

Article

Psychological Restoration and the Effect of People in Nature and Urban Scenes: A Laboratory Experiment

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Abstract: It is well-evidenced that exposure to natural environments increases psychological restoration as compared to non-natural settings, increasing our ability to recover from stress, low mood, and mental fatigue and encouraging positive social interactions that cultivate social cohesion. However, very few studies have explored how the inclusion of people within a given environment—either urban or natural settings—affect restorative health outcomes. We present three laboratory-based studies examining, first, the effect of nature vs. urban scenes, and second, investigating nature ‘with’ vs. ‘without’ people—using static and moving imagery—on psychological restoration and social wellbeing. Our third study explores differences between urban and natural settings both with vs. without people, using video stimuli to understand potential restorative and social wellbeing effects. Outcome measures across all studies included perceived social belonging, loneliness, subjective mood, and perceived restorativeness. Studies 1 and 2 both used a within group, randomized crossover design. Study 1 ($n = 45$, mean age = 20.7) explored static imagery of environmental conditions without people; findings were consistent with restorative theories showing a positive effect of nature exposure on all outcome measures. Study 2 compared nature scenes with vs. without people ($n = 47$, mean age = 20.9) and we found no significant differences on our outcome measures between either social scenario, though both scenarios generated positive wellbeing outcomes. Study 3, conducted on Amazon Mechanical Turk, employed an independent group design with subjects randomly assigned to one of four conditions; an urban vs. nature setting, with vs. without people. We explored the effect of moving imagery on psychological restoration ($n = 200$, mean age = 35.7) and our findings showed no impact on belonging, loneliness, or mood between conditions, but did show that—regardless of the inclusion of people—the nature settings were more restorative than the urban. There were no differences in psychological restoration between nature conditions with vs. without people. We discuss the implications for restorative environment research exploring social-environmental interactions.

Keywords: social wellbeing; psychological restoration; social contact; urban; nature; belonging; loneliness



Citation: Neale, C.; Lopez, S.; Roe, J. Psychological Restoration and the Effect of People in Nature and Urban Scenes: A Laboratory Experiment. *Sustainability* **2021**, *13*, 6464. <https://doi.org/10.3390/su13116464>

Academic Editors: Helena Nordh and Katinka H. Evensen

Received: 11 March 2021

Accepted: 28 May 2021

Published: 7 June 2021

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1. Introduction

It is well understood that there are benefits of nature on various psychophysiological outcomes including brain activity [1–4], heart rate variability [5], cognition [6,7], and mood [8–10]. A large body of literature cites the role of nature in restoring depleted attentional capacities as a mechanism for this [11–13]. To date, there has been limited attention given to the inclusion of people within laboratory stimuli (often incorporating static images without the presence of people), or accounting for people in situ studies. However, social and physical environments do not exist independently of each other, and in many cases, these are experienced concurrently [14,15].

Despite a significant body of research showing beneficial effects of restorative environments (particularly nature settings) to individual psychological wellbeing, this has largely

focused on the physical setting minus the social context. Various systematic reviews have explored the role of natural restorative environments; Ohly and colleagues [16] identified 31 studies that explored nature as a restorative tool (from an initial study $n = 15,443$). Further to this, Kondo and colleagues [17] identified 68 studies that support the restorative properties of urban green space (from an initial study $n = 7066$). Despite the large number of studies that have attempted to assess restorative properties of nature and/or urban green space, we identified a limited number of studies that have discussed the inclusion of people in tandem with nature settings and the effect on psychological restoration. In a study seeking to understand the impact of hotel room views on what participants were willing to pay for that room, restorative views that included people were preferred and participants were willing to pay significantly more, compared to views without people [18]. Further studies have identified that psychological restoration can be aided by the presence of people in nature [19], including friends [20], as long as they are non-threatening [21]. The number of people present in images of small urban parks may be important, with higher ratings of perceived restoration obtained in response to images of parks that include 'few people' in comparison to none or a crowd of people [22], indicating the importance of perceived safety in restoration [19]. Most laboratory-based studies exploring the effects of urban versus natural spaces on psychological wellbeing utilize visual stimuli that excludes people. However, this is not how we, commonly, experience our environment. Our environmental experience often contains people, so the prevalence of stimuli that do not include people in environmental psychology literature is not reflective of our normal experience.

The question regarding the inclusion of people in research stimuli leads to questions regarding the impact of restorative environments on social behavior more broadly. A recent systematic review identified 30 studies that show exposure to nature, in both laboratory and in situ study scenarios, improves mood and leads to increased levels of subjective prosociality and benevolent attitudes (such as increased generosity and helpfulness) towards others [23]. Furthermore, this effect is mediated by mood, sense of belonging, social relatedness, emotion regulation, and feelings of trust. However, the review did not include any studies that overtly test the presence of people in nature compared to the absence of people in nature and outcomes on prosociality. Further research has correlated nature and social determinants; for example, those residing in neighborhoods with lower levels of green space report higher feelings of loneliness and reduced social support compared to those with higher levels of local green space in their living environment [24]. Similarly, exposure to urban green space (e.g., tree cover, and urban parks) has been linked to increased perceptions of neighborhood social cohesion [25] and improves feelings of social interconnectedness when compared to sitting indoors [8]. There are studies that explore the therapeutic benefits of activities within nature settings [26–28] that include social group experiences outside of laboratory conditions. However, these studies cannot separate the social environment from the physical environment, making it difficult to attribute any finding to one or other environment.

Attention restoration theory (ART) provides a theoretical framework from which to understand the beneficial impacts of restorative environments on depleted attentional resources [13]. ART considers four properties of a restorative environment that contribute to recovery from mental fatigue [11,29]: 'being away', 'extent', 'fascination', and 'compatibility'. 'Being away' can be psychological or geographical, but ultimately requires a change from the current mental content. 'Extent' refers to the creation of an environment that is broad enough in scope to engage the mind. 'Fascination', also described as involuntary attention, requires minimal effort and allows depleted attentional resources to replenish, such as engaging with leaves moving in the wind. Finally, 'compatibility' refers to the synergy between the environment presented and the preferences of the individual. All four of these components can be reliably measured using the Perceived Restoration Scale (PRS) acutely post exposure to a given environment [30]. There is no indication in the current literature that the inclusion of people enhance or deplete the effect of any of these components.

A further important framework to understanding the prosocial impacts of nature is the relationship between nature and the individual. Increased time in nature increases the sense of connectedness to nature [31,32], integrating nature with part of one's self-identity in order to restore cognitive, affective, and behavioral capacities [33]. The impact this may have on social interactions within environmental settings has not been explored, but—given the mechanism by which nature connection has an effect—connection to nature may mediate any prosocial impact of nature.

In summary, there appears to be a relationship between restorative nature exposure and positive social cohesion and social connection. However, there is little research that has attempted to understand if this relationship is enhanced by the inclusion of people in nature settings. Furthermore, there has been little to understand if there are beneficial impacts of people within urban settings. The aim of this research was to address the inclusion of people in both urban green and urban visual imagery (static and moving) to capture a more realistic image of 'everyday urban nature' in which people are present. To achieve this, we build on previous work [18] and standardize the presentation of people in visual stimuli designed to test effects of natural and built scenery on psychological wellbeing.

