

ENVIRONMENTAL NARRATIVES AND PSYCHOLOGICAL RESTORATION: AN
IMMERSIVE EXPERIENCE

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Morgan Clarke

Department of Psychology

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Advisor: Dr. Stephen Van-Hedger

Reader: Dr. Kathryne Van-Hedger

The thesis by:

Morgan Clarke

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Dr. Irene Cheung
Chair of Department

Abstract

The restorative benefits of nature are well-established in the current scientific literature. However, prior research has focused on perceptual exposure to environmental stimuli, from going for a nature walk to looking at nature pictures. The present study sought to explore whether conceptual representations of natural or urban environments could elicit restorative effects comparable to direct experiences with these environments, and how individual differences in absorption and mental imagery would relate to restoration effects. We hypothesized that individuals who are high in absorption and mental imagery would experience more cognitive and affective restoration, relative to individuals low in absorption. Undergraduate students ($n = 54$) listened to four brief narratives depicting either natural or urban scenes and were given a short reflection period to imagine each scene. Participants completed measures of cognitive performance, affect and perceived restoration to measure psychological restoration before and after the narrative listening intervention. Results revealed interactions of absorption and narrative condition on several measures (calmness, perceived restoration), with individuals high in absorption showing the predicted differences between nature and urban conditions and individuals low in absorption showing no discernible effects of environment. No significant results were observed for cognitive performance. The findings demonstrate that the restorative benefits of nature are not limited to direct exposure to perceptual features of the environment, although the efficacy of more conceptual representations of nature to elicit restorative effects may depend on absorption. Implications and future research directions are discussed.

Keywords: *nature, imagery, absorption, restoration*

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Table of Contents

Abstract	iii
Acknowledgements	iv
Table of Contents	v
Introduction	1
Participants	6
Materials	7
Physiological Recordings	7
Current Mood and Anxiety	7
Trait Individual Difference Measures	8
Cognitive Measures	9
Perceived Restoration	9
Procedure	9
Data Analysis	11
Results	12
State-Trait Anxiety Inventory	12
VAS Mood	14
Perceived Restorativeness	16
Cognitive Performance and Mental Fatigue	17
Narrative Ratings	19
Discussion	19
Implications and Future Research Directions	22
Limitations	24
Conclusion	25
References	27
Curriculum Vitae	30

Introduction

As we navigate an increasingly urbanized and technology-driven world, cognitive resources like directed attention are easily exhausted, often leaving individuals feeling mentally fatigued. As such, identifying and incorporating tools for psychological restoration into our daily lives is crucial for the well-being of society. Throughout history, interacting with nature has been recognized as a therapeutic reprieve from the weight of everyday life (e.g., Berman *et al.*, 2008). Extensive research has demonstrated that experience in natural environments is associated with stress reduction, relaxation, attention restoration, and improvements in mood and positive emotions (Berto, 2005; Corazon *et al.*, 2019; Shuda *et al.*, 2020; Ballew & Omoto, 2018).

There have been several theoretical accounts of how nature is able to confer these restorative benefits. According to Attention Restoration Theory (ART; Kaplan, 1995), nature provides an ideal environment for the restoration of directed attention. Directed attention is an effortful and goal-directed cognitive process that is used to direct focus towards a particular stimulus or task (e.g., doing work). It is effortful to maintain goal-directed attention, as one must tune out distracting task-irrelevant stimuli and keep one's mind from wandering. In contrast, involuntary attention is an undemanding process that is easily captured or drawn to fascinating stimuli in the environment. When involuntary attention is sufficiently captured, it creates an environment in which directed attention can rest and replenish.

Kaplan (1995) argues that natural environments are restorative because they effortlessly engage and occupy involuntary attention, giving direct attention the time and space to recover. ART proposes that an environment is restorative under four conditions:

fascination, being away, extent, and compatibility (Kaplan, 1995). The premise of “being away” refers to the ability to escape one’s usual thoughts and concerns. It does not require a physical change in the environment (although this can certainly be helpful), but rather a conceptual shift in which one is able to psychologically detach from present worries and demands. The “fascination” component refers to the presence of intriguing stimuli within the environment that can capture attention without effort. “Extent” refers to the richness of the environment, such that its features are stimulating and engaging enough to explore and feel totally immersed within. Finally, ART suggests that there must be “compatibility” between the environment and the individual, meaning that the individual is comfortable in the environment and chooses to be there out of their own free-will and personal preference.

While Kaplan’s argument that exposure to natural environments restores cognitive resources has been well supported by research (see Hartwig *et al.*, 1991; Berto, 2005), the mental fatigue resulting from a drain on cognitive resources can represent a form of stress, which has also been theorized to be impacted by nature. Stress Reduction Theory (SRT; Ulrich, 1981) suggests that interactions with nature facilitates stress recovery, while urban settings tend to have an impeding effect on this process. According to Ulrich (1981), exposure to nature immediately elicits a positive emotional response that captivates attention and overtakes negative affect. As humans evolved in natural environments and relied on natural resources to survive, we have an innate preparedness to attend and positively respond to (unthreatening) natural settings. Humans have adapted a perceptual sensitivity towards elements of nature, which are then processed with ease and efficiency (Ulrich *et al.*, 1991). From this evolutionary perspective, we are not

adapted towards highly stimulating environments like cities, filled with visual complexities, plenty of noises and constant motion, producing higher psychological and physiological arousal that induces stress and mental fatigue (Ulrich *et al.*, 1991). Given the evolutionary salience, SRT asserts that urban environments are conducive to stress, while natural environments reduce stress and restore positive mood by inherently sustaining attention and an immediate positive response (Ulrich *et al.*, 1991).

