



## Effect of biophilic shopping environments featuring Christmas trees on perceived attentional and mental fatigue: A national study

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### ABSTRACT

The Mayo Clinic and the American Psychiatric Association recognize that many people experience stress around the holidays. For example, households with children, people living alone, etc. during the Christmas holiday might be feeling mentally fatigued or maybe they simply want to improve their mental state. We aimed to investigate the extent to which Christmas tree shopping environments that include real trees in the outdoors (a common type of biophilic store design) provide opportunities to help them recover from mental and attentional fatigue (derived from Attention Restoration Theory) when compared to artificial indoor tree displays. A nationwide online survey (n=1208, 45 questions, and two video evaluations) was used to compare real-time and post video evaluations of outdoor displays of real Christmas trees with indoor displays of artificial Christmas trees using two measures of overall perceived restorative quality. The key finding indicates that real/outdoor trees have a higher perceived restorative quality (real-time video evaluation  $p < .05$  and post-video evaluation  $p < .001$ ). Although the fascination ratings for artificial/indoor tree ratings were significantly higher ( $p < .01$ ), it had a much weaker effect than real trees (less than half) on overall restorative quality. That is, although indoor artificial trees were more fascinating, it appears to be the kind of “hard” fascination that does not contribute nearly as much to restoration when compared to the “softer” fascination associated with real trees. The positive effect of coherence (e.g., orderly tree displays) and scope (e.g., perception of depth and spaciousness) on overall restorative quality that was perceived by respondents was greater for real/outdoor tree displays. These larger effects were measured in a multivariate multiple regression model but also identified in most of the peak restorative moments during the video evaluation.

### 1. Introduction

The Mayo Clinic (and other top-ranked hospitals and health organizations) recognize that many people experience stress around Christmas. For example, the American Psychiatric Association reported that 41% of people in their study experienced stress and anxiety during the holiday season (American Psychiatric Association, 2021). Based on the literature that documents the mental health benefits of nature immersion (e.g., immersion in nature in general, in biophilic shopping stores, and during urban forest bathing), it seems possible that shopping for real Christmas trees can help answer Mayo Clinic’s call for restoring the inner calm (Mayo Clinic, 2020). The purpose of the nationwide study is to examine and compare the extent to which Christmas tree shopping environments that include real trees in the outdoors (i.e., choose and cut

farm, garden center, and home improvement store) and artificial trees indoors (i.e., variety of chain store displays) provide opportunities for the recovery from mental fatigue and have the capacity to focus attention. By doing so, this research will fill a void in the literature by examining not only the factors of attention restoration associated with different Christmas tree shopping environments (outdoor biophilic designs offering real trees vs. indoor store designs offering artificial trees), but it will also identify the specific natural elements that contribute to positive consumer responses.

Despite the plethora of literature that identifies the health benefits of nature, the authors are not aware of any research that empirically examines the phenomena in detail as it relates to the Christmas tree shopping environment (a common biophilic store design in our communities that can offer forest bathing opportunities during the holidays).

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### 1.1. Immersion in nature in general

Nature and plants have been traditionally viewed as healers in the history of human development (Jiang, 2022). Trees have been associated with many spiritual and therapeutic qualities in different cultures due to their longevity, historical status, and continuity from one season to another (Squire, 2002). Landscape architects started to associate nature and parks with human salutogenesis as early as in the 18th century – several urban park systems were initiated by Frederick Law Olmsted (known as the father of American landscape architecture and arguably also park management given it was a topic once taught in landscape architecture schools) to address the stress, pollutions, and unhealthy living conditions in major American cities (Szczygiel and Hewit, 2000). The visual qualities of natural environment have been proven with dominant effects in reducing people's stress (Ulrich et al., 1991) and relieve mental fatigue (Kaplan, 1995). The amount or density of trees in outdoor spaces usually serves as a positive predictor of people's aesthetic preferences and high degrees of restorativeness (Wang et al., 2019). Increasing tree coverage can also provide health benefits associated with cooling urban environments (Lungman et al., 2023). Tree coverage (more so than low-lying vegetation or grass) was associated with a decreased risk of postpartum depression (Sun et al., 2023). In intimate spaces, the psychological benefits of plants include stress-reduction, emotional support, and increased pain tolerance (Bringslimark et al., 2009). The multi-sensory stimuli, particularly the odorant stimuli from nature, such as methyl salicylate (wintergreen scent), have been universally rated as smelling healthful (Dalton, 1999).