We present three sequential studies, each building on each other. Given the exploratory nature of the research, we present research questions instead of firm hypotheses.

1. Does exposure to static nature stimuli increase psychological restoration and social wellbeing when compared to static urban stimuli? (Study 1).
2. Does the inclusion of people within static nature stimuli increase psychological restoration and social wellbeing when compared to static nature stimuli without people? (Study 2).
3. Does the inclusion of people in video stimuli of both nature and urban stimuli increase psychological restoration and social wellbeing when compared to video stimuli of both nature and urban settings without people? (Study 3).

Across each study, we will further explore if nature identity mediates any effect of stimuli on psychological restoration and social wellbeing.

2. Materials and Methods

Across all three studies presented here, we use the same outcome measures.

2.1. Primary Outcome Measures (Social Wellbeing)

1. Sense of belonging; measured using the General Sense of Belonging Scale (GBS), a 12-item scale capturing social acceptance/inclusion and lack of social rejection/exclusion [34]. Participants respond to each of the items (e.g., 'I have a sense of belonging') on a 7-point scale (strongly disagree to strongly agree), with each point recoded to 1–7, with the sum of the participant's response used as the final score. Scores therefore range from 12 to 84, with a higher score indicating a higher sense of social belonging.
2. Loneliness; measured using the UCLA-3 Loneliness Scale, a 3-item scale capturing participants' lack of companionship and feelings of isolation [35]. Participants respond to each of the items (e.g., 'How often do you feel isolated from others?') on a 3-point scale (hardly ever, sometimes, often), with each point recoded to 1–3 and the sum of the participant's response used as the final score. Scores therefore range from 3 to 9, with a higher score indicating a higher level of loneliness.

2.2. Secondary Outcome Measures (Psychological Restoration)

1. Mood; measured using the short version of the University of Wales Institute of Science and Technology (UWIST) Mood Adjective Check List (MACL) which measures participants' hedonic tone, stress, and arousal [36]. The scale used requires participants to respond to 12 descriptive statements (e.g., 'energetic' or 'happy') relating to how they feel at the present moment, which they respond to on a 4-point scale (definitely, slightly, slightly not, definitely not), with each point scored from 1–4. Each

subcomponent (hedonic tone, stress, and arousal) is measured across four descriptors and scores for each range from 4 to 16 with higher scores indicating higher hedonic tone (positive valence), stress or arousal.

2. Perceived restorativeness; measured using the Perceived Restorativeness Scale (PRS), which measures the four components of perceived environmental restorativeness—‘being away’, ‘fascination’, ‘extent’, and ‘compatibility’ [30]. The scale consists of four statements, each corresponding to the four components of attention restoration theory, that participants respond to on a 7-point scale (strongly agree to strongly disagree), with each point reverse scored from 7–1, and total scores summed to calculate a total perceived restoration score ranging from 4 to 28. Higher scores indicate higher levels of restoration post-stimuli condition.

2.3. Mediating Factors

Nature identity; measured by the Inclusion of Nature in Self Scale (INS) is a single item question to understand how nature is incorporated into personal identity [33]. The measure uses seven pairs of circles with one labelled ‘self’ and other ‘nature’ from which participants are asked to choose which best describes their relationship with nature. Circle pairs range from not overlapping to almost complete overlap, scored on a scale from 1 (no overlap) to 7 (almost complete overlap).

2.4. Ethical Consideration

For all three studies, the Institutional Review Board for Social and Behavioral Sciences (IRB-SBS) at the University of Virginia provided full ethical approval (#3187).

3. Study 1: Static Nature vs. Urban Imagery

The aim of Study 1 was to establish a beneficial effect of nature images when compared to urban images.

3.1. Method

3.1.1. Subjects

Participants ($n = 45$) were adults aged between 18 and 34 ($M = 20$ (years), $SD = 3.4$), recruited through a participant pool via the Behavioral Research and Decisions (BRAD) Lab at the University of Virginia. Of these participants, 9 were male, 35 were female, and 1 participant did not respond to this question. Participants were paid a USD 15 gift card for taking part.

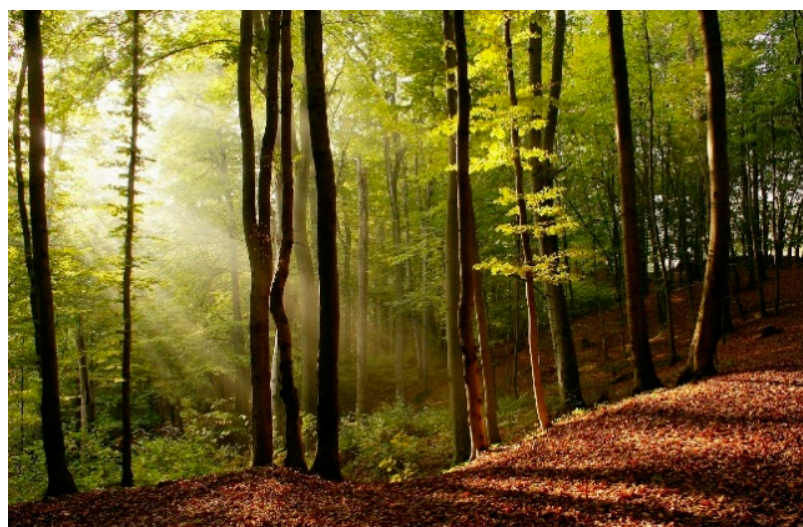
3.1.2. Stimuli

Participants viewed two image banks throughout the study experience, both consisting of full color urban and nature images validated in previous restorative environment research [37] that did not include any people or sound. Participants viewed a nature and an urban block of images, each containing 16 images displayed for 25 s each (400 s total per block). Figure 1 shows examples of these images.

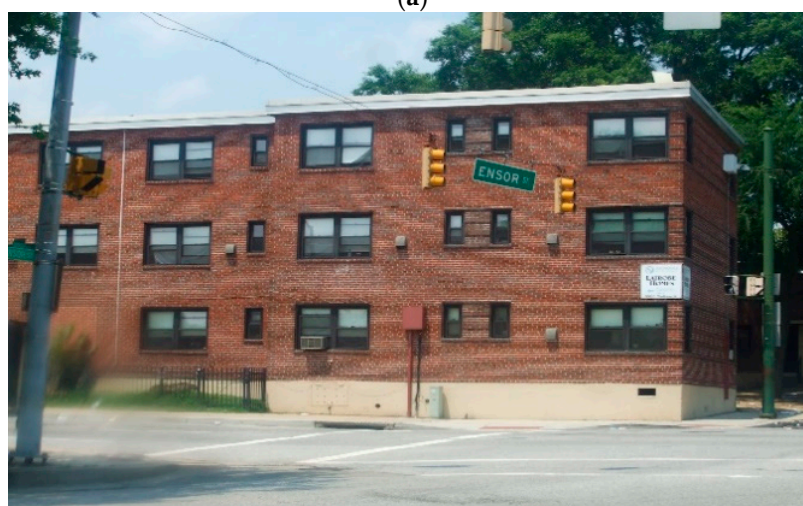
3.1.3. Study Design and Procedure

We employed a within group randomized crossover design where participants were allocated to one of two conditions determining order of image bank presentation (i.e., nature first or second). The study protocol, including randomization to condition order, was administered via a Qualtrics survey. Participants arrived at the laboratory, reviewed and signed their consent form before completing the survey. Participants completed the first series of questions (UCLA-3, GBS and UWIST-MACL) before watching the first randomized image bank and repeating these questions, with the addition of the PRS. After a five-minute break where they were asked to relax and not interact with phone/emails, participants watched the second image bank, culminating with the UCLA-3, GBS, UWIST-

MACL, and PRS as well as a series of demographic questions, including the INS. This concluded the study.