Based on these two theories, it is unclear as to which features of nature elicit psychologically restorative effects. In a study examining the restorative effects of natural and urban environments, Berman *et al.*, (2008) found that participants showed significant performance improvements on cognitive tasks (the attention network test and backwards digit span) after completing a nature walk in the park or viewing photos of natural stimuli on a computer, relative to participants who completed an urban walk in a city or who viewed photos of urban stimuli on a computer. These results highlight that brief interactions with nature can restore cognitive abilities and improve task performance, relative to urban environments, even when the depictions of these environments were limited to pictures presented on a computer screen.

Although restorative effects have been observed using different types of environmental interventions (e.g., real-life nature walks versus viewing nature images on a computer), this does not necessarily mean that these types of interventions elicit comparable degrees of psychological restoration. Indeed, a meta-analysis revealed that the type of exposure to nature (real-life vs simulated) moderates changes in positive affect, with real-life exposure leading to larger increases in positive affect than simulated exposure (McMahan & Estes, 2015). This suggests the possibility that feeling immersed

(i.e., absorbed) in natural environments may be an important feature of the optimal restorative effect of nature, aligning with many dimensions of ART (most notably “being away” and “extent”). Although McMahan and Estes (2015) found influences of real-life versus simulated environments on affect, one unexplored question is whether individual differences in relevant constructs (e.g., absorption, mental imagery ability) might make simulated or otherwise more conceptual representations of nature more restorative.

By providing individuals with simulations of nature (e.g., pictures of nature on a computer screen), there is an obvious disconnect between an individual and the simulated nature in front of them. However, some individuals have an easier time immersing themselves in a given context, taking on feelings of an experience as if it were genuinely occurring to them in that moment (e.g., this commonly happens when reading fiction novels). This disposition is referred to as *absorption*. Specifically, absorption is an individual difference in the tendency to be deeply engrossed or immersed in sensory or imaginative experiences, devoting full attention intensely on an internal (e.g., fantasy) or external (e.g., music) stimuli, with high absorption individuals often getting lost in the experience (Roche & McConkey, 1990; Menzies et al., 2008).

Moreover, mental imagery is thought to be one dimension of absorption, along with emotional engagement, transportation, and attention (Mak et al., 2020; Kuijpers et al., 2014). Mental imagery refers to the ability for one to recreate sensory experiences, like seeing or hearing, in one’s mind (Koivisto & Grassini, 2022). Mental imagery of nature might elicit psychological restoration similar to direct exposure through a significant overlap in neural networks when imaging vs actually perceiving a stimulus in real-life, particularly for individuals high in imagery ability (Dijkstra et al., 2017). The

finding that this overlap between perception and imagery networks depends on imagery ability suggests a role for individual differences in the extent to which psychological restoration may be elicited through active mental imagery.

If individuals can fully immerse themselves in a natural environment via mental imagery, they may experience greater degrees of psychological restoration (e.g., heightened positive affect), comparable to the effects of being physically present in nature. As the majority of research on environmental restoration involves directly exposing participants to the perceptual features (e.g., sights or sounds) of an environment, it is unclear whether direct perceptual input (e.g., viewing pictures or videos, listening to sounds) is necessary for nature-related improvements in psychological restoration, or whether more conceptual representation of nature, in which participants are not directly provided with the perceptual features of nature, can also be restorative.

In a recent study, Koivisto and Grassini (2022) sought to investigate whether top-down processing with mental imagery of natural environments could elicit positive emotional effects. Results revealed that imagining being in nature for 30 seconds produced more positive emotions and relaxation, compared to mental imagery of urban or built settings. While individual differences in nature connectedness and environmental preference moderated the effect of nature imagery, it did not fully explain the emotional benefits of imagining nature compared to imagining urban or built settings. This finding suggests the need for further research to explore potential individual difference factors that may influence the effects of imagining natural environments. Although this study did not explicitly measure perceptions of psychological restoration, the findings suggest that abstract representations of nature may elicit restorative effects on affective well-being.

The purpose of this study is to further explore the restorative effects of natural vs. urban environments, by specifically assessing the influence of conceptual experiences with nature on psychological restoration. Using brief narratives depicting natural and urban environments to guide mental imagery, the present study investigates the extent to which cognitive and affective benefits can be observed without direct exposure to the perceptual stimuli of nature, but through abstract representations instead. Participants completed measures of cognitive performance and affect before and after narrative listening in one of two conditions (i.e., nature or urban). All participants additionally rated the perceived restorativeness of the narratives at the end of the study.

We predict that narratives depicting nature may bring the perceptual features of nature to mind and allow individuals to mentally immerse themselves within the described environment, hypothetically eliciting similar restorative effects as studies involving physical immersion in nature or exposure to natural stimuli. We further predict that individual differences in mental imagery ability and trait absorption will moderate the restorative effects of nature narratives. More specifically, we hypothesize that individuals scoring high in absorption and mental imagery will display greater levels of psychological restoration after listening to nature narratives compared to similar individuals in the urban condition.