### 1.2. Immersion in biophilic store designs

The growth of urbanization and the hectic pace of life are just a few reasons why the health benefits of green infrastructure, such as biophilic designs, are important (Hung and Chang, 2022). Although Biophilic Design (including store designs like outdoor Christmas tree lots) is a relatively new line of research, the idea of bringing plants into houses and gardens reflects the biophilic quality of the human mind and is common in most cultures including those that go back more than 2000 years (Grinde and Patil, 2009). Kellert et al. (2008) proposed the biophilic design of landscape architecture to describe methods that include natural elements, patterns, natural lines etc. in the built environment. Hung and Chang (2022) used the perceived biophilic design items (PBDi) in their study to explain landscape preferences and positive emotional states in urban green spaces. They conclude that "Vegetation, waterscape, sky, etc., with the appropriate landscape layout, create a kind of fascination, an important component that attracts involuntary attention and influences human perception and positive emotions." (p. 9). More specifically, the concept of biophilic store design was introduced by Joye et al. (2010) as the integration of greenery or natural elements into the built *retail* environment. Adding elements of nature can help counteract shopper boredom stemming from a lack of newness and unique experience in built environments like shopping malls (Rosenbaum et al., 2018) that may suffer from what Verde and Wharton (2015) call customer "discovery deficit".

### 1.3. Immersion in nature during forest bathing

Immersion in an urban forest during the practice of Shinrin-Yoku, known as forest bathing, can lead to a plethora of positive health benefits for human physiological and psychological systems (Hansen et al., 2017). The idea of forest bathing originated in Japan in the 1980s. It involves slow, mindful sensory activities (e.g., slow wandering) that can occur in 10–15 minutes, typically in natural areas such as forests, parks, and yards with plants (Kil, 2022). Song et al. (2016) demonstrated that a 15-minute walk in an urban park can decrease stress and heart rates. Sturm et al. (2022) found that weekly 15-minute outdoor walks (called awe walks that offer awe-inspiring moments) for 8 weeks promoted

prosocial positive emotions in older adults. An example of an even shorter recovery time was documented in an experimental study where participants restored their attention directed at a task and lowered their skin conductance level (SCL) after watching a 5-minute nature video, which they called a nature break condition. On the higher end of recovery time, Berman et al. (2008) found that study participants realized positive effects on short-term memory and directed attention when exposed to nature during a 50-minute walk. Perhaps the better suggestion for the minimum time dose of nature immersion (e.g., forest bathing) was offered by Meredith et al. (2020). Their review of 14 studies, published in *Frontiers in Psychology*, found that 10–50 minutes sitting or walking in natural spaces helped improve mood, focus and physiological markers (e.g., blood pressure and heart rate), but the benefits tended to plateau after 50 minutes. Ten of the 14 studies they examined were conducted in Japan where the government has heavily promoted forest bathing programs. Given the seemingly endless benefits of forest bathing, it is important to find ways to create opportunities in more aspects of our lives, especially during stressful periods of time or seasons of the year.

### 1.4. Conceptual framework

Attention Restoration Theory (ART) is a specific theoretical framework associated with the mental health benefits of nature (Kaplan, 1995), and it was used in this study. A large body of research has accumulated in support of ART and is one of the most important and widely adopted theories that explains nature's restorative effects (Lin et al., 2014). Marketing research efforts that explore the restorative potential (i.e., recovery of mental fatigue) of commercial environments primarily draw from ART and are especially important for this study (Kaplan, 1995; Kaplan, 2001; Berto, 2005; Joye et al., 2010). In addition, over 100 studies of recreation experiences in wilderness and urban nature areas indicate that restoration is one of the most important verbally expressed benefit opportunities afforded by nature (Ulrich, 1981). ART suggests that prolonged mental effort leads to fatigue and natural environments foster restoration because they hold non-taxing attention (Kaplan, 1995). That is, natural environments allow information processing mechanisms to recover from the mental fatigue that results from everyday life and hassles. Prolonged and excessive demands commonly require focused attention and considerable effort (Kaplan, 1995). Mental fatigue can lead to a variety of problems such as psychological stress, and since attention is essential for human effectiveness, there can be a decline in problem solving, decline in behaving appropriately, increase in irritability, increase in accidents, etc. (Berto, 2007). As emphasized by Kaplan (1995, p. 172), "the restoration of effectiveness is at the mercy of directed (focused) attention fatigue." A way to benefit from attention regeneration (Berto, 2005) and recover from stress (Ulrich, 1981), is by exposure to natural environments.

