing from 0 to 1.

Second, to find out the effect of the type of message and type of environment on perceived restorativeness, a two-factor ANOVA was carried out. To determine the size effects, the omega-square statistic was calculated, as it allows to obtain less biased scores than eta-square (e.g.: Albers & Lakens, 2018), with values around 0.01 being interpreted as low intensity, 0.06 as medium intensity and 0.14 as high intensity (Cohen, 1988). Next, to find out whether the

message can influence each of the variables proposed previously as mediators, an ANOVA, for each one, was accomplished.

Results

Mediating variables

The first mediational analyses (Table 1), including the four variables reported by Harting et al. (2014) revealed significant indirect effects of the environment on perceived restorativeness through three of the variables (perceived air quality, appropriate for meeting loved ones, and potentially stressful).

Table 1. Mediating effect of environment (Env) on perceived restorativeness (ROS) through air quality (AQ), sport suitability (SS), social relationships (SR) and stress (S).

Effect		Estimate	SE	95% CI	β
Indirect	Env→AQ→ROS	2.72	0.96	[0.82;4,52]*	.25
	Env→SS→ROS	1.03	0.63	[-0.22;2.25]	.10
	Env→SR→ROS	3.91	0.62	[2.69;5.12]*	.36
	Env→S→ROS	2.74	0.46	[1.90;3.70]*	.26
Component	Env→AQ	2.20	0.06	[2.09;2.32]*	1.68
	Env→SS	1.85	0.08	[1.70;2.00]*	1.45
	Env→SR	1.82	0.08	[1.65;1.98]*	1.36
	Env→S	-1.11	0.08	[-1.27;-0.95]*	-1.00
	AQ→ROS	1.24	0.40	[0.46;2.02]*	.15
	SS→ROS	0.56	0.33	[-0.09;1.20]	.07
	SR→ROS	2.15	0.30	[1.57;2.73]*	.27
	S→ROS	-2.47	0.28	[-3.02;-1.92]*	-.26
Direct	Env→ROS	5.41	0.94	[3.56;7.26]*	0.50
Total	Env→ROS	15.81	0.62	[14.60;17.03]*	1.47

*Confidence intervals that do not include zero indicate a statistically significant effect $p<.05$

In the same vein, mediational analysis was conducted but, in this case, including as mediating variables those proposed by Lumber et al. (2017). The results revealed significant indirect effects of the environment on perceived restorativeness through three of the variables - contact, meaning and emotion - (Table 2).

Table 2. Mediating effect of environment (Env) on perceived restorativeness (ROS) through contact (C), beauty (B), meaning (M), emotion (E) and compassion (Co).

Effect		Estimate	SE	95% CI	β
Indirect	Env→C→ROS	7.93	0.99	[6.06;9.98]*	.74
	Env→B→ROS	1.30	0.69	[-0.07;2.66]	.12
	Env→M→ROS	2.24	0.43	[1.43;3.10]*	.21
	Env→E→ROS	1.04	0.42	[0.25;1.86]*	.10
	Env→Co→ROS	0.43	0.59	[-0.72;1.56]	.04
Component	Env→C	6.19	0.23	[5.75;6.64]*	1.50
	Env→B	5.88	0.22	[5.44;6.31]*	1.49
	Env→M	3.44	0.24	[2.98;3.91]*	1.05
	Env→E	4.04	0.23	[3.59;4.49]*	1.19
	Env→Co	5.47	0.21	[5.07;5.87]*	1.50
	C→ROS	1.28	0.10	[1.08;1.48]*	.49
	B→ROS	0.22	0.09	[0.04;0.40]*	.08
	M→ROS	0.65	0.10	[0.46;0.84]*	.20
	E→ROS	0.26	0.09	[0.08;0.44]*	.08
	Co→ROS	0.08	0.09	[-0.10;0.26]	.03
Direct	Env→ROS	2.77	0.73	[1.34;4.20]*	0.26
Total	Env→ROS	15.70	0.62	[14.49;16.92]*	1.46

*Confidence intervals that do not include zero indicate a statistically significant effect $p<.05$.

Meaning attribution

The results show a statistically significant effect of the interaction between type of environment and message presented (F(2,556) = 4.631; p = .010; $\widehat{\omega}^2$= 0.02). Bonferroni post-hoc analyses, revealed that there were significantly higher scores (p = .004; 95% CI: -5.99, -0.87) in perceived restorativeness when appraising a natural environment with a positive message (M = 28.66; SD = 6.22) compared to evaluating the same environment associated with a negative message (M = 25.23; SD = 8.32) (Figure 1).

Furthermore, higher scores are observed in the control group (M = 28.10; SD = 6.24) than in the group that rated the environment associated with the negative message (p = .022; 95% CI: -5.41,-0.32), while no statistically significant differences are found between the control group and the group with the positive message (p = .999). However, no differences are found on the basis of the message when the urban environment is rated.