Method

Participants

A total of 54 participants (44 women) completed the study ($M = 20.7$ years old, $SD = 4.6$ years old). All participants provided informed consent prior to completing the

study, and participants were compensated with either 1.0 course research credit or \$15 CAD.

Materials

All participants completed the study in a designated laboratory space. The study was programmed in jsPsych (de Leeuw, 2015) and run on a Dell G5 Laptop connected to a 24" ViewSonic monitor. Sounds were presented through Edifier MR4 studio monitor speakers, which were connected to the computer through a Steinberg UR-12 auditory interface.

Physiological Recordings

The Muse S (Gen 2) headband (InterAxon: Toronto, ON) was used to measure electroencephalography (EEG). The Muse S is a consumer-oriented physiological recording device that has been increasingly used and validated in research settings (e.g., Krigolson et al., 2017). In the present study, the Muse S EEG data was streamed via a Bluetooth connection to Mind Monitor (<https://mind-monitor.com/>), an application that provides real-time EEG visualization as well as delta, theta, alpha, beta, and gamma band power calculation. Band power for these five frequency bands was recorded at a 2 Hz sampling rate.

Current Mood and Anxiety

The Visual Analogue Scale (VAS), which has been used in prior nature-intervention research (e.g., Brancato et al., 2022), was used to measure current mood. Four items (happy, sad, calm, anxious) were each rated on a 100-point visual analog slider scale (0: *Not at all*, 100: *Extremely*). Sliders began at the midway point (50).

Additionally, the short-form state portion of the State Trait Anxiety Inventory (STAI) was used to measure state anxiety (Zsido et al., 2020). Participants answered five questions (e.g., “I am jittery”) on a Likert scale, ranging from 1 (*Not at all*) to 4 (*Very much so*).

Trait Individual Difference Measures

To capture trait individual differences in abilities hypothesized to relate to the narrative intervention, several measures were utilized. The Tellegen Absorption Scale (Tellegen & Atkinson, 1974) was used to assess trait absorption. Participants answered 34 true or false questions (e.g., “My thoughts often do not occur as words but as visual experiences”).

The Visual Vividness of Imagery Questionnaire (Marks, 1974) was used to assess visual imagery. It includes 16 items capturing individuals’ vividness of visual imagery rated on a scale from 1 (*No image at all, I only “know” I am thinking of the object*) to 5 (*Perfectly realistic, as vivid as real seeing*).

The Vividness Subscale of the Bucknell Auditory Imagery Scale (Halpern, 2015) were used to assess auditory imagery ability. Participants are asked to rate how vividly they are able to image sounds on a scale of 1 (*no image is present*) to 7 (*image is as vivid as the actual sound*). The Cognitive and Affective Mindfulness Scale (Feldman et al., 2007) was used to measure mindfulness.

Cognitive Measures

Cognitive performance was evaluated using the N-back task, a widely used measure of working memory (e.g., Kane et al., 2007), in which participants monitor a visual or auditory sequence and must respond if the current item matches the one presented “N” positions previously. In the present study, sequences were presented in blocks of 30+N letters, containing 10 target letters and 20 non-target letters in a randomized order. Participants completed one block of a 2-Back, which was treated as practice, and then three blocks of the 3-Back, which was scored. Following this task, participants’ current mental fatigue was also assessed on a Likert scale, ranging from 1 (*Not at all*) to 5 (*Extremely*).

Perceived Restoration

The Perceived Restorativeness Scale (PRS) was used to assess the restorative dimension of the narratives. The 9-item scale was identical to the version used in Brancato et al. (2022) and was adapted from Norling et al. (2008). Three items each were used to assess the dimensions of *Being Away* (e.g., “Listening to these narratives was an escape for me”), *Extent* (“These narratives sustained my interest”), and *Fascination* (“While listening to the narratives, my attention was drawn to many interesting things”). Participants responded to each prompt on a Likert scale ranging from 1 (*Very slightly or not at all*) to 5 (*Extremely*).

Procedure

Participants were recruited through various channels including flyers, course announcements, and email. Condition assignment was dependent upon the participant

number (e.g., Participant 1 would listen to nature narratives, Participant 2 would listen to urban narratives etc.), as opposed to entirely randomly determined, to facilitate even sample sizes across conditions. Upon arrival at the designated in-person study location (V106 at Huron), participants were provided with a letter of information to review before signing a consent form.

After signing the consent form, participants donned a Muse S headband and remained seated quietly for 2.5 minutes to establish a baseline EEG recording. Subsequently, participants completed the VAS and STAI questionnaires to assess current mood and anxiety pre-intervention. Following this, participants completed the Tellegen Absorption Scale, Visual Vividness of Imagery Questionnaire, Bucknell Auditory Imagery Scale, and the Cognitive and Affective Mindfulness Scale. They were also asked to provide demographic information such as age and gender. After completing the questionnaires (approximately 20 minutes), participants engaged in an N-back task to evaluate working memory performance. Following the N-Back, participants were also asked to rate their level of mental fatigue on the same visual analog scale used to assess mood.