(a)



(b)

Figure 1. Example of a ‘nature’ (a) and an ‘urban’ (b) static image slide.

3.2. Study 1 Analyses

We created change scores for our primary and secondary study measures by subtracting the baseline (pre-image bank 1) measures from the post-image bank measures, creating urban and nature change scores. In order to be confident in using change scores we ran an independent *t*-test on the baseline scores for each outcome measure, using image bank order as a condition. This test was to ensure that there were no significant differences in baseline outcomes prior to watching image banks between participant groups, a factor that would impact the use of change scores.

To understand if there were order effects of image bank presentation of which to factor for, we ran independent *t*-tests on the urban and nature change scores independently, using image bank order as the condition. This would determine differences between same condition outcomes based on the order which they viewed the images.

For our main analysis, we used paired *t*-tests between the nature and urban change scores (e.g., GBS nature change vs. GBS urban change) in order to understand the impacts of the image bank stimuli, answering RQ1. As the PRS was conducted post-image bank only, not at baseline, we ran a paired *t*-test on the PRS score post-nature and post-urban images for both the total score as well as the four subcomponent outcomes (‘being away’,

‘compatibility’, ‘extent’, and ‘fascination’). For each of these paired *t*-tests, we calculated effect size, using Cohen’s *d* [38].

Finally, we explored the mediating effect of the INS. First, we ran Pearson’s correlation on the INS against each of the primary and secondary outcome measures. For those correlations which were significant, we used INS as the independent variable in a linear regression against the previously identified outcome measure (change score) as the dependent variable. We present the effect size of these regressions using R^2 of any relevant models.

3.3. Study 1 Results

3.3.1. Baseline Change and Order Effects

A series of independent *t*-tests showed no significant differences between baseline levels of GBS ($p = 0.47$) or UCLA-3 ($p = 0.83$), hedonic tone ($p = 0.54$), stress ($p = 0.54$), or arousal ($p = 0.77$). Furthermore, a series of independent *t*-tests using each change score for both nature and urban conditions showed no impact of image bank presentation order (Nature: GBS, $p = 0.37$, UCLA-3, $p = 0.26$, hedonic tone, $p = 0.66$, stress, $p = 0.21$ and arousal, $p = 0.20$; Urban: GBS, $p = 0.25$, UCLA-3, $p = 0.11$, hedonic tone, $p = 0.63$, stress, $p = 0.09$, and arousal, $p = 0.99$). These results show a stable baseline between participants and no order effects present between image bank viewing order.

Establishing no order effects, we present the combined means for each of the outcomes. For ease, we present the GBS and UCLA-3 outcomes in Table 1 and the UWIST MACL outputs in Table 2.

Table 1. Means and Standard Deviations (in parentheses) for social wellbeing (i.e., General Sense of Belonging Scale (GBS) and UCLA-3 Loneliness scale measures) shown by condition.

Pre		Post Nature		Post Urban	
GBS	UCLA-3	GBS	UCLA-3	GBS	UCLA-3
63.56 (12.50)	5.58 (1.74)	64.93 (13.15)	5.16 (1.69)	61.82 (13.63)	5.53 (1.70)

GBS = General Sense of Belonging Scale; UCLA-3 = UCLA Loneliness Scale.

Table 2. Means and Standard Deviations (in parentheses) for subjective mood (UWIST Mood Adjective Checklist (MACL) outputs), shown by condition.

Pre			Post Nature			Post Urban		
Arousal	HT	Stress	Arousal	HT	Stress	Arousal	HT	Stress
9.27 (1.88)	11.87 (2.36)	10.22 (2.18)	7.98 (1.37)	12.53 (2.06)	9.80 (1.82)	8.49 (1.84)	11.09 (2.45)	9.58 (1.97)

HT = Hedonic Tone.

3.3.2. Nature vs. Urban Change Score Analyses

Primary Outcome Measures

The paired *t*-tests showed statistically significant differences between change scores of both GBS ($t(44) = 3.77$, $p < 0.001$, $d = 0.63$) and UCLA-3 ($t(44) = 3.04$, $p = 0.004$, $d = 0.52$). Both results show a moderate effect size. Figure 2 shows the change scores; for GBS, the results show belonging increasing post-nature images when compared to the urban images. For the UCLA-3, loneliness decreases post images, regardless of condition, but this effect is more pronounced from exposure to the nature images.

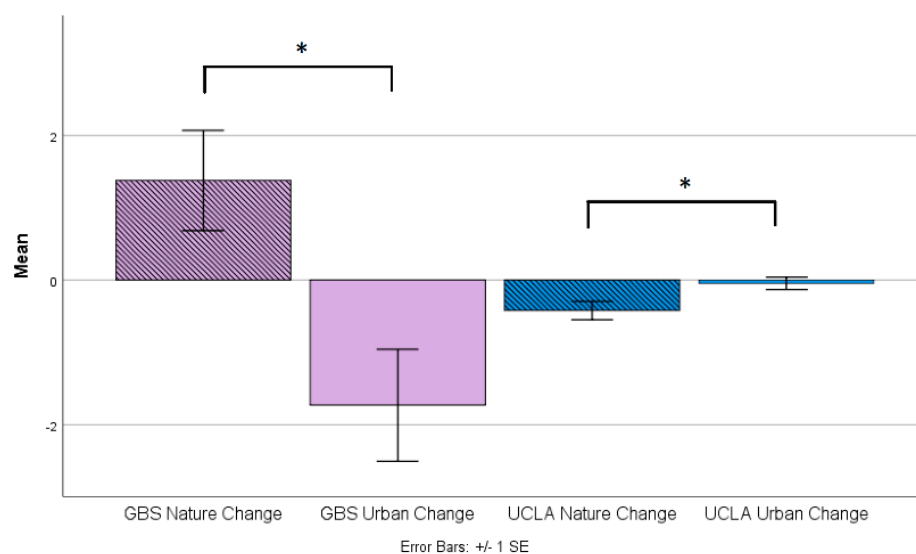


Figure 2. Change scores of the General Sense of Belonging Scale (GBS, purple bars) and UCLA-3 Loneliness scale (blue bars). Positive scores for the GBS suggest increases in belonging. Negative scores in the UCLA-3 suggest decreases in loneliness. Nature scores have hatched bars and significant differences ($p < 0.005$) denoted by *.