## 2. Method

### 2.1. Conceptual and operational definitions of ART concepts

The Perceived Restorativeness Scale (PRS) was developed to measure the extent to which environments have restorative qualities (Hartig et al., 1997). PRS is based on ART and was initially made up of twenty-six items that measured study respondent's perception of the restorative factors (including those presented by Kaplan, 1995) that can exist in an environment to varying degrees. The scale has been frequently reported in the literature, and in 2014, a short form of the scale was developed to make it more suitable for research where time is limited (Pasini et al., 2014). Based primarily on this work (Kaplan, 1995; Hartig et al., 1997; Pasini et al., 2014), the conceptual and operational definitions of five restorative factors (fascination, being-away, compatibility, coherence, and scope) associated with PRS follow.

### 2.1.1. Fascination

The fascination of settings can hold one's attention effortlessly and without capacity limitations. Natural settings such as clouds, sunsets, snow patterns, leaves in the breeze are examples because they are undramatic (e.g., gentle form of fascination called soft fascination) and allow the perceiver to think about other things as well (Kaplan, 1995). This is one of the main components of a restorative environment and was measured using items including 'Places like this are fascinating', 'In places like this, my attention is drawn to many interesting things', and 'In places like this, it is hard to be bored'.

### 2.1.2. Being-away

This concept involves physical and/or psychological being-away from demands on directed attention. Being-away is a setting that is physically or conceptually distant from everyday environments, unwanted distractions, reminders of one's usual work, noise, and stimulation overload. A sense of being away is important but it does not require that the setting be distant. It was measured with items including 'Places like this are a refuge from nuisances' and 'To stop thinking about the things that I must get done, I like to go to places like this'.

### 2.1.3. Coherence

ART originally focused on four restorative factors including fascination, being-away, compatibility, and extent. Extent was defined as being in a whole different world that entails large tracts of land or in a small area that seems much larger with the addition of trails, paths, etc. that are sufficient to sustain exploration. Extent involves a place "rich enough and coherent enough so that it constitutes a whole other world" (Kaplan, 1995, p. 173). Therefore, extent was later thought to comprise elements such as coherence and scope. Coherence is an orderly environment with distinct areas, and repeated themes and textures. "In a coherent environment, things follow each other in a relatively sensible, predictable, and orderly way" (Kaplan, 2001, p. 488). The items used in this study include 'There is a clear order in the physical arrangement of places like this', 'In places like this it is easy to see how things are organized', and 'In places like this everything seems to have its proper place'.

### 2.1.4. Scope

Scope is the second element of extent. It requires a setting that is physically or conceptually large enough so that one's mind can wander, and their thoughts can drift away from daily activities (Lin et al., 2014). The items measured include 'That place is large enough to allow exploration in many directions' and 'In places like that there are few boundaries to limit my possibility for moving about'.

### 2.1.5. Compatibility

Compatibility or the match between a person's goals and inclinations and the demands provided by the environment can also be important. Analogs of compatibility include Csikszentmihalyi's (1975) "flow" experience which is an optimal experience that involves becoming immersed or feeling "in the zone". It can occur when the degree of challenge is balanced with one's skillfulness (physical or mental). The items include 'Being in places like this suits my personality', 'I can do things I like in places like this', and 'I have a sense that I belong in places like this'.

## 2.2. Development of videos and study instrument

Literature using visual representations of environmental conditions has traditionally been found in studies of environmental aesthetics and restorative character. For example, methodologies including photograph, simulation and video, and self-reported experiences (closed and open-ended survey/journal) have been used. The goal of these methods is to produce the most valid and reliable data on measuring environmental preference (Brown and Daniel, 1987). Historically, most

research has been conducted posteriori with a researcher providing students with a series of photographs or slides and asking participants to evaluate these images on a preference scale (Ewing et al., 2005). A review of three texts containing 58 research studies on aesthetics or restorative character of the natural environment utilized 60 different methodologies: 73% used photographs/slides, 17% experiential, 8% used computer simulation/virtual reality, and 2% used video (Kaplan and Kaplan, 1989; Nasar, 1992; Sheppard and Harshaw, 2001). Most studies were posteriori (conducted off site after photos, simulations, or videos were taken). Only two studies were conducted on site, asking participants to visit the area of study and assess conditions. However, Qin et al. (2008) also used real-time evaluations of videos (2 minutes in length) to study the visual quality of a scenic highway. Pierskalla et al. (2016) used real-time evaluations of videos (4–6-minutes in length) to examine the scenic beauty along five streets in the historic district of Savannah, GA. Therefore, the study presented in this paper further fills the void in the literature by examining videos with a length that falls within that narrow range of 2–6 minutes.

