

# Enhancing post traumatic growth during the COVID-19 lockdown: the roles of nature relatedness and perceived restorativeness

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## Research Article

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## Abstract

## Background

Although the negative outcomes related to traumatic events are well documented, people who experience traumatic events is able to manage the consequences in an adaptive way. This study aims to understand if perception of nature relatedness and perceived potential of restorativeness related to own house, explain Post-Traumatic Growth (PTG) in the context of a pandemic.

## Methods

Through an online survey, disseminated during the national lockdown, we recruited 308 adults ( $M_{age} = 35.31$ ;  $SD = 13.91$ ; 22.7% males) administering them questionnaires to evaluate post-traumatic stress disorder (PTSD), PTG, perceived restorativeness and nature relatedness.

## Results

Controlling for age and gender, we found that different facets of PTG were differently predicted by PTSD, Nature relatedness and perceived restorativeness. PTSD significantly predicted all dimension of PTG.

## Conclusions

Perceived connection to nature as well as the sensation that own house is a place where one can escape from daily routine significantly predicted spiritual change and awareness of new possibilities in own life. Finally, fascination for the place where the individual lived significantly predicted spiritual change.

## Introduction

### The negative consequences on mental health of the COVID-19 lockdown

The COVID-19 pandemic has been a disruptive experience that has had a decisive impact on people lives worldwide. It has been a unique epidemic due to speed of transmission and in a few weeks after hitting a single country, it became a global health emergency (Wang et al., 2020). Starting from the threat to one's own health and that of loved ones, this is an event that has upset many aspects of daily life suddenly and unexpectedly. The pandemic - and the consequent measures to stem the risk of contagion - have distorted people's daily lives and their habits in the working, relational and family spheres. According to DSM-5 (APA, 2013, p.271) trauma concerns "actual or threatened death, serious injury, or sexual violence", which can be experienced through "direct exposure", by "witnessing, in person", "indirectly, by learning that a close relative or close friend was exposed to trauma "or even through "repeated or extreme indirect exposure to aversive details of the event (s), usually in the course of professional duties (e.g., first responders, collecting body parts; professionals repeatedly exposed to details of child abuse)". It is therefore possible to think of the experience of COVID-19 pandemic as a trauma to which the world has been exposed globally in these months and it is not possible not to consider the impact that this will have on people's psyche.

One of the most anticipated consequences after exposure to a trauma according to literature is post-traumatic stress disorder (PTSD), defined as a stress-related disorder that develops as a consequence of the exposure or testimony of a life-threatening traumatic event (Kessler, 2000). Previous studies on COVID 19 and other epidemic events, such as SARS outbreak, have shown that high levels of PTSD were one of the main consequences in percentages ranging from 10 to 47.8% (Chamberlein et al., 2021; Mak et al., 2009; Wu et al., 2009) on general population. In addition to PTSD, there are many other negative outcomes related to the traumatic experience of epidemics such as anxiety (Velotti et al., 2021; Desclaux et al., 2017; DiGiovanni et al., 2004; Bai et al., 2004), insomnia (Taquet et al, 2021; Desclaux et al., 2017; DiGiovanni et al., 2004; Lee et al., 2005), depressed mood (Velotti, Rogier et al., 2021; DiGiovanni et al., 2004; Hawryluck et al., 2004; Lee et al., 2005; Liu et al., 2005) addiction (Rogier, Beomonte Zobel & Velotti, 2021; Dubei et al., 2020) and irritability (Panda et al., 2021; Bai et al., 2004; Lee et al., 2005).

### Covid-19 And Post Traumatic Growth

Although the negative outcomes related to traumatic events are well documented, from literature is known that from 80–90% of people who experience traumatic events is able to manage the consequences in an adaptive way, to find a meaning to what happened, to integrate trauma-related memories and to find a new balance in their functioning (Kessler et al., 1995; Pat-Horenczyk & Brom, 2007). This phenomenon, from which it generates the concept of resilience, refers to the idea that it is possible to return to a condition of equilibrium prior to the trauma but in recent years the idea has developed that it is also possible to go ahead and establish a new equilibrium condition as a response to adversity (Walsh,

2002). From the idea that there is a possibility of growth after trauma and disaster, the concept of post-traumatic growth (PTG) was developed (Tedeschi & Calhoun, 1995; Tedeschi, Park, & Calhoun, 1998).