Secondary Outcome Measures

For the mood outcomes, the paired t -tests showed statistically significant change for hedonic tone only, with a large effect size in change scores ($t(44) = 5.45, p < 0.001, d = 0.87$) but not of stress ($t(44) = 1.02, p = 0.31, d = 0.14$) or arousal ($t(44) = 1.91, p = 0.06, d = 0.31$). Figure 3 shows how hedonic tone (blue bars) increases post-nature images when compared to post-urban images. Stress (beige bars) and arousal (red bars) decrease after both nature and urban images, and there is no significant difference between these conditions.

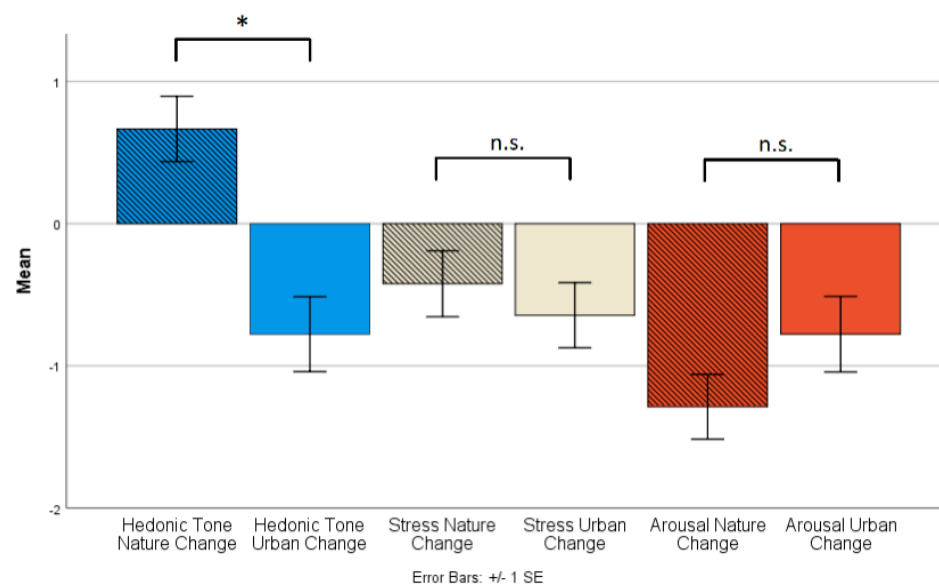


Figure 3. Change scores of the UWIST-Mood Adjective Checklist (MACL) outcomes (hedonic tone, stress, and arousal). Positive scores indicate increases in outcome measure post-image bank condition. Nature scores have hatched bars and significant differences ($p < 0.001$) denoted by *.

There was also a statistically significant difference between the PRS score post-nature ($M = 17.29, SD = 2.20$) and urban images ($M = 11.40, SD = 3.71$) with a large effect size ($t(44) = 8.67, p < 0.001, d = 1.93$).

We further explored the four individual components of the PRS to ascertain if any of these components was driving the overall difference between perceived restoration between the nature and urban images. We found no significant differences between PRS scores for ‘fascination’ ($t(44) = -1.56, p = 0.13, d = 0.38$), ‘being away’ ($t(44) = 0.35, p = 0.73, d = 0.09$), ‘extent’ ($t(44) = 0.09, p = 0.93, d = 0.02$), or ‘compatibility’ ($t(44) = 0.06, p = 0.96, d = 0.01$).

3.3.3. Mediating Effect of Nature Identity (INS)

Two outcome measures significantly correlated with the Inclusion of Nature in Self scale: UCLA-3 (urban change, $r(45) = 0.39, p = 0.004$) and arousal (urban change, $r(45) = -0.39, p = 0.004$). A linear regression predicting loneliness (UCLA-3), using INS as the independent variable, showed little of the variance was explained by the model ($R^2 = 0.149$), but the overall model was statistically significant ($F(1, 43) = 7.55, p = 0.009$), with the beta coefficient ($B = 0.148$) suggesting that as nature identity increases, so do feelings of loneliness post-exposure to the urban images.

A linear regression predicting arousal, using INS as the independent variable, showed little of the variance was explained by the model ($R^2 = 0.154$), but the overall model was statistically significant ($F(1, 43) = 7.83, p = 0.008$), with the beta coefficient ($B = -0.476$) suggesting that as nature identity increases, feelings of arousal decrease post-exposure to the urban images.

3.4. Study 1 Summary

The results for Study 1 support the beneficial effects of nature when compared to urban settings using static imagery with no people, demonstrated by improvements in our primary outcome measures (i.e., increased sense of belonging (GBS) and less loneliness (UCLA-3) as well as improvements in hedonic tone in post-nature compared to post-urban images. As expected, the PRS outcomes show that participants found the nature stimuli more restorative than the urban stimuli.

4. Study 2: Static Nature Imagery with and without People

After establishing a benefit of nature relative to urban space in Study 1, the aim of Study 2 was to explore differences in our outcome measures between nature images with vs. without people, again using static images.

4.1. Method

4.1.1. Subjects

Participants ($n = 47$) were adults aged between 18 and 29 ($M = 20.98$ (years), $SD = 2.82$), recruited through a participant pool via the Behavioral Research and Decisions (BRAD) Lab at the University of Virginia. Of these participants, 7 were male and 40 were female. Participants were paid a USD 15 gift card for taking part.

4.1.2. Stimuli

Participants viewed two image banks throughout the study experience; both consisted of full color nature images. The first, nature with no people, was the same used in Study 1. The second, nature with people, was made up of static images staged by research assistants in which models were instructed to walk towards the camera with a neutral, non-threatening “Mona Lisa” smile. Across the 16 images, 7 confederates were used (age range: 19–32 years, 3 male, 4 female, 6 Caucasian, and 1 mixed race). All images included one confederate walking towards the camera, with up to 2 people in the background walking away from the camera. Both image banks contained 16 images displayed for 25 s each (400 s total per block). Multiple images were generated, with the final 16 being chosen based on the results of short assessment of restorative qualities of each by a class of Architecture graduate students. Figure 4 shows an example of these images.

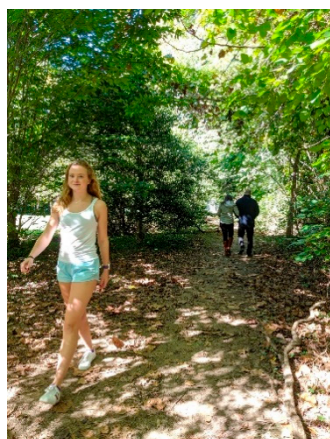


Figure 4. Example of a ‘nature plus people’ image slide with multiple confederates.

4.2. Study Design, Procedure and Analysis

The study replicated Study 1 design and procedure, varying only the environmental stimuli content to compare nature stimuli with nature stimuli including people. We also used the same data analyses methods as per Study 1.

4.3. Study 2 Results

4.3.1. Baseline Change and Order Effects

A series of independent *t*-tests showed no significant differences between baseline levels of GBS ($p = 0.56$) or UCLA-3 ($p = 0.72$), hedonic tone ($p = 0.09$), stress ($p = 0.61$) or arousal ($p = 0.27$). Furthermore, a series of independent *t*-tests using each change score for both nature conditions showed no impact of image bank presentation order (Nature Only: GBS, $p = 0.83$, UCLA-3, $p = 0.64$, hedonic tone, $p = 0.20$, stress, $p = 0.90$ and arousal, $p = 0.27$; Nature with people: GBS, $p = 0.09$, UCLA-3, $p = 0.42$, hedonic tone, $p = 0.33$, stress, $p = 0.22$ and arousal, $p = 0.19$). These results show a stable baseline between participants and no order effects present between image bank viewing order.