Participants then completed the narrative listening task. Participants were presented with four narratives describing either natural environments or urban environments (depending on condition assignment). After each narrative, participants were given 30 seconds to reflect on the narrative and imagine the scene it depicted, while EEG recordings were collected from the Muse S. After each reflection period, participants were asked to rate how much they liked each narrative and how easily they were able to imagine the scene, responding on the same visual analog scale as used for

the mood and mental fatigue measures. Following completion of the intervention (i.e., narrative listening), participants were asked to rate their mood and state anxiety again using the VAS and STAI. Afterwards, participants engaged in another session of the N-back task and provided a subsequent mental fatigue rating. Participants then completed the Perceived Restorativeness Scale, evaluating how restorative they perceived the narratives to be.

Upon completion of all measures, participants were given a debriefing letter informing them of the study's purpose and hypothesis. For participants receiving course credit, they completed a brief survey at the end of the study, not linked to their responses, where they were asked to provide their name, student number, and to which course they wanted to apply the course credit. Participants seeking compensation received \$15 cash and filled out a payment receipt with their name and signature.

Data Analysis

All analyses were performed in R 4.3 using RStudio. To assess the effects of narrative condition on mood, anxiety, cognitive performance, and self-reported mental fatigue, linear mixed-effects models were constructed using the "lme4" package in R (Bates et al., 2015), as these measures contained a repeated measurement (pre-intervention and post-intervention). The mixed-effects models contained time (pre-intervention, post-intervention), narrative condition (nature, urban), absorption, visual imagery, and auditory imagery. Interaction terms were included in the model with the exception that interactions among the trait measures were not considered (e.g., the

interaction between absorption and visual imagery). The random effect structure included participant intercepts.

The PRS and post-narrative questions on liking and imageability used linear regression models, as these did not contain repeated measures. Each model contained a term for narrative condition (nature, urban), as well as the interactions between narrative condition and (1) absorption, (2) visual imagery, and (3) auditory imagery.