Post Traumatic Growth is defined by Tedeschi & Calhoun (2004, p.108) as the "experience of individuals whose development, at least in some areas has surpassed what was present before the struggle with crises occurred. The individual has not only survived, but has experienced changes that are viewed as important, and that go beyond the status quo". Instead of ruminating on what happened, why it happened and how it happened, PTG processes productively reframes the traumatic event(s), facing these crucial questions with an organized style of thinking that provides an heightened sense of control (Addington, Calhoun, & Tedeschi, 2016). In that sense, the construction of a coherent narrative including temporal continuity between the pre-event, the event and the post-event, is thought to underline the process of "considering the lesson from the struggle" (Calhoun & Tedeschi, 2013). PTG research has shown how this growth can take place in different areas of the individual's life: in their skills and competences (Elder & Clipp, 1989), in self-confidence (Carver, 1998) and in relationships with others (Fromm, Andrykowski, & Hunt, 1996). PTG is a multidimensional construct involving the modification of a plurality of core beliefs including those related to the relevance attributed to interpersonal relationships, to the possibility to follow new and relevant life paths, to the development of spirituality and existential awareness, to a moment-to-moment appreciation of life and to an increased sense of self-efficacy (Tedeschi & Calhoun, 1996).

PTG appears a crucial topic to investigate in time of COVID-19 outbreak. Indeed, it has been shown to buffer the negative consequences of stressful events on mental health (Addington et al., 1986). But primarily, previous studies suggested that individuals having developed high levels of PTG after a stressful event, were more mentally resilient to successive similar stressful events (e.g. violence exposure during war) (Kunst, Winkel, & Bogaerts, 2010). This is relevant because the psychological stressful facets of the COVID-19 phenomena (e.g. lockdown, social distancing and health-related stress) are likely to be chronic. Therefore, we should identify which mechanisms are likely to buffer, with long-term effects, the negative consequences of the outbreak. In turn, we need to know which variables account for PTG in order to provide useful empirical evidences that may orientate institutional policies.

### **Which psychological variables are likely to enhance PTG during the COVID-19 Lockdown?**

The growing interest in the post-traumatic growth construct has led to an examination of the various factors that contribute to growth. The research hypothesizes that among these there are some more obvious aspects, such as the levels of post-traumatic distress and the support of the social network, and others less obvious, such as the environment and the ability to derive restorativeness from it.

## **Home-related restorativeness**

During the acute phases of the COVID-19 outbreak, several nations decided for social distancing and for "stay-at-home" orders. Consequently, home became, for most people, the predominant environmental context being the only place where we slept, eat, socialized and engaged in recreative activities. Past studies, based on the socioecological framework, documented that environmental features impact on mental health and well-being. During the lockdown, the time spent at home may have potentiated the relevance of the relationship between home features and mental health. Supporting this idea, a study conducted by Amerio et al. (2020), during the lockdown, highlighted that poor housing is predictive of depression, stressing the role of views and indoor quality. These promising results call for further research investigating the relationship between home and mental outcomes during forced "stay-at-home" conditions. Moreover, we may speculate that home-related experiences would impact mental health not only negatively but also positively, for instance enhancing PTG. However, this hypothesis has not been empirically tested. Also, we lack from a psychological explanation of why experiencing home would account for mental outcomes. Regarding this point, the construct of perceived restorativeness is likely to illuminate this issue. It has been developed within the framework of environmental psychology that highlighted how some environments are able to promote the "recovery" of resources and energies, since environmental conditions play a fundamental role in stress-related mechanisms: they can be both stressful factors, challenging human adaptive abilities, but also coping strategies, contributing to the re-establishment of a balance between environment demands and individual resources (Berto, 2014). The Attention Restoration Theory (ART; Kaplan, 1995) and the Stress Recovery Theory (SRT; Ulrich, 1983) argue that places vary in their capacity to restore from psychophysiological stress and that this capacity arises from different components. For instance, a specific place would be perceived as more restorative if it provides a sensation of escape or "being away" that relieves from daily stress. Also, the perceived presence of coherence organizing the place and elements eliciting spontaneous selective attention are thought to contribute to the restorative capacity of a specific place. Finally, the opportunities provided by the place that allow the individual to pursue own interests and inclinations is a central feature that make a place especially restorative. Noteworthy, the restorative capacity of a specific place is not an objective feature but a subjective experience. Therefore, we may speculate that inter-individual differences in the perceived restorativeness of own home are likely to account for mental health outcomes (e.g. PTG) during the COVID-19 lockdown.