Establishing no order effects, we present the combined means for each of the outcomes. For ease, we present the GBS and UCLA-3 outcomes in Table 3 and the UWIST MACL outputs in Table 4.

Table 3. Means and Standard Deviations (in parentheses) for social wellbeing (General Sense of Belonging Scale (GBS) and UCLA-3 Loneliness Scale measures) shown by condition.

Pre		Post Nature Only		Post Nature + People	
GBS	UCLA-3	GBS	UCLA-3	GBS	UCLA-3
65.30 (13.36)	4.96 (1.50)	66.04 (12.96)	4.91 (1.46)	65.55 (13.62)	4.96 (1.44)

GBS = General Sense of Belonging Scale; UCLA-3 = UCLA Loneliness Scale.

Table 4. Means and Standard Deviations (in parentheses) for subjective mood (UWIST Mood Adjective Checklist outputs) shown by condition.

Pre.			Post Nature Only			Post Nature + People		
Arousal	HT	Stress	Arousal	HT	Stress	Arousal	HT	Stress
9.66 (2.83)	12.72 (2.48)	8.30 (2.70)	9.45 (2.74)	13.09 (2.54)	6.53 (2.36)	9.47 (2.80)	12.81 (2.68)	7.15 (2.46)

HT = Hedonic Tone.

4.3.2. Nature vs. Urban Change Score Analyses

Primary Outcome Measures

The paired *t*-tests showed no statistically significant differences between change scores of both GBS ($t(46) = 0.644, p = 0.52, d = 0.09$) and UCLA-3 ($t(46) = -0.573, p = 0.57, d = 0.06$). Both results show a negligible effect size.

Secondary Outcome Measures

For the mood outcomes, the paired *t*-tests showed statistically significant change, with a small effect size, in stress between change scores ($t(46) = -2.23, p = 0.03, d = 0.24$) but not of hedonic tone ($t(46) = 0.99, p = 0.33, d = 0.14$) or arousal ($t(46) = -0.09, p = 0.93, d = 0.01$). Figure 5 shows how stress (beige bars) decreases post both image bank conditions, with an increased reduction in stress post-nature only images. Hedonic tone (blue bars) increases post both image bank conditions while arousal (red bars) decreases post both image conditions; there is no significant difference between these conditions.

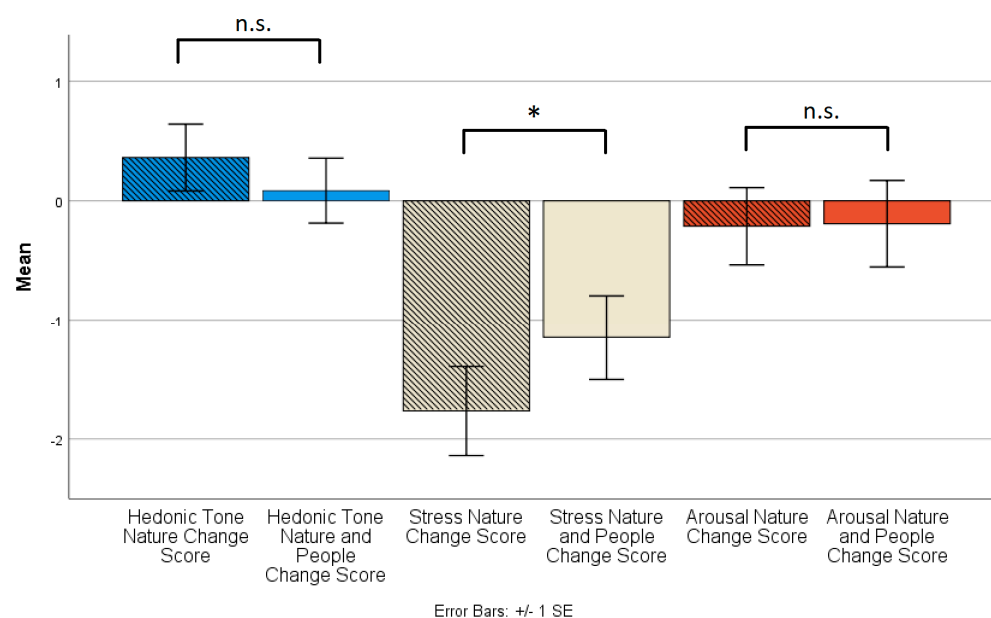


Figure 5. Change scores of the UWIST-Mood Adjective Checklist (MACL) outcomes (hedonic tone, stress, and arousal). Positive scores indicate increases in outcome measure post-image bank condition. Nature scores have hatched bars and significant differences ($p < 0.05$) denoted by *.

There was also a statistically significant difference between the PRS score post-nature ($M = 17.28, SD = 2.37$) and nature + people images ($M = 14.11, SD = 3.45$) with a large effect size indicating that the difference between the two means is greater than 1 standard deviation ($t(46) = 6.87, p < 0.001, d = 1.07$).

We further explored the four individual components of the PRS to ascertain if any of these components was driving the overall difference between perceived restoration between the nature only and nature + people images. We found a significant effect, with a small to moderate effect size, between conditions for 'being away' ($t(45) = 2.37, p = 0.02, d = 0.40$). The mean 'being away' scores were higher in the nature only condition ($M = 5.11, SD = 1.08$) compared to the nature + people condition ($M = 4.54, SD = 1.64$). We found no significant differences between PRS scores for 'fascination' ($t(45) = 0.92, p = 0.36, d = 0.20$), 'extent' ($t(44) = 0.163, p = 0.11, d = 0.34$), or 'compatibility' ($t(45) = -1.82, p = 0.08, d = 0.34$).

4.3.3. Mediating Effect of Nature Identity

Two outcome measures significantly correlated with the Inclusion of Nature in Self scale: arousal post-nature ($r(47) = 0.40, p = 0.005$) and arousal post-nature + people ($r(47) = 0.76, p < 0.001$). A linear regression predicting arousal post-nature, using INS

as the independent variable, showed little of the variance was explained by the model ($R^2 = 0.162$), but the overall model was statistically significant ($F(1, 45) = 8.73, p = 0.005$), with the beta coefficient ($B = 0.534$) suggesting that as nature identity increases, so do feelings of arousal in the change scores post-nature images.

The linear regression predicting arousal post-nature + people condition, using INS as the independent variable, showed little of the variance was explained by the model ($R^2 = 0.161$), but the overall model was statistically significant ($F(1, 45) = 8.62, p = 0.005$). The beta coefficient ($B = 0.595$) suggests that as nature identity increases, feelings of arousal also increase post-nature + people condition.

4.4. Study 2 Summary

Study 2 shows no difference between nature only or nature + people images on social wellbeing outcomes (i.e., general belonging (GBS) and loneliness (UCLA-3)). We found a significant difference between the stimuli on perceived stress (UWIST); stress decreased to a greater extent in the nature only condition vs. the nature + people condition, noting that both conditions reduce stress relative to baseline. We also show that the total score for perceived restoration (PRS) and its subcomponent, 'being away', is higher when viewing images of nature only compared to nature + people.