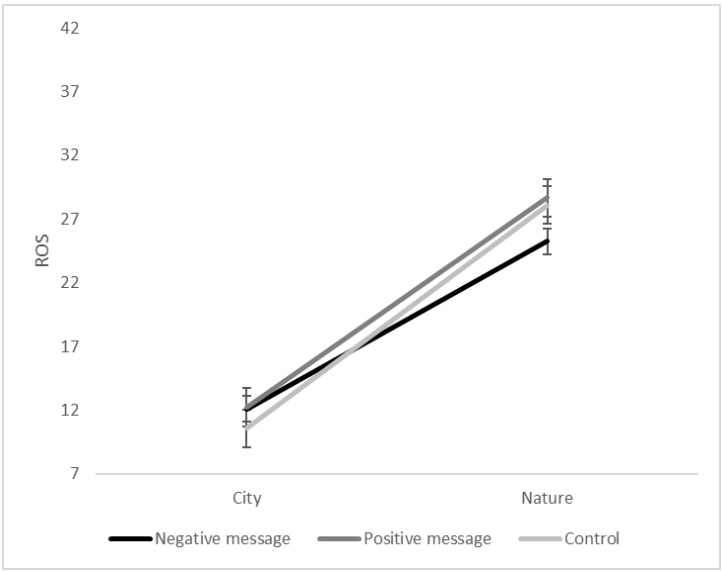

Figure 1. Means in ROS based on the type of environment and type of message, with a confidence interval of 95%.

To find out the potential impact of messages on mediating variables when modifying the restorativeness of natural environments (defined as the environment's capacity to promote restoration), an analysis of variance (ANOVA) was conducted. This analysis compared both types of messages for each variable, focusing exclusively on cases featuring the presentation of a natural environment image. The findings indicate a significant difference in perceived air quality ($F(2,277) = 4.721$; $p = .010$; $\widehat{\omega}^2 = 0.03$) between environments associated with a negative message ($M = 3.30$; $SD = 0.88$) and those without any message ($M = 3.59$; $SD = 0.56$). Specifically, environments with negative messages were perceived to have inferior air quality compared to those without any message. Furthermore, a lower adequacy ($F(2,276) = 7.997$; $p < .001$; $\widehat{\omega}^2 = 0.05$) of environments associated with a negative message to meet with loved ones ($M = 2.43$; $SD = 1.17$) than those associated with a positive message ($M = 2.98$; $SD = 0.88$) or no message ($M = 2.88$; $SD = 0.94$) is observed. On the other hand, these environments associated with the negative message were perceived as more stressful ($M = 0.93$; $SD = 1.06$) than those associated with a positive message ($M = 0.38$; $SD = 0.66$) or the control group ($M = 0.46$; $SD = 0.67$) ($F(2,277) = 12.152$; $p < .001$; $\widehat{\omega}^2 = 0.07$). However, no statistically significant differences were found for sport ($F(2,277) = 1.845$; $p = .160$).

Taking into account the second set of variables - those regarding to Lumber's (2017) pathways -, the ANOVA results showed statistically significant differences based on the type of message in beauty ($F(2,277) = 3.214$; $p < .042$; $\widehat{\omega}^2 = 0.02$), being greater in that natural environment associated with a positive message ($M = 10.46$; $SD = 2.06$) than in those associated with a negative message ($M = 9.64$; $SD = 2.43$). Similarly, differences were found between positive ($M = 11.23$; $SD = 1.51$) and negative ($M = 10.39$; $SD = 2.39$) message in terms of Compassion ($F(2,277) = 4.435$; $p = .013$; $\widehat{\omega}^2 = 0.02$). However, no differences were found for contact ($p = .073$), meaning ($p = .624$), or emotion ($p = .051$).

Discussion

The main objective of this research was to empirically analyze the mediating mechanisms in the relationship between natural environments and restoration. These mechanisms provide a typology of the type of relationships that offer specific routes to a better psychological connection with nature and consequently to well-being (Richarson et. al., 2020). As Hartig et al. (2014) point out, the study of these variables has highlighted the importance of mediating variables such as air quality, social relationships, physical exercise, and stress in understanding restoration. When we analyzed these variables together, we observed significant indirect effects of air quality, social relationships, and perceived stress, indicating their mediating role between environments and perceived restorativeness. However, we did not find a mediating effect of sport suitability on perceived restorativeness. For this study, we categorized settings into two extremes based on their degree of naturalness (Mausner, 1996; Pasca et al., 2020): urban environments and completely natural settings located far from civilization. The existing literature on physical activity has primarily focused on green areas within or near urban areas, with research emphasizing the accessibility of such spaces and the availability of sports facilities (Van Hecke et al., 2018; Vert et al., 2019). Therefore, it is possible that the influence of physical activity on restoration may differ in other types of natural environments, such as parks. Furthermore, we observed that the perception of mediating variables were influenced when environments were associated with negative messages. Individuals perceived lower air quality, diminished suitability for social interactions with loved ones, and higher levels of stress when environments were linked to negative events. It appears that these associations create a halo effect that can even impact the perception of more objective variables, such as air quality. It is important to note that, although physical aspects of the environment such as air quality are mentioned, reference is actually being made to individuals' subjective perception of these aspects. This subjective perception may be influenced by a variety of factors, including

negative events in the environment. In other words, the feeling of lower air quality may not necessarily reflect objective measurements, but rather the personal interpretation of environmental conditions in relation to emotional and social experiences. Therefore, it is essential to consider the associations individuals may have regarding specific environments, as they can diminish the restorativeness of nature-based interventions.