## **Connection to Nature**

Another potential variable accounting for PTG during the COVID-19 lockdown is relationship with Nature and, in particular, levels of Nature Relatedness (NR). This construct identifies the subjective sense of connection people have with the natural environment (Nisbet, Zelenski, & Murphy, 2009). There are several reasons for speculating that NR fostered PTG during the COVID-19 lockdown.

First, broadly speaking, NR is thought to be associated with a greater coping capacities and emotion regulation capacities (e.g. mindfulness) that are likely to buffer the disruptive psychological effects of a stressful event (Huynh, 2017; Pritchard et al., 2020). In particular, research has shown the positive influence of the environment on three emotional dimensions: anger, fear and positive affects (Ulrich et al., 1991; Zuckerman, 1977; Ulrich, 1979). For instance, experimental studies have confirmed the role of exposure to nature in the restoration process from psychological stress and fatigue, qualifying it precisely as a coping strategy (Hartig et al., 2003; Ulrich et al., 1991). The natural environment would lie in its ability to produce positive changes in emotional states and to act as a mediator between stress and elicited negative emotions (Kaplan, 1995). This awareness even led some authors to advise the watching of documentary on nature during the COVID-19 lockdown to relieve from stress (Young-Mason, 2020). However, this would explain why individuals with higher NR should experience less negative outcomes, but it does not fully explain why they should experience higher PTG.

A second explanation may arise from the observation that the COVID-19 outbreak elicited numerous -and somewhat catastrophic- reappraisal of the event in light of an ecological perspective. Indeed, we assisted to a so-called temporary "Nature's return". Anecdotal stories about wild animals invading cities were documented. Air, water and noise pollution indexes dramatically decreased (Paital, 2020; Helm, 2020; Yunus et al. 2020). This leads a number of journalists and scientists expressing the idea that the COVID-19 was part of a "self-generation plan" of Mother Nature and that the lockdown was a natural levelling strategy used to re-order the ecosystem (e.g. Dossey, 2020; Paital, 2020). Whereas it is beyond the scope of the present study to examine this debate, we may speculate that this line of argument has been likely to influence the processes of giving a restructured and coherent meaning to the stressful event of the pandemic. In other words, the identification of a transcendental meaning in this ecological discourse may have fostered the PGT processes. Preliminary evidences supporting the idea that individuals developed an heightened sensitivity to ecological thematic have been brought by the analyses of Google trends (Rousseau & Deschacht, 2020). Following the assertion of Dunn (2019) that states that stressful events "change the way we live and relate to both the human and non-human world [...] we need to reimagine and respect the things we value", we may speculate that people who have develop the value of being connected to Nature during the COVID-19 would experience higher levels of spiritual change (a component of PTG). Indeed, the process of change in spirituality may have been even more enhanced in individuals with high Nature Relatedness that see in Nature a superior entity. The relationship of humans with Nature is central in a number of religions and is an highly spiritually connoted topic (Zabaniotou, 2020).

Finally, the COVID-19 lockdown period has been characterized by an increase of green area frequentation, especially in urban areas. For instance, nearby half of the sample of Brode (2020) reported to be more engaged in outdoor activities as such as hiking, visiting local parks, and boating/fishing. As noted by Sachs (2020) many people are connecting with nature more than they have do in their whole life, if ever. This phenomenon may have led to the discovery of new possibilities offered by daily life, that is a central component of PTG.

As a whole, a number of potential reasons exist to hypothesize that both the perceived restorativeness of own home and the levels of nature relatedness would longitudinally predict the PTG related to the COVID-19 lockdown beyond and above the role played by PTSD. However, to our knowledge, no empirical data on the topic is available. Therefore, we conducted a study aiming to test this hypothesis and bring preliminary evidences that may guide institutional policies aiming to increase the psychological resilience of population during future outbreaks.