We also show that nature identity plays a mediating role in increasing arousal in both nature image conditions; both models show that greater feelings of nature identity leads to increased feelings of arousal/energetic vigor. We did not see this result in the nature condition in Study 1.

5. Study 3: Moving Imagery

The aim of Study 3 was to understand how the use of moving images, versus static stimuli, influence our outcome measures, and addressing RQ3. This study included four experimental conditions: nature only, nature + people, urban only and urban + people.

5.1. Method

5.1.1. Subjects

Participants ($n = 200$) were adults aged between 21 and 73 ($M = 35.7$ (years), $SD = 10.2$) were recruited through TurkPrime [39] to undertake this study in MTurk. Of these participants, 135 were male, 64 were female, and 1 participant preferred not to disclose. A total of 78% of participants were white, 15% Black or African American, 5.5% Asian, and 1.5% other. Participants were paid USD 1.56 for taking part.

5.1.2. Stimuli

We created four videos, each lasting between 3 and 3.5 min, for use in this study: nature, urban, nature + people, and urban + people. Our two nature videos (nature and nature + people) were filmed at a nature trail near a small university city and the two urban videos (urban and urban + people) were filmed on a linear median strip adjacent to an urban strip mall and overpass. In both video locations, we filmed the settings without people, and with the inclusion of confederates. Confederates ($n = 7$, age range 18–35, 2 male, 5 female, 6 Caucasian, and 1 Hispanic) consented to their image being used for research purposes; no members of the public were in these videos. The confederates walked solo or in pairs, filmed walking towards or away from the camera, and acted in a non-threatening and as 'normal' a manner for a walk scenario, as presented in Figure 6. The same confederates were used for both the nature + people and urban + people videos. Study participants experienced the videos as a proxy for a solo walk in the nature or urban environment. All films were recorded in September and October 2020 and the YouTube links to these videos can be found in the Supplementary Materials section of this paper.



(a)



(b)

Figure 6. Screenshots of the nature + people video (a) and urban + people video (b).

5.1.3. Study Design and Procedure

We employed an independent groups design for this study where participants were randomly allocated to one of four conditions, in which they were shown only one of our study videos. As with Studies 1 and 2, the study protocol, including randomization to condition, was administered via a Qualtrics survey embedded into MTurk. Participants clicked on the study link, reviewed and indicated consent before completing the survey. Participants completed the first series of questions (UCLA-3, GBS and UWIST-MACL) before watching the first randomized video and then repeating these questions, the PRS and a series of demographic questions, including the INS. This concluded the study.

5.2. Study 3 Analyses

We created change scores for our primary and secondary study measures by subtracting the baseline (pre-video) measures from the post-video measures. In order to be confident in using change scores we ran a one-way ANOVA on the baseline scores for each outcome measure, using video as a condition (four conditions). This test was to ensure that there were no significant differences in baseline outcomes prior to watching videos between participant groups.

For our main analysis, we used a one-way ANOVA using change scores as the dependent variable(s) and used video as the condition, in order to understand the impacts of the video stimuli, answering RQ3. As the PRS was only conducted post-video, not at baseline,

we ran a one-way ANOVA on the total PRS score alone (i.e., no change score) as well as the subcomponent scores. For each ANOVA output, effect size was calculated using η^2 [32].

Finally, we explored the mediating effect of the INS. First, we ran Pearson's correlation on the INS against each of the primary and secondary outcome measures. For those correlations which were significant, we used INS as the independent variable in a linear regression against the previously identified outcome measure (change score) as the dependent variable. We present the effect size of these regressions using R^2 of any relevant models.

5.3. Study 3 Results

5.3.1. Baseline Differences

A one-way ANOVA was used on each of the primary and secondary outcomes, using video as the condition to assess differences between group level outcomes prior to the video. There were no statistically significant differences in outcomes at baseline for any measure (GBS, $p = 0.59$; UCLA-3, $p = 0.08$; hedonic tone, $p = 0.14$; stress, $p = 0.46$ or arousal, $p = 0.14$). These results show a stable baseline between participants prior to watching the assigned video.

Establishing no order effects, we present the combined means for each of the outcomes. For ease, we present the social wellbeing (GBS and UCLA-3) in Table 5 and the subjective mood (UWIST MACL) outputs outcomes in Table 6.

Table 5. Means and Standard Deviations (in parentheses) for General Sense of Belonging (GBS) and UCLA-3 Loneliness Scale measures, shown by condition.

Pre			Post Nature		Post Urban	
GBS	UCLA-3		GBS	UCLA-3	GBS	UCLA-3
55.89 (15.55)	5.27 (1.81)	With People	56.51 (16.16)	5.18 (1.74)	56.82 (15.35)	5.16 (1.80)
		Without People	53.84 (16.45)	5.56 (1.76)	55.10 (18.37)	5.08 (2.01)

GBS = General Sense of Belonging Scale; UCLA-3 = UCLA Loneliness Scale.

Table 6. Means and Standard Deviations (in parentheses) for UWIST MACL outputs, shown by condition.

Pre				Post Nature			Post Urban		
Arousal	HT	Stress		Arousal	HT	Stress	Arousal	HT	Stress
10.73 (2.03)	12.15 (2.80)	8.63 (2.41)	With People	10.57 (1.75)	12.78 (2.69)	8.39 (2.07)	11.06 (1.90)	12.39 (2.51)	8.41 (2.20)
			Without People	10.20 (2.18)	11.60 (2.59)	8.76 (2.24)	10.52 (2.60)	11.60 (3.19)	8.44 (2.53)

HT = Hedonic Tone.

5.3.2. Nature vs. Urban Change Score Analyses

Primary Outcome Measures: Social Wellbeing

The paired t -tests showed no statistically significant differences between change scores of both GBS ($F(3, 196) = 0.32$, $p = 0.81$, $\eta^2 = 0.004$) and UCLA-3 ($F(3, 196) = 1.50$, $p = 0.22$, $\eta^2 = 0.02$), with a minimal effect size for each.

Secondary Outcome Measures: Psychological Restoration

For the mood outcomes, the one-way ANOVAs showed no statistically significant change between any of the three UWIST MACL outcome measures (hedonic tone, ($F(3, 196) = 1.24$, $p = 0.29$, $\eta^2 = 0.01$), stress ($F(3, 196) = 1.69$, $p = 0.16$, $\eta^2 = 0.02$), or arousal ($F(3, 196) = 0.72$, $p = 0.54$, $\eta^2 = 0.01$)), with a minimal effect size for each.

There was a statistically significant effect of video condition on PRS outcomes ($F(3, 196) = 12.18, p < 0.001, \eta^2 = 0.18$), with a small effect size. Post hoc comparisons using Bonferroni correction indicated that the mean restoration score for the nature only video ($M = 21.08, SD = 3.93$) was greater than both the urban only ($M = 17, SD = 5.51$) and urban + people ($M = 18.29, SD = 4.11$) videos. The nature + people video ($M = 21.59, SD = 4.11$) also showed significantly higher restoration than both urban videos. There were no differences between nature with or without people or urban with or without people. These results are shown in Figure 7.