Two videos (three minutes in length) were created that represent two categories of Christmas tree shopping environments: (1) real trees displayed in the outdoors (i.e., choose and cut farm, garden centers, Boy Scout lot, and home improvement store) and (2) artificial trees displayed indoors (i.e., variety of chain store displays). (See Tables 9 and 10 for photos representing both videos). We wrote and used the same video script for each Christmas tree business including main entrance, landscape view or broad overview of full tree displays using 180-degree rotating view on a tripod, walk along tree displays of various heights, and close view of tree needles (short and long) in the researcher's hand. Following the script, the videos were produced by a professional videographer during the first week of December 2022 with each business represented in random order within the video. Given this is a quasi-experimental design, the researchers were not able to control everything presented in the video which is a study limitation.

Continuous audience response technology (CART) provided by Dialsmith LLC was used to collect moment-to-moment and post-video evaluation responses from respondents. The perception analyzer system technology has been used to conduct focus groups and market research, and to measure audience reaction to video such as advertisements, films, and campaign messages "so everything that is perceived is also recorded...Nothing slips through the cracks." (Dialsmith, 2023). In this study, the newest technology, the on-screen slider for online video evaluations, was used within an online survey instrument.

Our online survey started by asking respondents to read a definition of "restorative qualities":

We would like you to evaluate the "restorative qualities" of Christmas tree shopping environments or settings that you perceive in a three-minute video. Before you start the short video evaluation, take a moment to better understand what we mean by "restorative qualities" of a Christmas tree shopping environment by carefully reading the following: When you experience environments or settings with the highest "restorative qualities" you are more likely to:

- i. recover from mental fatigue
- ii. improve your ability to concentrate
- iii. restore your capacity to focus your attention
- iv. feel less irritable in these settings as you recover from mental and attentional fatigue.

On the other hand, when you experience environments or settings with the lowest "restorative qualities" you are less likely to recover from mental and attentional fatigue.

Following a twenty second practice video clip, respondents were asked to evaluate one of the two randomly selected videos based on a 100-point 'restorative quality' scale by using the on-screen slider. Note that this 100-point scale is a single-item or global measure of attention restoration (dependent variable) that was used because it would not be

practical to ask respondents to evaluate multiple restorative factors (independent variables including fascination, being-away, coherence, scope, and compatibility) simultaneously during every second of the video evaluation. The evaluation began with the on-screen slider set at the midpoint (50). Respondents were asked to move the slider to the right (100 = highest quality) if they felt that the restorative quality has improved in the setting and to the left (0 = lowest quality) if it decreased. Data were collected during every second of the three-minute video evaluation. Post-video evaluations were also included to assess the five restorative factors of the Christmas tree shopping environment based primarily on previous work (Kaplan, 1995; Hartig et al., 1997; Pasini et al., 2014). A total of thirteen PRS items (representing five restorative factors including fascination, being-away, coherence, scope, and compatibility) were evaluated on 0–10-point scale, where 0 = not at all to 10 = completely. The specific items that were examined were defined earlier in this paper. In addition, respondents were asked to provide a post-video assessment (0 = not at all to 10 = completely) of their overall perception of “restorative quality” represented in the type of environments or settings shown in the video. Questions regarding socio-demographics were also included in the survey such as gender, race, age, education, household income, type of household, and region of country of residence.

### 2.3. Sampling

Sampling was conducted by DialsSmith, Inc. during the last week of January 2023. DialsSmith uses the Cint platform which offers 4,500+ panel partners and 28,259,312 panelists in the USA. Study participants were contacted through online recruitment, email recruitment, specific invitations, and loyalty websites. All participants/panelists are subject to comprehensive quality checks. DialsSmith, Inc. distributed the online survey using the sample provider. Study participants included both current and potential customers of real Christmas trees. Upon successful completion of a survey, the panelists were immediately credited with a \$4.50 (or a \$4.50 points equivalent) incentive.

### 2.4. Data analysis

Data were analyzed using IBM SPSS Statistics Version 28. Descriptive statistics for response rate, socio-demographics, region, type of recent Christmas tree purchase, etc. are provided. Chi-square was used to examine the association of type of Christmas tree purchase and household. Several t-tests examined differences of the five restorative factors (measured with PRS scales) by type of video evaluated (real/outdoor vs artificial/indoor trees). ANCOVA was used to examine the effect of a video on overall restorative quality (both real-time and post-video evaluations) while controlling for the five restorative factors. Multivariate multiple regression (MMR) was used to measure the effect of the five restorative factors on both measures of overall restorative quality. Moment-to-moment results (e.g., timelines) helped pinpoint the peak restorative quality identified in the real/outdoor and artificial/indoor trees videos.