## Methods

### *Participants and Procedure*

An online survey was created was disseminated throughout a snowball sampling technique three days before the end of the national lockdown related to the COVID-19 emergency. As the survey was performed online, the presentation of the study 'aims and scopes has been carried out throughout a cover letter. Also, a detailed explanation of information related to anonymity and privacy was presented. In case the participant accepted to participate to the study, the subscription on an online format of informed consent was mandatory. After this initial phase, the participant was asked to fulfil a battery of self-report questionnaire. This empirical procedure applies with the official ethical guidelines of the American Psychological Association and has received the approval of the Ethic Board of the University of [Blinded for review].

The whole procedure allowed the recruitment of 308 adults ( $M_{age} = 35.31$ ;  $SD = 13.91$ ; 22.7% males). Despite 44.3% of them obtained at least a college degree, nearly half of the sample (47%) referred to have an income per year inferior to 36.000 €. Also, 23% of participants were not involved in any romantic relationship and only 24.4% of the sample reported to be parents.

### *Measures*

The battery of self-report questionnaires evaluated the following area:

**Demographic characteristics** throughout the creation of a questionnaire asking for information as such as Age, Gender and economical incomes.

**PTSD symptomatology related to the COVID-19 outbreak** has been assessed throughout the National Stressful Events Survey PTSD Short Scale (NSESSS), a 9 items self-report questionnaire developed by LeBeau et al. (2014). The participant is asked to answer to each item on a 5-points Likert-type scale ranging from 0 (*Not at All*) to 4 (*Extremely*). Higher total scores correspond to higher severity of PTSD symptoms. We adapted the

version of this instrument asking the participant to answer keeping in mind only stressful events related to the COVID-19 pandemic. The Alpha Cronbach value calculated for this tool reached .88.

The extent by which individuals experiment **Post Traumatic Growth** throughout the use of the Post Traumatic Growth Inventory (PTGI, Tedeschi & Calhoun, 1996; Prati & Pietrantonio, 2014). This is a 21 items self-report questionnaire asking the participant to answer on a 6-points Likert-type scale ranging from 0 (*I did not experience this change as a result of my crisis*) to 5 (*I experienced this change to a very great degree as a result of my crisis*). The instrument was slightly adapted for the purpose of the study, asking the participant to indicate for each of the statements the degree to which this change occurred in your life as a result of the COVID-19 related crisis. This instrument provides a scores for five distinct dimensions namely *Relating to Others*, *New Possibilities*, *Personal strength*, *Spiritual Change* and *Appreciation of Life*. In this study, the tool confirmed its good psychometric proprieties with Cronbach alpha's values ranging from .75 (*Spiritual Change*) to .91 (*Appreciation of Life*).

The levels of **Nature Relatedness** have been measured throughout the Nature Relatedness Scale 6 items (NRS-6; Nisbet & Zelenski, 2013). This instrument asks the participant to answer on a 5-point Likert-type scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*) and provides an evaluation of the extent by which the individual feels to be connected with Nature. In this study, the scale showed a good internal consistency index ( $\alpha = .84$ ).

The extent by which participant perceived their home (i.e. the place where they were lockdown) as restorative has been measured throughout the administration of the **Perceived Restorativeness Scale** (PRS; Hartig, Evans, Korpela, & Garling, 1997). This 26-items self-report questionnaire to indicate how much a specific place (in this study the home where the individual stayed during the lockdown) matched with 26 descriptions on a 7-points Likert-type scale ranging from 0 (*Not at all*) to 6 (*Completely*). The instrument provides four scores related to four dimensions of the perceived restorativeness being *Being Away*, *Fascination*, *Coherence* and *Compatibility*. The instrument showed a good reliability with Cronbach alpha's value ranging from .75 (*Coherence*) to .89 (*Fascination*).