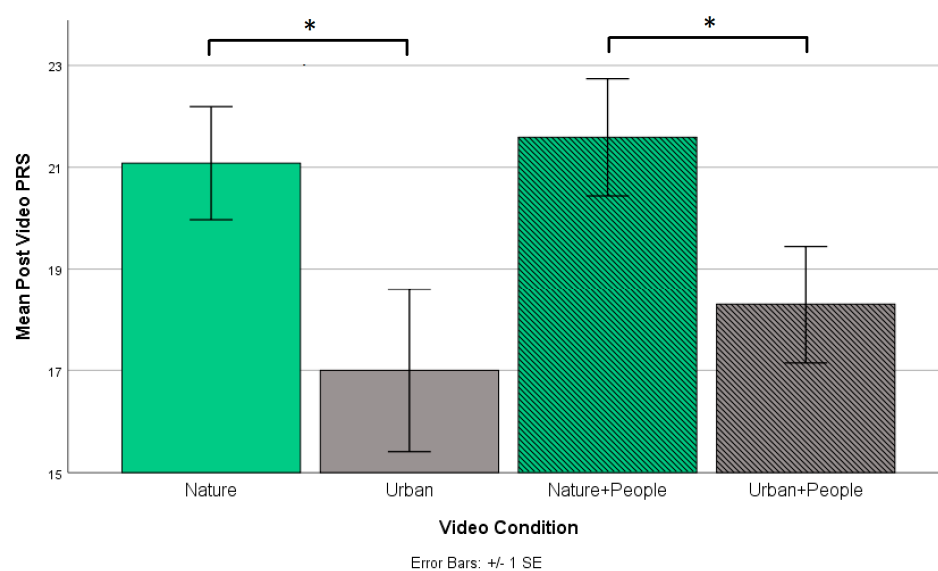


Figure 7. Perceived Restorative Scale scores post-nature and post-urban videos (hatched bars indicate presence of people in video). Higher scores indicate higher perceived restoration. Inclusion of people conditions have hatched bars and significant differences (Bonferroni; $p < 0.05$) denoted by *.

We further explored each of the four components of the PRS and found a significant effect of condition on ‘fascination’ ($F(3, 195) = 14.06, p < 0.001, \eta^2 = 0.17$), ‘being away’ ($F(3, 195) = 9.51, p < 0.001, \eta^2 = 0.13$), and ‘extent’ ($F(3, 195) = 12.98, p < 0.001, \eta^2 = 0.17$) outcomes. We found no statistically significant effect of condition on ‘compatibility’ ($F(3, 195) = 0.344, p = 0.793, \eta^2 = 0.005$).

For ‘fascination’, post hoc comparisons using Bonferroni correction indicated that the mean ‘fascination’ for the nature video ($M = 5.66, SD = 1.15$) was greater than both the urban ($M = 4.49, SD = 1.53$) and urban + people ($M = 4.57, SD = 1.40$) videos. The nature with people video ($M = 5.80, SD = 1.13$) also showed significantly higher restoration than both urban videos. As with the total PRS score, there were no differences in ‘fascination’ between either nature with or without people or urban with or without people.

For ‘being away’, post hoc comparisons using Bonferroni correction indicated that the mean ‘being away’ score for the nature video ($M = 5.60, SD = 3.93$) was greater than both the urban ($M = 4.30, SD = 1.81$) and urban + people ($M = 4.78, SD = 1.68$) videos. The nature + people video ($M = 5.78, SD = 1.46$) also showed significantly higher restoration than both urban videos. There were no differences between either nature with or without people or urban with or without people.

For ‘extent’, post hoc comparisons using Bonferroni correction indicated that the mean ‘extent’ score for the nature video ($M = 5.50, SD = 1.42$) was greater than both the urban ($M = 3.89, SD = 1.80$) and urban + people ($M = 4.45, SD = 1.54$) videos. The nature + people video ($M = 5.41, SD = 1.24$) also showed significantly higher restoration than both urban videos. There were no differences between either nature with or without people or urban with or without people.

5.3.3. Mediating Effect of Nature Identity

None of the outcome measures correlated with the INS, so we ran no further regression analyses.

5.4. Study 3 Summary

We found no significant effect of video condition on social wellbeing nor on subjective mood. However, we found that perceived restoration (PRS) scores were higher in both nature conditions, irrespective of the inclusion of people in these videos, relative to the urban videos. This suggests that the inclusion of people does not reduce the perceived restorative potential of nature, and this was shown to be true on the PRS subcomponents for ‘fascination’, ‘being away’, and ‘extent’.

6. Discussion

Much of the current environmental psychology literature utilizes visual stimuli that may or may not contain people, but the impact of the inclusion of people on social and psychological wellbeing has rarely been examined to date. We therefore collated new visual imagery including people in nature and urban scenes to test the effects on psychological restoration in a series of lab-based experiments. We present three studies that show the impact of nature and nature + people on social wellbeing and psychological restoration (as captured by mood and perceived restorativeness of the scene).

6.1. Summary of Findings

Our first study, addressing RQ1, asked: does exposure to static nature stimuli increase psychological restoration and social wellbeing when compared to static urban stimuli? We found beneficial effects of static nature images when compared directly to static urban images consistent with other lab-based studies [4,37,40,41]. We found increases in perceptions of general belonging as well as decreases in loneliness post-exposure to static nature images, as well as improved subjective mood (i.e., hedonic tone). One possible mechanism for this effect is the perceived restorativeness of the stimuli presented, with results for PRS indicating that the nature stimuli is significantly more restorative than the urban stimuli. In this study, we did not see any significant differences in scores between the subcomponents of perceived restoration (PRS), suggesting the nature stimuli was equally effective at inducing a sense of ‘being away’, ‘fascination’, ‘compatibility’, and ‘extent’. In addition, we also found that personal nature identity had a mediating effect on loneliness when exposed to urban stimuli. In this case, the greater one’s nature identity, the greater the increase in feelings of loneliness when watching urban stimuli.

We do not show the expected reduction in stress (or arousal) post-nature stimuli shown by our previous work [1,5], and that of other groups [42–45]. This was surprising, but a key finding from Study 1 is the positive effect of nature exposure on social wellbeing when compared to urban scenes, when these scenes are static and do not contain people.

Our second study, addressing RQ2, asked: does the inclusion of people within static nature stimuli increase psychological restoration and social wellbeing as compared to static nature stimuli without people? We show no beneficial impact of either visual condition on social wellbeing (i.e., general belonging or loneliness), suggesting that the inclusion of people does not alter the psychologically beneficial effects of static nature shown in Study 1. For subjective mood outcomes, we found a significant and positive change in stress between conditions, with the nature only stimuli reducing stress more effectively than the nature + people stimuli, suggesting that the exclusion of people from nature stimuli is more beneficial for stress reduction. This aligns with the concept of ‘being away’, which is defined in the Introduction as a measure of psychological or geographical escape [11–13]. This is supported by the higher total and ‘being away’ PRS scores found in the nature only condition when compared to the nature + people condition. A key finding is that both nature and nature + people stimuli generated reductions in perceived stress and increases in perceived restoration, but this effect was greater in the nature-only stimuli.