## 3. Results and discussion

### 3.1. Sample characteristics

A nationwide sample of 1208 qualified completed surveys (604 respondents per video) were collected. The response rate was 57% and the average completion time was fourteen minutes and nineteen seconds (median = 10:24). The sample was also balanced across four regions of the US (South = 30.6%, Northeast = 22.1%, Midwest = 21.3%, and West = 26.0%). It was also reasonably balanced among several demographics including gender (51.3% females), race (18% Black or African Americans, 61.3% White/Caucasian, 16.1% Hispanic or Latino, and 10.6% Asian), age (15–30% per age category from 18 to 24–55–64 years old),

education (ranging from 18% high school graduate or equivalent to 16% graduate degree), and household income (12.6% with less than \$20,000–22.7% with \$100,000+).

Nearly one third of the respondents had a real Christmas tree in their home in 2022 and 50.7% only had an artificial Christmas tree (Table 1). The remaining respondents (16.6%) did not have any Christmas tree in their home. Table 2 further breaks down these frequencies by type of household. Households most likely to have a real Christmas tree in their home include a foster child (100%), roomer/boarder (100%), child (44.4%), opposite-sex spouse (42.4%), other nonrelative (54.5%), grandchild (40.0%), and same-sex spouse (38.1%). That is, the top market for real Christmas trees includes households with children.

On the other hand, those living alone were least likely (34.4%) to have any tree and could potentially benefit from the restorative experience associated with shopping for a real tree outdoors (Table 1). Loneliness and isolation are considered an epidemic in the United States with serious health risks (Office of the Surgeon General, 2023). Although loneliness and isolation are widespread throughout the population, Nguyen et al. (2020) identified a significant association between loneliness and not having a spouse or partner ( $p < .001$ ) across all age groups examined in their large nationwide survey. Given the high percentage of respondents living alone without a home Christmas tree, easy access to forest bathing opportunities in local lots and farms could be especially useful to them. Cuncic (2021), medically reviewed by Morin, provided several ways to cope with being alone at Christmas including addressing their mental state. The restorative benefits offered when shopping for a real tree might be another way to accomplish that.

Of those respondents that indicated they had a real Christmas tree in their home, most purchased their tree at a chain store (37.2%), followed by a retail lot (29.2%), choose and cut farm (27.3%), nursery (23.0%), online (19.2%), and non-profit group (12.2%) (Table 3). This reflects a balanced sample among shopping locations.

### 3.2. Fascination of artificial/indoor trees

The Perceived Restorative Scales (PRS) are reliable and have Cronbach’s alpha scores near or well above 0.70. The items were measured on an 11-point scale (0 = Not At All to 10 = Completely). Fascination and its items (Table 4) were the only ratings that were significantly different (t-test, 2-sided  $p < .01$ ) between participants ( $n = 604$ ) who evaluated the video representing real/outdoor Christmas trees and participants ( $n = 604$ ) who evaluated the video representing artificial/indoor Christmas trees. Specifically, the fascination mean scores were higher (Cohen’s  $d = 2.5$ – $3.1$ ) for the group evaluating the artificial/indoor tree video. As explained later, this type of fascination might not be the “soft” fascination that is required for a restorative experience given the much smaller effect (Partial  $\eta^2 = .024$ ) on overall restorative quality perceived in the artificial/indoor trees video.

### 3.3. Perceived restorative quality of real/outdoor Christmas tree displays

When the authors used analysis of covariance (ANCOVA) to test for differences in overall restorative quality represented in the videos, the results were significant ( $p < .05$ ). ANCOVA is a general linear model that combines ANOVA and regression to examine random treatment effects (real/outdoor trees vs. artificial/indoor trees video evaluations) on overall perceived restorative quality. Covariates (i.e., fascination, being-

**Table 1**  
Type of Christmas tree(s) in your home in 2022.

Type of tree	n	Percent
Only a real Christmas tree(s)	247	20.4
Only an artificial Christmas tree(s)	613	50.7
Both artificial and a real Christmas tree(s)	148	12.3
No Christmas tree (real or artificial)	200	16.6