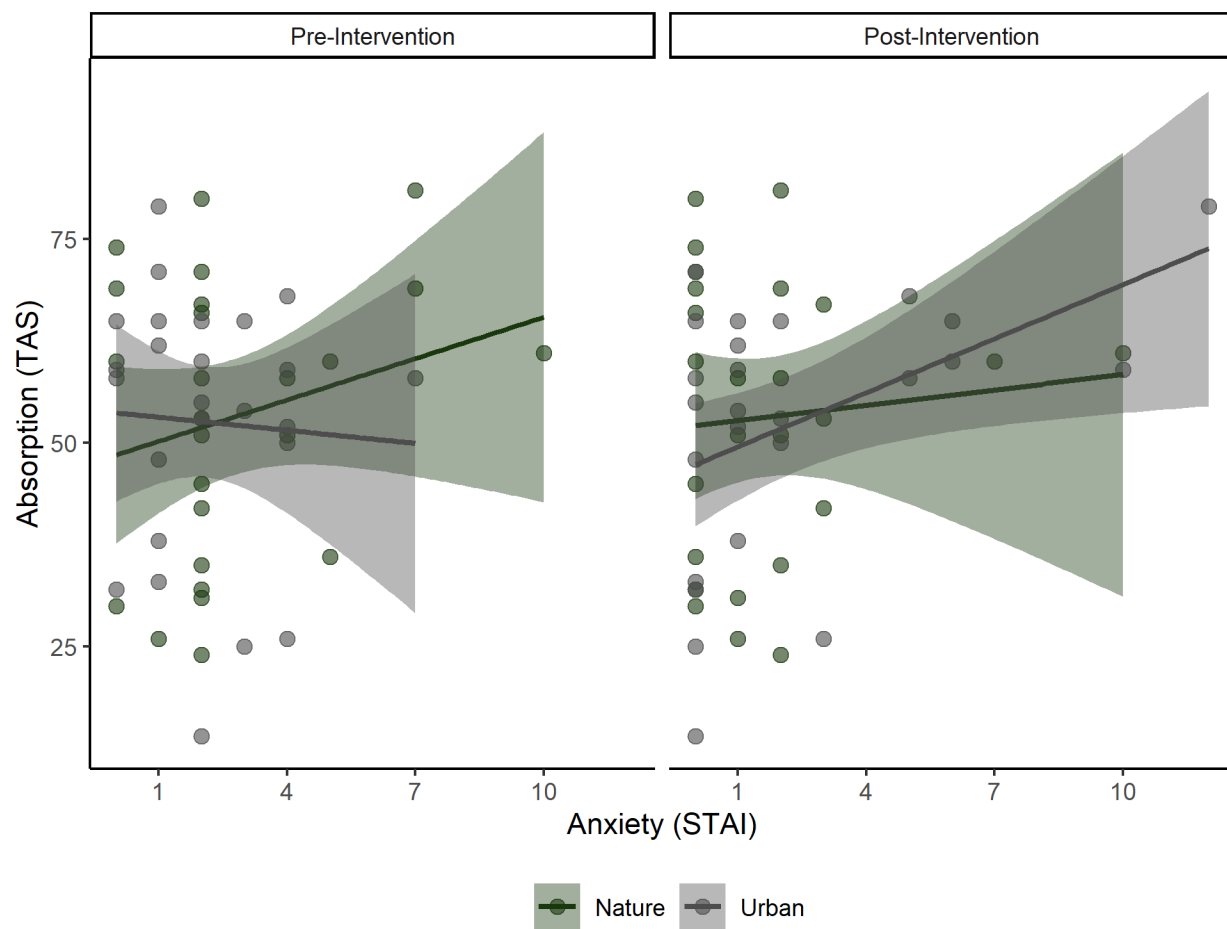
Results

State-Trait Anxiety Inventory

There was a significant three-way interaction between time, narrative condition, and absorption, $F(1, 46) = 6.35, p = .015$. This interaction, which is shown in Figure 1, is driven by a positive association between absorption and anxiety in the urban condition during the post-intervention measurement. The only other significant term in the model was a two-way interaction between time and absorption, $F(1, 46) = 4.68, p = .036$; however, this two-way interaction should be interpreted with some caution given the presence of the three-way interaction of time, condition, and absorption. No other term was significant in the model.

Figure 1

Three-way interaction of condition, time, and absorption for the state anxiety (STAI)



Note: Error ribbons represent 95% confidence intervals.

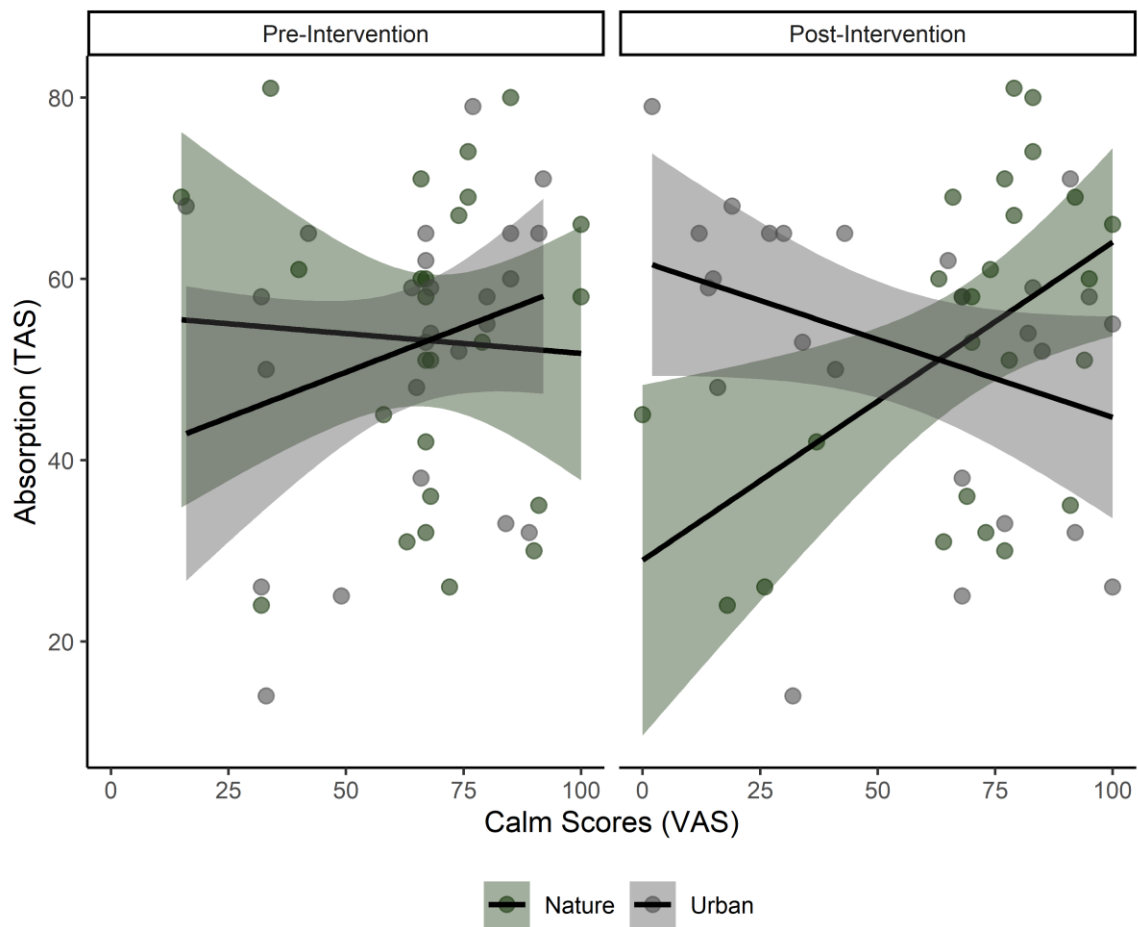
VAS Mood

For happiness ratings, there was a marginal three-way interaction of time, condition, and absorption, $F(1, 46) = 2.92, p = .094$, which can be characterized in terms of increased happiness for higher absorption individuals in the nature narrative condition. No other term was significant in the model.

For calm ratings, there was a significant three-way interaction of time, condition, and absorption, $F(1, 46) = 8.67, p = .005$, in which individuals higher in absorption who were in the nature condition showed increased calmness, whereas individuals higher in absorption who were in the urban condition showed decreased calmness. Figure 2 plots this interaction. In addition to this three-way interaction, there were significant two-way interactions between time and the mental imagery measures (visual: $F(1, 46) = 6.56, p = .014$; auditory: $F(1, 46) = 5.17, p = .028$), which was characterized by increased feelings of calmness for individuals higher in visual and auditory imagery. There was also a significant interaction between time and absorption, $F(1, 46) = 6.42, p = .015$, and time and condition, $F(1, 46) = 5.43, p = .024$, and there was additionally a significant main effect of time, $F(1, 46) = 7.45, p = .009$. There were no significant effects for the negative valence measures (sadness, anxiety).