Our second study also showed a mediating effect of nature identity on arousal, where greater nature identity resulted in increased feelings of arousal/energetic vigor during both nature stimuli conditions. However, overall our findings were mixed and not replicated across our experiments, suggesting more research is required to understand the relationship between nature identity and natural and urban imagery.

The third, and final, study, in this series, addressing RQ3, asked: does the inclusion of people in video stimuli of both nature and urban stimuli increase psychological restoration and social wellbeing when compared to video stimuli of both nature and urban settings without people? For this study, we moved from static imagery to moving imagery (videos) depicting both nature and urban settings with vs. without people. This builds towards a more ecologically valid set of stimuli that is more representative of real-world experience of urban nature outside of a laboratory experience. In our sample, we showed no statistically significant benefit of either nature or urban spaces, with or without people on social wellbeing, nor on subjective mood. However, we do replicate the findings of Studies 1 and 2 in that both nature and nature + people conditions were perceived to be more restorative than either the urban videos with and without people. We further investigated the four subcomponents of perceived restoration (PRS) and showed that there was a restorative benefit of both nature conditions on 'fascination', 'being away', and 'extent' relative to the urban videos. However, within both the nature and urban conditions, there were no added benefit of including people or not. This is important for future laboratory studies, as we have shown benefits of nature to perceived restorativeness across both static and moving stimuli, with or without people, suggesting that the social condition of a nature setting could elicit beneficial restorative effects relative to urban settings.

Across the three studies, we have presented evidence that exposure to visual stimuli of nature without people improved social wellbeing. Whilst we found no added benefit of including people to nature stimuli on social wellbeing, the broad benefits of nature to psychological mood appear to hold. However, as we have described, there is limited direct research into the inclusion of people in nature (and control) stimuli, so replication of these findings is required. We do show consistent restorative effects of nature relative to urban settings both with and without people using static and moving stimuli.

6.2. Limitations and Further Future Research

That we found no differences in either social wellbeing or psychological mood when comparing moving nature and urban stimuli (with vs. without people), raises questions when placed in the context of the current laboratory-based experiments which have reliably and consistently shown psychological benefits of nature over urban spaces [16,17]. That both nature and nature + people videos are more beneficial to psychological restoration than urban spaces suggests that the visual stimuli developed for this study captured at least three components of restoration (specifically 'fascination', 'being away', and 'extent'). However, our results suggest that these components in and of themselves were not 'enough' to show a benefit over the urban condition in measures of belonging, loneliness and mood. We suggest that future studies should concentrate on stimuli development of moving imagery in order to understand what components (specifically, social composition) of a video are having beneficial effects. This directly feeds into more practical applications, where understanding of spatial and social components is vital to amplifying nature (and urban) benefits in our public spaces. For example, research has identified specific spatial characteristics of urban spaces that require further exploration to understand their benefits on health and wellbeing [46], as well as work that has attempted to study the subcomponents of restoration (specifically 'fascination') in isolation [47]. Related to this, research using in-person confederates in real-world settings to support this study, but also to understand any potential age, race, or gender effects, for example. More broadly, the restorative benefits of nature over urban spaces here suggest that the inclusion of people in nature spaces does not appear to have any significant benefit (or deficit) on restorative outcomes. Further investigation should also focus on the scale of social inclusion; for ex-

ample, understanding the impact of an additional group of people versus overpopulation of a space (i.e., overcrowding), and the increments in between.

Research has shown how both social cohesion and loneliness may act as mediators in the relationship between green space visits and mental health score [48]. While our study did not measure or test multiple visits to green spaces, we show that, in static images, nature directly increases sense of belonging as well as decreases perceived loneliness, though no discernable additional benefit was shown with the inclusion of people to the stimuli. Therefore, the mechanism for the benefits of nature on social wellbeing (specifically ‘loneliness’ and ‘belonging’) remains unclear. Research has shown that lower levels of nature in one’s living environment correlate with feelings of loneliness as well as perceived lack of social connections [24]. Therefore, is exposure to images of nature images in this study ‘enough’ to improve these feelings? Further study may also consider exploring personality, in particular extroversion, as a potential mediator in the relationship between nature and social wellbeing.

None of our three studies were able to adequately sample for equal gender representation, meaning we were unable to reliably explore any gender differences that might arise from these studies. There is research that has examined disparities in safety of public spaces for women compared to men [49–52], with clear gender differences between how public spaces are perceived; specifically that females perceive these spaces to be less safe than their male counterparts. Further studies may wish to utilize the experimental protocol presented here and examine gender differences (as well as other demographic differences) both in participant responses as well as explicitly modifying gender presence within the study stimuli itself.

Finally, this study captures a better context of ‘everyday urban nature’ in which people are present. Since the COVID-19 pandemic began, more and more people in cities are using their local open spaces for recreation and physically distant socializing with many urban parks and green trails becoming well used and even overcrowded. Understanding the effects of people in outdoor settings on psychological wellbeing under social distancing restrictions is extremely timely at a time when other kinds of restorative environments, such as local or national parks, may not be readily available. Considerations must be made here with regard to the psychological impact of crowding—a tolerance threshold relating to presence of people—compared to numerical crowd density [53,54], understanding that the pandemic may have altered our tolerance for crowding.

7. Conclusions

Across a series of laboratory-based studies we present the perceived restorative benefits of nature exploring the social context of nature and urban scenes, i.e., with and without people present in the scenes. Our results suggest that nature scenes provide a reliable restorative environment to support social and psychological wellbeing as compared to urban settings, and that this outcome holds irrespective of the inclusion of people in the scene. Further investigation is required to understand more comprehensively the impact of nature connection on this effect, as well as further exploration of social scenarios (e.g., groups, and social distancing) when developing lab-based and/or real world studies.

Supplementary Materials: The YouTube links for the videos (static slides and videos) used across Studies 1–3 are available online at <https://www.mdpi.com/article/10.3390/su13116464/s1>.

Author Contributions: J.R. and S.L. conceived and designed Study 1 and 2. J.R. and C.N. conceived and designed Study 3. S.L. and C.N. collected data across all three studies. All authors contributed to the analysis of the data. C.N. wrote the first draft of the manuscript and all authors revised the manuscript for critical intellectual content and approved the final version. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was approved by the Institutional Review Board (Social and Behavioral Sciences) of the University of Virginia (#3187, approved October 2019).

Informed Consent Statement: Informed signed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are openly available in FigShare at the following locations. Study 1: doi.org/10.6084/m9.figshare.14195966; Study 2: doi.org/10.6084/m9.figshare.14195963; Study 3: doi.org/10.6084/m9.figshare.14195969.

Acknowledgments: The authors would like to thank Madeline Smith for her assistance in creating the images (Study 2) and videos (Study 3) used in this paper as well as the student raters whose feedback determined the images used in Study 2. Further, we thank the confederates who appeared in the stimuli created in Study 2 and Study 3. We thank the Behavioral Research at Darden (BRAD) Lab staff for their recruitment assistance and use of laboratory space in Study 1 and 2. Finally, we thank Miles Patterson, Department of Psychological Sciences, University of Missouri—St. Louis, for advising on various aspects of this study.

Conflicts of Interest: The authors declare no conflict of interest.

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