### *Statistical Analyses*

Analyses were performed with the SPSS v.23 software for Windows. Preliminary analyses were first run, as such as computation of frequencies, means and standard deviations as well as exploration of QQ-plots and Cronbach alpha's values for continuous variables, to check the assumptions for successive parametric analyses. Afterward *r*-Pearson coefficients were calculated to appreciate the nature of the relationships between all variables involved in the study. Finally, the hypotheses of the study were tested performing multiple linear regressions.

## **Results**

### *Correlations between variables*

First, bivariate *r*-Pearson correlations between all variables involved in the study were calculated. PTSD scores were all positively and significantly associated with PTGI dimensions with coefficients ranging from .12 (*Spiritual Change*) to .26 (*Appreciation of Life*). Then, the matrix correlation between PTGI and PRS dimensions were explored (see Table 1). Results showed that the PRS dimensions *Being away* was positively and significantly correlated with all the dimensions of the PTGI and that the dimension *Fascination* of the PRS was positively and significantly related to all the subscales of the PTGI except for the *Relating to Others* one. No other significant associations between PTGI and PRS scales were observed. Finally, the estimation of correlations coefficients between the NRS scores and the PTGI and PRS dimensions highlighted that NRS was positively and significantly associated with the *Being Away* dimension of the PRS as well as with the *New Possibilities* and *Spiritual Change* subscales of the PTGI.

Table 1  
Correlations between main variables of the study.

	PTSD	Away	Fascination	Coherence	Compatibility	NRS	Others	Possibilities	Strength	Spiritual	Life
PTSD	-										
Away	-.07	-									
Fascination	-.20**	.57**	-								
Coherence	-.19**	-.01	.15*	-							
Compatibility	-.27**	.35**	.58**	.07	-						
NRS	.06	.03	.18*	.09	.02	-					
Others	.20**	.13*	.11	-.05	.05	.08	-				
Possibilities	.17**	.22**	.17**	-.05	.09	.15*	.76**	-			
Strength	.13*	.16*	.13*	-.03	.06	.06	.74**	.80**	-		
Spiritual	.12*	.16*	.19*	.01	.02	.21**	.52**	.56**	.55**	-	
Life	.26**	.18*	.14*	-.02	.05	.06	.72**	.72**	.68**	.47**	-

*Note:* PTSD: Post Traumatic Stress Disorder scale; NRS: Nature Relatedness Scale; \*\*  $p < .001$ ; \*  $< .05$ .

#### Regression analyses

To test the role of both PRS and NRS in the prediction of PTGI levels we performed five multiple linear regression analyses entering the five dimensions of PTGI as dependent variables. As predictive factors we entered gender and age in the first steps, PTSD scores in the second steps, and both NRS scores and PRS dimensions in the final steps. Results are fully displayed in Table 2. Regarding the *Relating to others* dimension of the PTGI, we found that only PTSD scores significantly and positively of this variable's levels. In contrast, the *New possibilities* subscale of the PTGI was positively and significantly predicted by PTSD levels, NRS scores and the *Being Away* dimension of the PRS. In addition, the *Personal strengths* subscale of the PTGI was found to be significantly predicted only by Age (negatively) and PTSD levels (positively). Also, PTSD scores, NRS levels and scores obtained on the *Fascination* subscale of the PRS were found to positively and significantly predict the *Spiritual Change* scores of the PTGI. Finally, the results of the last regression analyses showed that the *Appreciation of life* dimension of the PTGI was significantly and negatively predicted by Age but significantly and positively predicted by PTSD scores and the levels of the *Being Away* dimension of the PRS.

Table 2  
Hierarchical multiple regressions predicting post traumatic growth levels.