Figure 2

Three-way interaction between time, condition, and absorption for calmness ratings



Note: Error ribbons represent 95% confidence intervals

Perceived Restorativeness

All three subscales of the PRS showed significant interactions of narrative condition and absorption (see Figure 3). For the *Being Away* subscale, there was a significant interaction of condition and absorption, $F(1, 46) = 8.32, p = .006$, with higher absorption leading to greater feelings of being away in the nature condition and lower feelings of being away in the urban condition. Additionally, there were main effects of visual imagery, $F(1, 46) = 7.81, p = .008$, and absorption, $F(1, 46) = 6.02, p = .018$, with higher visual imagery and higher absorption generally leading to greater feelings of being away. No other term was significant.

For the *Fascination* subscale, there was a significant interaction of condition and absorption, $F(1, 46) = 5.18, p = .028$, with higher absorption leading to greater feelings of fascination in the nature condition and lower feelings of fascination in the urban condition. There was additionally a significant main effect of visual imagery, $F(1, 46) = 4.27, p = .044$, with individuals higher in visual imagery reporting greater amounts of fascination. There was additionally a marginal main effect of narrative condition, $F(1, 46) = 4.04, p = .050$, with participants in the nature condition reporting greater fascination. No other term was significant in the model.

For the *Extent* subscale, there was a significant interaction of condition and absorption, $F(1, 46) = 6.73, p = .013$, with higher absorption leading to greater feelings of extent in the nature condition and lower feelings of extent in the urban condition. There was also a main effect of visual imagery, $F(1, 46) = 4.52, p = .039$, with higher visual

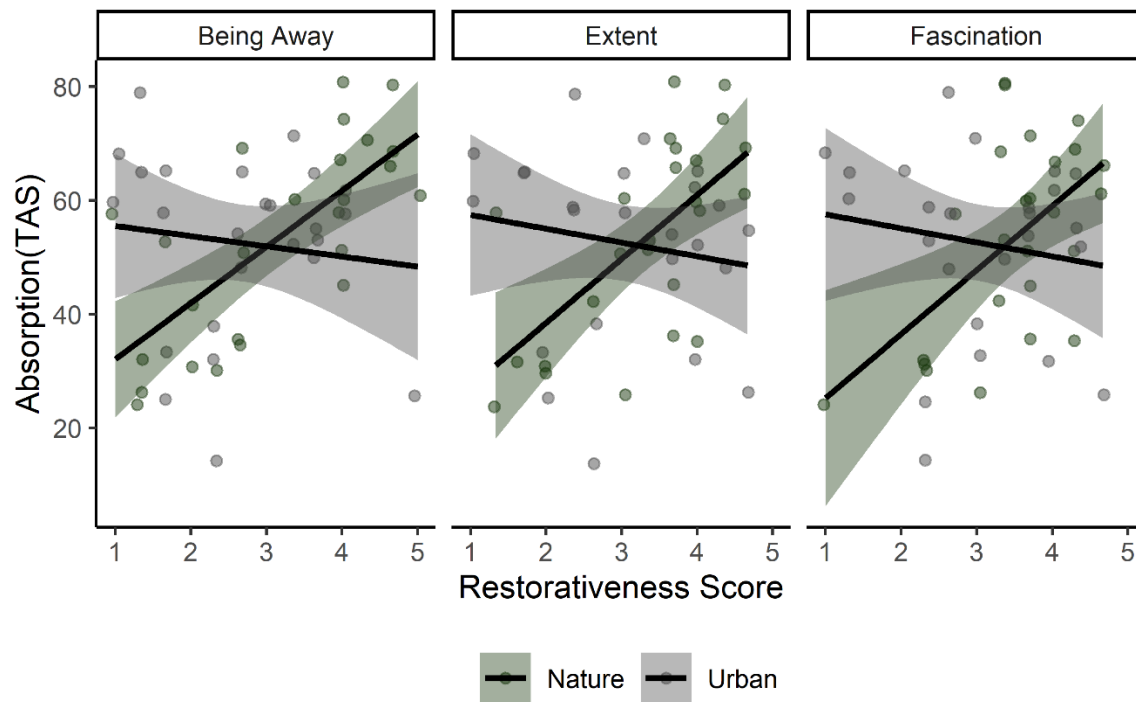
imagery associated with greater feelings of extent. No other term was significant in the model.

Cognitive Performance and Mental Fatigue

For n-back performance, which was operationalized as a d-prime value (z-normalized hit proportion minus z-normalized false alarm proportion), there was a marginal interaction between time and visual imagery, $F(1,46) = 3.68, p = .061$, with individuals higher in visual imagery showing a greater improvement from pre-test to post-test. For the self-reported mental fatigue measure, there was a significant main effect of time, $F(1, 46) = 4.07, p = .049$, with participants generally reporting greater fatigue post-intervention. There were additionally marginal main effects of absorption, $F(1, 46) = 3.76, p = .059$, and visual imagery $F(1, 46) = 3.75, p = .059$, with individuals higher in absorption and visual imagery showing overall greater fatigue ratings. No other term was significant in the model.