**Table 2**  
Household by type of Christmas tree(s) in home in 2022 by household.

Household (Check all that apply)	Type of Tree in the Home <sup>1</sup>			$\chi^2$	df	Cramer's V
	Real Tree	Artificial Tree Only	No Tree			
Opposite-sex Spouse (Husband/Wife)	206 (42.4%)	244 (50.2%)	36 (7.4%)	64.50*	2	.231*
Opposite-sex Unmarried Partner	30 (27.5%)	63 (57.8%)	16 (14.7%)	2.41	2	.045
Same-sex Spouse (Husband/Wife)	8 (38.1%)	10 (47.6%)	3 (14.3%)	0.30	2	.016
Same-sex Unmarried Partner	3 (23.1%)	7 (53.8%)	3 (23.1%)	0.73	2	.025
Child	192 (44.4%)	212 (49.1%)	28 (6.5%)	69.97*	2	.241*
Grandchild	2 (40.0%)	2 (40.0%)	1 (20.0%)	0.23	2	.014
Parent (Mother/Father)	67 (27.8%)	130 (53.9%)	44 (18.3%)	3.34	2	.053
Brother/Sister	54 (33.3%)	87 (53.7%)	21 (13.0%)	1.81	2	.039
Other relative (Aunt, Cousin, Nephew, Mother-in-law, etc.)	17 (32.7%)	30 (57.7%)	5 (9.6%)	2.10	2	.042
Foster Child	3 (100.0%)	0 (0%)	0 (0%)	6.19	2	.072
Housemate/Roommate	16 (32.0%)	25 (50.0%)	9 (18.0%)	0.08	2	.008
Roomer/Boarder	2 (100.0%)	0 (0%)	0 (0%)	4.12	2	.058
Other nonrelative	6 (54.5%)	4 (36.4%)	1 (9.1%)	2.45	2	.045
No one (I live alone)	46 (22.0%)	91 (43.5%)	72 (34.4%)	60.29*	2	.223*

\*Significant (p < .001)

<sup>1</sup>Percentages are by rows.

**Table 3**  
Purchase location of your home's real Christmas tree(s) in 2022.

Type of Business (check all that apply)	n	Percent
Real tree from a chain store (Walmart, Home Depot, Lowes, etc.)	147	37.2
Real tree from a choose and cut farm	108	27.3
Real tree from a retail lot	115	29.1
Real tree from a nursery	91	23.0
Real tree from a non-profit group (Boy Scouts, churches, etc.)	48	12.2
Real tree purchased online	76	19.2
Other location	8	2.0
I don't know	4	1.0

away, compatibility, coherence, and scope) were included in the general linear models to help increase precision of the treatment effect. By controlling for those five restorative factors using ANCOVA, both measures of perceived restorative quality were significantly ( $p < .05$ ) higher for the real/outdoor Christmas trees video (Tables 5 and 6). That is, the authors reject the null hypothesis that our treatment (randomly assigned video) results in equal mean restorative quality: real-time video evaluation  $F(1, 1201) = 4.126, p = .042$  (Table 5) and post-video evaluation  $F(1, 1201) = 15.96, p < .001$  (Table 6). The effect size of the video (partial  $\eta^2 = .013$ ) on overall perceived restorative quality was greater for the post-video evaluation measure (Table 6). Although the effect size is

acceptable (Cohen, 1969), it was greatly increased (partial  $\eta^2 = .057$ ) by narrowing the inclusion criteria of the analysis to those respondents that did not have a real or artificial tree in their home in 2022 (Table 7). Arguably these respondents have less bias from a personal preference for purchasing real or artificial trees that could impact evaluations. These findings suggest that future research that uses an even more robust method is very promising.

### 3.4. The effect of restorative factors on perceived restorative quality

Multivariate multiple regression (MMR) analysis was used to better understand the effect that the five restorative factors (predictors) have on two measures of overall perceived restorative quality (1. post-video assessment and 2. real-time video assessment) for each video (Table 8). The overall test for multiple responses (two dependent variables) was used in this study because it is more powerful than separate univariate regressions (one dependent variable) and it avoids multiplying error rates. Also, since separate univariate regression analysis of both dependent variables provided similar results, only the MMR results are provided in Table 8.

The assumptions for MMR that were examined in this study were satisfied. Both dependent variables are related conceptually and are at least moderately correlated ( $r = .583$ ) which is ideal. Scatterplots indicate that the relationships between the dependent and independent variables are positive and linear. The predicted values that were plotted against standardized residuals (i.e., residual plot) were symmetrically distributed (clustering towards the middle of the plot) and did not have any clear patterns which is also ideal.

The effects (partial  $\eta^2$ ) of the five restorative factors (predictors) on the overall perceived restorative quality can be compared for both videos in Table 8. Most notable is the larger effect fascination, coherence and scope have on overall restorative quality perceived in the real/outdoor trees video. Compatibility was the only factor to have a notably larger effect size for the artificial/indoor trees video. The discussion of these results follows.