	Relating to others		New possibilities		Personal strength		Spiritual change		Appreciation of life	
<i>Model 1</i>	$R^2 = .12; p = .132$		$R^2 = .07; p = .482$		$R^2 = .13; p = .068$		$R^2 = .04; p = .746$		$R^2 = .19; p = .005$	
	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p
<b>Constant</b>	14.62	<.001	10.79	<.001	8.74	<.001	2.00	.006	8.97	<.001
<b>Age</b>	-.06	.064	-.03	.235	-.04	.040	.01	.560	-.05	.001
<b>Gender</b>	.64	.591	.05	.950	.61	.429	-.13	.681	.14	.796
<i>Model 2</i>	$R^2 = .22; p = .003$		$R^2 = .17; p = .027$		$R^2 = .17; p = .037$		$R^2 = .14; p = .130$		$R^2 = .29; p < .001$	
	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p
<b>Constant</b>	12.55	<.001	9.48	<.001	8.00	<.001	1.60	.031	7.79	<.001
<b>Age</b>	-.04	.226	-.02	.531	-.04	.094	.01	.307	-.04	.016
<b>Gender</b>	.11	.925	-.28	.745	.42	.589	-.24	.470	-.16	.760
<b>PTSD</b>	.21	.001	.13	.006	.07	.079	.04	.025	.12	<.001
<i>Model 3</i>	$R^2 = .29; p = .001$		$R^2 = .34; p < .001$		$R^2 = .27; p = .005$		$R^2 = .32; p < .001$		$R^2 = .38; p < .001$	
	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p	$\beta$	p
<b>Constant</b>	7.98	.033	4.73	.074	5.00	.040	-.03	.975	5.45	.001
<b>Age</b>	-.07	.064	-.04	.107	-.06	.021	<-.01	.791	-.05	.002
<b>Gender</b>	.07	.951	-.30	.720	.35	.646	-.21	.505	-.29	.579
<b>PTSD</b>	.22	.001	.14	.003	.09	.047	.04	.037	.14	<.001
<b>NRS</b>	.14	.180	.17	.021	.08	.224	.09	.002	.03	.502
<b>Being Away</b>	.09	.242	.14	.016	.08	.105	.03	.174	.07	.048
<b>Fascination</b>	.07	.242	.05	.238	.05	.276	.04	.019	.05	.106
<b>Coherence</b>	-.04	.702	-.04	.548	-.01	.908	-.01	.773	.03	.525
<b>Compatibility</b>	.02	.638	.02	.623	.01	.748	-.02	.235	.01	.778
<i>Note:</i> PTSD: Post Traumatic Disorder scale; NRS: Nature Relatedness Scale.										

## Discussion

Considering the role of both perceived restorativeness and connection to nature, this study aimed to empirically test an explanation model of post-traumatic-growth within the context of COVID-19 pandemic. The results observed allowed us to highlight how both the levels of nature relatedness and the levels of specific dimensions of perceived restorativeness positively and significantly predict some aspects of post-traumatic growth, controlling for the portion of variance already explained by PTSD symptomatology.

What emerges clearly from this research is the key role of the relationship with nature in dealing with a traumatic event, such as the months of lockdown with all their stressful correlates, which contributes to post-traumatic growth. Specifically, levels of perceived connection to nature were found to positively predict two dimensions of PTG, namely *New Possibilities* and *Spiritual change*. Faced with the confinement due to COVID-19 epidemic, nature relatedness seems to have acted not only as a protective factor - in line with the work of Grahn and Stigsdotter (2003) who identified a causal relationship between accessibility (and therefore the possibility of use) of green spaces and the stress levels of individuals, understood as fatigue, irritation and a general feeling of being chased, harassed and stressed - but also as a determining factor in the transformation of the stressful experience in a chance of growth for the individual.

In particular, the spiritual change dimension refers more widely to individual awareness concerning the meaning of existence, regardless of religious tradition (Huguelet & Koenig, 2009). It is possible to hypothesize that in the context of confinement the power of nature to give people a restful experience (Kaplan & Talbot, 1983) has led many people to rethink in a more "intimate" way the meaning and the ways in which they live their existence and consequently to experience post-traumatic growth in this area, rather than in other areas such as *Appreciation of Life*, *Personal Strength* or *Relating to Others*. NR may have enhanced the spiritual dimension of PTG for several reasons. First, the relationship with Nature is, at

least partially, spiritual in its nature. Indeed, most of existing religions include philosophical considerations towards the human-Nature relationship. Therefore, elevated levels of NR may predict an higher capacity to use spiritual coping. This would be a relevant results, as this coping strategy has been shown to have a protective role in relation to a number of outcomes. Moreover, future studies may want to investigate the relationship (and potential overlapping) between nature connectedness and spiritual coping. Regarding the reason of why NR predicted PTG in its spiritual dimension in the context of outbreak pandemic, some interpretations can be formulated. Indeed, we may think that narratives, widely mediatized, understanding the COVID-19 outbreak as a punishment or at least, a strategic plan, of Mother Nature, depicted as a superior and transcendental entity influence this process. These narratives may have provided to the individuals new meanings that make sense to the overwhelming and stressful events. In other word, Nature may have been the explanation that helped disrupted minds to find a feeling of coherence and unity.