Figure 3

Interactions of condition and absorption for perceived restorativeness



Note: Error ribbons represent 95% confidence intervals

Narrative Ratings

In terms of narrative liking, there was a significant interaction between condition and absorption, $F(1, 46) = 8.41, p = .006$, characterized by individuals high in absorption showing greater liking for nature narratives and reduced liking for urban narratives.

There were additionally main effects of visual imagery, $F(1, 46) = 7.07, p = .011$, absorption, $F(1, 46) = 4.56, p = .038$, and narrative condition, $F(1, 46) = 5.28, p = .026$, with individuals higher in visual imagery, higher in absorption, and individuals listening to nature narratives showing greater narrative liking, respectively. No other term was significant in the model.

In terms of narrative imageability, there were significant main effects of visual imagery, $F(1, 46) = 24.65, p < .001$, and auditory imagery, $F(1, 46) = 6.42, p = .015$, with individuals higher in imagery abilities reporting an easier time imagining the narratives. There was additionally a marginal main effect of absorption, $F(1, 46) = 3.42, p = .071$, with individuals higher in absorption reporting an easier time imagining the narratives. No other term was significant in the model.

Discussion

The present study found evidence that the restorative benefits of nature are not limited to direct, perceptual experiences with natural environments, but rather can extend to more conceptual representations of nature (spoken narratives). Critically, however, these restorative effects depended on an individual's level of absorption. When listening to nature narratives, high absorption individuals experience psychological restoration, including increased calmness and perceived restoration. However, when listening to

urban narratives, high absorption individuals showed little to no perceived restoration, as well as increased anxiety and decreased calmness. In contrast, individuals low in absorption did not show a clear effect of narrative condition on measures of restoration. As such, the interactions between absorption and environment narrative condition across several measures of restoration and mood support the hypothesis that individuals' level of absorption influences the restorative effects of narrative listening.

There are many potential explanations for why absorption influenced restoration in the present study. Participants had to actively imagine the sights and sounds of each described environment and were given time to do so during a 30 second reflection period after each narrative. As individuals with low absorption were presumably less able to place themselves in the nature scene described, they likely did not experience features of restoration such as “being away” or “fascination” from listening to the narratives, potentially even letting their minds wander during the reflection period. In contrast, participants high in absorption were likely able to immerse themselves in the depicted environments, making the experience more akin to perceptually based nature interventions. However, being highly absorbed in the urban narrative scenes likely makes it challenging to escape stress from the hustle and busyness of everyday life, as these individuals take on the feelings attributed to being in this arousing environment, including stress, intensity, and overstimulation.

In contrast, the mental imagery results did not interact with the condition as hypothesized. Rather, mental imagery was positively associated with restoration generally, regardless of condition. Individuals with higher visual mental imagery abilities reported significantly greater feelings of calmness and features of perceived restoration,

including being away, fascination and extent, after narrative listening in both conditions. This highlights that potentially individuals with strong mental imagery find the task of conjuring up images satisfying in general. More specifically, the main effects shown across conditions lead us to believe that it is the task itself, rather than the environmental landscape, that was creating a more positive experience for these individuals. We suspect that mental imagery does not have the same condition effects as absorption because they elicit different experiences. For instance, there is a difference between vividly imagining the sights and sounds of an environment and experiencing the feelings of being present in that environment. Further, it could be that engaging in mental imagery in general takes the mind off present thoughts or worries (i.e., “being away” and “extent”), providing an alternative form of mental stimulation that individuals with strong imagery abilities find restorative, given the ease with which they are able to complete this task.

While calmness scores significantly differed from pre to post intervention, we did not find a significant result for changes in happiness ratings. This could be due to the sole reliance on a single-item measure using the VAS scale, as prior work has shown that mental imagery of natural environments can increase positive mood (e.g., Koivisto & Grassini, 2022). Furthermore, the significant result for the single-item measure of calmness on VAS was further strengthened by the significant interaction found using the STAI, providing a more comprehensive measure of anxiety and calmness, which can be considered as opposite states along a singular dimension. Additionally, as narrative listening did not elicit consistent changes in negative valence mood, this could also be due to the single item measure on VAS. However, this finding is in line with findings from a meta-analysis by McMahan and Estes (2015), suggesting that the enhancing effect

of nature on emotional well-being is primarily driven by increases in positive affect, rather than decreases in negative affect.

Contrary to the study's hypotheses, there was no evidence that the narrative condition was associated with cognitive performance or reported mental fatigue. However, one plausible explanation for the lack of effects on cognitive restoration stems from the design of the study, in which participants were instructed to mentally place themselves in the environment in an active, directed manner. Actively imagining each depicted narrative requires directed attention (e.g. Moriya, 2018); thus, it is not surprising that we did not find significant results for cognitive measures or mental fatigue restoration. In alignment with Kaplan (1995), these findings support the notion that directed attention needs to rest for cognitive restoration to occur. As this guided imagery task involved top-down processing, where participants listened to the narratives, processed the environmental scene, generated mental images, and actively placed themselves within it, this presumably placed demands on attentional resources, and likely engaged directed attention, rather than letting it rest. In this sense, this study was not ideally designed to measure mental fatigue and cognitive restoration, as participants might not have had enough time to rest and replenish their cognitive resources.