In the same way, we aimed to empirically analyze the pathways proposed by Lumber et al. (2017) to determine if these variables can explain the perceived restorativeness of environments. While these variables had been previously suggested in a theoretical model, we sought to examine them empirically. The results indicate that three of the proposed pathways - contact, meaning, and emotion - play a mediating role in the relationship between the type of environment and its perceived restorativeness. Furthermore, we tested the impact of associating natural environments with positive or negative messages on them, and we found that they were affected to a lesser extent compared to the variables proposed by Hartig et al. (2014). Interestingly, none of the three pathways included in the mediation model were influenced by the message.

On the other hand, the literature on psychological restoration has consistently shown the positive relationship between natural environments and individuals' well-being (e.g., Brancato et al., 2022; Hartig et al., 1991). In fact, research has demonstrated that merely informing individuals that an auditory stimulus corresponds to a natural environment can elicit restorative benefits (Haga et al., 2016). This association of nature with positive effects on individuals suggests a potential role for top-down processes, which have received less attention in the literature (Egner, 2016; Egner et al., 2020). As evidenced in the present research, perceived restorativeness varied depending on the setting and the associated message. As Ries and Schwan (2023) propose, environmental and personal characteristics are placed in a particular

historical and social context, giving rise to psychological processes that in turn will have an effect on how environments are perceived. However, we were unable to confirm that a positive narrative or information enhances the perceived restorativeness of a natural environment, as no significant differences were found between a natural environment with a positive message and one without a message. However, we did find that the restorativeness of a natural environment could be diminished when presented with a negative narrative. This finding could be particularly relevant in contexts where natural environments are commonly associated with inherently negative characteristics. Then a visit to a natural environment about which no negative aspects are known would be advisable according to our results. In this regard, there is an opportunity for future studies to investigate the extent to which various narratives about the same environment overlap and influence perceived restorativeness. Despite the potential reduction in restorativeness when a natural environment is presented with a negative message compared to other messages, our findings align with previous research by Scopelliti et al. (2019) indicating that natural environments are still perceived as more restorative than urban environments, regardless of the associated message.

Additionally, no significant differences were found based on the message when rating the urban environment. It appears that whether a positive, negative, or no message is presented, it does not have a significant impact on the perception of the urban environment in our study. This finding contrasts with other studies where urban environments were rated as more interesting and attractive when a narrative was included (Karmanov, 2008). Therefore, conducting further studies with different designs would be beneficial in order to better understand and characterize these discrepancies.

Limitations and future research

Participants had to rate the environments based on different variables solely by observing a picture. As a result, they may not have been able to fully appreciate the actual characteristics of the different settings in terms of visual quality. Mediating variables such as air quality could have been more accurately assessed if participants were able to experience the environments in person. However, despite this limitation, the participants' assessments still revealed an effect of the message on their perceptions. This suggests that even though the evaluation may have been subjective or biased, the attribution of certain characteristics to the environment remains relevant to psychological restoration.

Secondly, it is worth considering that participants were asked to rate a single photograph depicting either a rural or natural setting. However, it is crucial to acknowledge that there are diverse types of nature and environments that may have distinct effects on restoration. Moreover, recently, it is beginning to be suggested that urban environments could also be healthy and restorative (Bornioli & Subiza, 2023). Exploring and examining these different types of nature and urban environments could provide a more comprehensive understanding of their varied restorative qualities. Furthermore, it should be taken into account the fact that in this study, only the visual aspect has been evaluated while other aspects should be considered (Franco et. al., 2017) such as tactile (Richard & White, 2021), sound (Bergman et. al., 2008; Haga et. al., 2016), soundscapes' animateness where the animated environments are perceived as more natural (Krzywicka & Byrka, 2020); place attachment (Subiza et. al., 2021); personality (Felsten, 2014) and/or olfactive memories (Martinez-Soto et al., 2021) among others. For instance, studies with similar conditions to the present one, carried out with olfactory stimuli, have found that context alters the perception of the same smell (Herz & von Clef, 2001). In this sense, people like a smell they think comes from parmesan cheese, while they dislike it if they think the same smell comes from vomit.

Lastly, it also should be noted that each pathway proposed by Hartig et. al. (2014) was measured with a single item. We believe that each of these pathways should be empirically analyzed in greater depth in future research. For instance, regarding the stress pathway, more specific aspects as suggested by Hartig himself and colleagues, could be taken into consideration such as the acquisition of coping resources, reduction of stressor exposures and/or affective and cognitive restoration, which could provide a more in-depth explanation of the observed effects.

In this vein, while this work attempts to explore the mediational mechanisms through the study of perceived restoration, it would be interesting to observe these variables in situ, in order to analyze the psychological restoration.

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