Fascination had about twice the effect on perceived restorative quality for real/outdoor trees when compared to artificial/indoor trees (Table 8). This means that although artificial/indoor trees were considered more fascinating by study participants as shown in Table 4, it is the kind of fascination that does not make a major contribution to the overall perceived restorative quality. Artificial Christmas trees located inside stores (see Table 10 which shows the top restorative moments of the video), with all the lights displayed, are very fascinating, but it is more likely a "hard" fascination. Hard fascination includes factors like fast movements and loud noises including watching sports games on television or visiting amusement parks. Perhaps the sometimes flashing (i.e., fast movements), bright and high value, and even clashing or chaotic colors of lights common in indoor Christmas tree displays are also a type of hard fascination. On the other hand, "soft" fascination involves stimuli that does not require much effort (which reduces the internal noise and burden). Classic examples include wind blowing through leaves or ripples of water traveling across a pond. Based on our study's findings, shopping for real Christmas trees outdoors may provide another example of "soft fascination" – a type of fascination that has a larger effect on restorative quality. This finding helps address the calls to better understand fascination (Basu et al., 2018) which argue that soft fascination is key but an underexamined element of Attention Restoration Theory. These results also have broader consequences for future research that examines the restorative quality of fast moving and sometimes chaotic light stimuli such as cell phones and video games.

Scope had a much larger (partial  $\eta^2 = .046$ ) and significant ( $p < .001$ ) effect on perceived restorative quality of real/outdoor Christmas trees when compared to artificial/indoor trees (partial  $\eta^2 = .007, p = .141$ ) (Table 8). Outdoor retailers have an advantage over indoor stores because they offer a setting (or the impression of a setting) that is physically or conceptually large enough so that one's mind can wander

**Table 4**  
Perceived Restorative Scale (PRS) item mean scores by real/outdoor trees video versus artificial/indoor trees video.

	Real/Outdoor Tree Video		Artificial/ Indoor Tree Video		<i>r</i> (1206)	<i>p</i> (2-sided)	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
<b>Perceived Restorativeness Scale (PRS) items<sup>a</sup></b>							
<b>Fascination</b>	5.80	2.54	6.35	2.49	-3.76	<.001	2.51
Places like this are fascinating	5.83	2.94	6.28	2.87	-2.72	.007	2.90
In places like this, my attention is drawn to many interesting things	6.23	2.71	6.96	2.55	-4.79	<.001	2.63
In places like this, it is hard to be bored	5.35	3.04	5.80	3.09	-2.58	.010	3.06
Scale reliability: Cronbach's alpha	.849		.847				
<b>Being-away</b>	5.60	2.63	5.50	2.88	0.61	.541	2.75
Places like this are a refuge from nuisances	5.65	2.84	5.41	3.03	1.37	.171	2.94
To stop thinking about the things that I must get done, I like to go to places like this	5.55	3.13	5.59	3.33	-.205	.838	3.23
Scale reliability: Cronbach's alpha	.709		.773				
<b>Coherence</b>	7.03	2.10	6.96	2.12	0.56	.577	2.11
There is a clear order in the physical arrangement of places like this	6.99	2.31	6.84	2.43	1.09	.275	2.37
In places like this, it is easy to see how things are organized	7.11	2.34	7.07	2.37	0.269	.788	2.35
In places like this, everything seems to have its proper place	6.99	2.34	6.97	2.34	.135	.892	2.34
Scale reliability: Cronbach's alpha	.885		.873				
<b>Compatibility</b>	5.77	2.72	5.99	2.82	-1.36	.174	2.77
Being in places like this suits my personality	5.82	2.95	6.02	3.04	-1.18	.237	2.99
I can do things I like in places like this	5.84	2.86	6.05	2.90	-1.30	.194	2.88
I have a sense that I belong in places like this	5.66	2.99	5.89	3.10	-1.32	.187	3.05
Scale reliability: Cronbach's alpha	.918		.930				
<b>Scope</b>	6.63	2.11	6.59	2.16	0.34	.731	2.13
That place is large enough to allow exploration in many directions	7.16	2.36	7.10	2.37	0.44	.662	2.37
In places like that, there are few boundaries to limit my possibility for moving about	6.10	2.58	6.08	2.62	0.17	.868	2.60
Scale reliability: Cronbach's alpha	.623		.658				

Note: The abbreviations *M* and *SD* stand for mean and standard deviation respectively.

<sup>a</sup> Perceived Restorativeness Scale (PRS) items measured on a 11-point scale (0 = Not At All to 10 = Completely).

**Table 5**

ANCOVA: Real-time video evaluations of overall perceived restorative quality<sup>a</sup> by video (controlling for five restorative factors<sup>b</sup>)—including all study respondents.

Treatment Groups (videos)	<i>Mean</i>	<i>SD</i>	Effect of Video		
			<i>F</i>	<i>p</i>	Partial $\eta^2$
Real/outdoor trees video	61.79	21.37	4.126	.042	.003
Artificial/indoor trees video	60.70	19.75			

<sup>a</sup> Dependent variable: Perceived restorative quality was measured every second (in real time) during the video evaluation on a 100-point scale from 0=lowest quality to 100=highest quality.