Implications and Future Research Directions

Given the growing rate of urbanization, fewer and fewer people have access to direct experiences with natural environments. Moreover, the global surge in mental health issues (World Health Organization, 2022) coupled with limited access to mental health care services amplifies the significance of gaining insight on pathways for restoration in different environments. Despite widespread recognition of a mental health

crisis, barriers such as cost, stigma, and lack of availability persist, leaving many individuals without access to necessary support. This study highlights the potential for restorative experiences to be found in accessible and abstract ways for some individuals. Through guided imagery interventions, such as narrative listening, individuals can mentally immerse themselves in natural environments to temporarily alleviate feelings of stress and anxiety, providing an accessible (cost-free) avenue to restoration for highly absorbed individuals. As such, the restorative benefits of nature narrative listening have important implications for supporting the well-being of individuals today, especially in an increasingly urbanized and mentally strained world.

As individuals with absorptive tendencies were strongly affected by conceptual experiences with different environments (i.e., nature or urban condition), highly absorbed individuals may also be more sensitive to or affected by their environment in real life. If highly absorbed individuals are more sensitive to their environment in general, they may also be more negatively affected by perceiving stress in the environment. In this sense, if being immersed in nature narratives can increase calmness and lead to perceived restoration, as shown in the present, it may also serve to reduce stress as well. Future research should investigate how absorption and nature narratives can affect stress, and potentially highlight nature narrative as an intervention for stress reduction technique. However, researchers should incorporate measures of both physiological and perceived stress to enhance robustness and provide comprehensive insight on stress at all levels, considering both the objective and subjective experience of stress, as individuals' interpretation of stress influences their response to stress.

As this study provides an initial exploration of the restorative potential of conceptual representations of nature, future research on the role of absorption is needed to further understand this relationship and its influence on psychological restoration. Although this study found strong evidence highlighting the critical role of absorption in determining the restorativeness of environmental narratives listening, future research is needed to further understand this interaction, particularly with respect to practice guidelines for developing more conceptually based interventions aimed at increasing psychological restoration. As we asked participants to rate how much they liked each narrative and found a significant interaction between liking, absorption and condition, aesthetic liking may also be influencing the restoration of positive affective. Since individuals with high absorption especially liked the nature narratives, immersing oneself in an aesthetically pleasing experience may be a pathway driving the shift towards more positive affect. Future research is needed to further explore the role of aesthetic preference in this interaction. Additionally, research on absorption as a trait is relatively scarce, particularly in environmental psychology research. Future research on the influence of individual differences in absorption is needed, as it can provide valuable insight on several various topics pertaining to cognitive, affective and social processes within human psychology.

Limitations

Although the study's hypotheses were largely supported, it is not without limitations. Firstly, the study consists of a convenience sample of university students, potentially limiting the generalizability of the findings. Additionally, ecological validity may pose a limitation through the use of artificial intelligence (Chat GPT) to generate the narratives. However, the narratives were rigorously reviewed by humans to ensure that

the narratives were well matched in terms of overall mood (positive vs. negative undertones), so that structure and tone of the narratives would not implicitly skew participants to favor one condition over the other. This in turn increases the likelihood that the only difference between the narratives was the environmental condition they were describing. Indeed, the comparability of nature and urban narratives was seen in the present study, as participants reported both sets of narratives to be comparable in terms of conjuring up mental images. Lastly, the reliance on self-report measures of positive affect and perceived restoration as an indication of restorative effects may be considered a limitation. However, the abstract nature of our study is a subjective experience in itself (i.e., narratives generating different imagery experiences and feelings from being immersed), requiring subjective measures. Perceived restoration is arguably the most important measure of restoration, as subjectively feeling restored would inform how restorative the experience actually is.

Conclusion

The present study expands the current literature on psychological restoration in environmental contexts by demonstrating that conceptual representations of urban and natural environments can have similar effects as direct, perceptual experiences with these environments. Listening to narratives that describe different environmental scenes (i.e., urban or nature) provides the opportunity for individuals to emulate an experience comparable to being physically present in the scene described. As absorption was a significant moderator between perceived restoration and descriptive narrative listening, our results suggest that the degree of affective and restorative benefits individuals can experience from abstract interactions with nature depends on the quality/depth of the

immersive experience they are able to generate. Highly absorbed individuals can experience perceived restoration and calmness while immersed in nature narratives, but experience the opposite immersed in the urban condition. The present study highlights the potential of narrative-based approaches in fostering connections to nature and promoting positive affect in diverse contexts for certain individuals. It presents a novel approach to understanding the restorative benefits of nature, and paves new paths for future research to explore.

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Curriculum Vitae

Name: Morgan Clarke

Secondary School Diploma: Senior Matriculation, Malvern Collegiate Institute, Toronto, Canada

Post Secondary Diploma: B.A. Honours, Huron University College, London, Canada

Experience: Volunteer Crisis Responder, Kids Help Phone
Presenter at Healthy Teen Social Media Use workshop

Awards: Huron Achievement Award

Publications: Clarke, M., Menzies, A., Nickie, Z., & Solnik, D. [@curlathuron]. (2024, April 11th) *Unraveling Mass Media's Effect On Romantic Relationships* [Power Point]. Instagram.
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