Then, NR predicted PTG also in its dimension of new possibilities for life. Indeed, an higher frequentation of green area is likely to be associated with NR. However, in our study, we did not measure the effective accessibility to natural environments but only the subjective experience of relationship with Nature. These two aspects are likely to interact in the prediction of PTG. This issue should be better explored in future studies. In addition, we may have expected a predictive role of NR on appreciation for life because this dimension of PTG appear in some aspect similar with mindfulness abilities that, in turn, are associated with NR. This result stresses the complex nature of the construct investigated and call for future research exploring the role of mediating variables as such as mindfulness or emotion regulation capacities.

Regarding the perceived restorativeness of home, our study brought interesting results, evidencing that this variable was predictive of several dimensions of PTG being spiritual change, appreciation of life and new possibilities. We found that the *Being away* dimension predicted both the *New possibilities* and *Appreciation of Life* dimensions of PTG whereas the *Fascination* subscale predict *Spiritual change*. To perceive own home, that is also like a jail during the COVID-19 lockdown, as a place that is highly compatible with own interests and inclinations may easily foster the process of reinventing own life, developing new interests and discovering new paths for own life. Also, for most people, the COVID-19 resulted in a dramatic change of daily routine with a potential reduction of frenetic and high-pressure lifestyle. To stay in a place that is perceived as restorative may allow to appreciate this opportunity that in turn would lead to a more mindful attitude towards the transient positive events of the existence.

As a whole, we found that both NR and perceived restorativeness of home are predictive of PTG in a context of lockdown, social distancing and outbreak. Because PTG is likely to be one of the most powerful mechanism underlying resilience, future research should aim to replicate and extend our results to provide useful empirical evidences that orientate policy. For instance, accessibility to urban green areas is known to be unequal and this kind of spatial discrimination may, as suggested by our results, lead to mental health inequalities. Also, we should study and test solution to elicit NR among young population in order to increase the psychological resilience among them. Finally, the replication of our results may lead the institutions to make recommendations aiming to increase the perceived restorativeness of home in population isolated for a long time (or for instance remaining in a smart-working condition).

## Limitations And Future Directions

Although carefully conducted, this study is also not exempt from limits. First, the study conducted is cross-sectional in its nature and for this reason we must be careful in making causal inferences from these results. Secondly, the study was conducted on a community sample, therefore caution should be exercised in generalizing the results obtained and in thinking of them as applicable to clinical population. It is not yet known if the relationships between the constructs analyzed could be different or could be influenced by other specific variables in clinical populations that undergo the traumatic event. Thirdly, since most of the sample is made up of Italian citizens, there might be cultural components that have not been evaluated and somehow play a role within the relationship between nature relatedness, perceived restorativeness and post-traumatic growth.

Globally, our results indicate the need to deepen the study of the effects of pandemic COVID-19, as long as the effects of preventive measure to contain contagion, as a very interesting context to study and analyze the dynamics related to the effects of a large-scale traumatic event. The hope is therefore that the components of post-traumatic growth can be further explored in the future by using a longitudinal approach to assess whether the relationships identified remain constant over time or change, or by replicating the study in different cultural contexts to see if post-traumatic growth is somehow connected to cultural factors.

## Declarations

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### Authors' contributions

SBZ and GR analyzed the data and wrote the first draft of the manuscript. LALP and PV critically revised the manuscript for intellectual content. All authors contributed to and have approved the final manuscript.

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## Data availability

Due to privacy policies, the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics approval and consent to participate

All procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The written informed consent was obtained from all the participants.

The study was approved (N. 356/20) by the Ethics Committee of the Sapienza University of Rome.

## Consent for publication

Not applicable.

## Competing interests

The authors declare that they have no competing interests.

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