<sup>b</sup> Covariance: The five restorative factor mean scores include Fascination, Being-away, Coherence, Compatibility, and Scope.

**Table 6**

ANCOVA: Post-video evaluations of overall perceived restorative quality<sup>a</sup> by video (controlling for five restorative factors<sup>b</sup>)—including all study respondents.

Treatment Groups (videos)	<i>Mean</i>	<i>SD</i>	Effect of Video		
			<i>F</i>	<i>p</i>	Partial $\eta^2$
Real/outdoor trees video	6.40	2.81	15.96	<.001	.013
Artificial/indoor trees video	6.16	2.66			

<sup>a</sup> Dependent variable: Overall perceived restorative quality (post-video evaluation) was measured on a 11-point scale (0=Not at All to 10=Completely).

<sup>b</sup> Covariance: The five restorative factors include Fascination, Being-away, Coherence, Compatibility, and Scope.

and their thoughts can drift away from daily activities (i.e., scope). It is not surprising that scope is an important restorative factor. Research suggests that park-like stands of trees with increased visual access and depth are appealing landscapes to people. In addition, distant views that are opened-up, especially to the horizon, are highly preferred landscapes (Heerwagen and Orians, 1993). We propose that scope (depth perception) in tree displays, especially for small outdoor displays where space is a premium, can be enhanced by modifying the (1) textural density, (2) relative size, (3) occluding events, and (4) linear perspective of the trees—each are explained in detail below.

**Table 7**

ANCOVA: Post-video evaluations of overall perceived restorative quality<sup>a</sup> by video (controlling for five restorative factors<sup>b</sup>)—including only respondents with no real or artificial tree in their home during 2022.

Treatment Groups (videos)	<i>Mean</i>	<i>SD</i>	Effect of Video		
			<i>F</i>	<i>p</i>	Partial $\eta^2$
Real/outdoor trees video	5.31	2.81	11.63	<.001	.057
Artificial/indoor trees video	4.54	3.03			

<sup>a</sup> Dependent variable: Overall perceived restorative quality (post-video evaluation) was measured on a 11-point scale (0=Not at All to 10=Completely).

<sup>b</sup> Covariance: The five restorative factors include Fascination, Being-away, Coherence, Compatibility, and Scope.

**Table 8**

Multivariate Multiple Regression (MMR): Effects of restorative factors<sup>a</sup> on restorative quality<sup>b</sup>.

Restorative factors	Real/Outdoor Christmas Trees Video		Artificial/Indoor Christmas Trees Video	
	<i>p</i>	Partial $\eta^2$	<i>p</i>	Partial $\eta^2$
Fascination	<.001	.052	<.001	.024
Being-away	<.001	.045	<.001	.049
Coherence	<.001	.057	<.001	.047
Compatibility	<.001	.032	<.001	.096
Scope	<.001	.046	.141	.007

<sup>a</sup> Independent variables: The five restorative factors were measured on 11-point scales from 0=Not At All to 10=Completely.

<sup>b</sup> Dependent variables: Perceived restorative quality was measured with two variables: Real-time video evaluation measured on a 100-point scale from 0=lowest quality to 100=highest quality and post-video evaluation measured on an 11-point scale from 0=Not at All to 10=Completely.

- (1) Gibson's ecological perception theory suggests that the rate of change in a landscape's textural density provides cues for depth perception (Bruce and Green, 1990). For example, a customer who views a display of trees (having uniform tree size and density throughout the display) will naturally notice an apparently lower density of trees in the near setting and higher density of trees in

the distant setting. The trees nearest the customer will also appear larger in scale than distant trees. These gradients of texture are perceived invariants and inform the visitor about the depth of the setting (i.e., provide scope). It is possible for retailers to heighten the perception of depth by altering this gradient pattern of trees. Establishing higher densities of smaller trees on the outmost edge, while allowing lower densities of larger trees to exist in the near setting by the entrance, can potentially heighten impressions of a landscape surface receding away; thus we propose that it can enhance depth perception and make the space appear larger. Exiting this same space would have the opposite effect because the space would be compressed, and the customer would feel immersed and pulled into the setting which could also provide a unique and enjoyable experience.

- (2) Similar to gradient pattern cues, we propose that relative size cues can also be enhanced to give the impression of a receding landscape of a space. The relative size of an object depends upon its distance. When a retinal image is large it can either be a small object up close or a large object that is far away. Therefore, when perceiving two similar objects such as two trees, there can be a tendency to see the smaller tree further away. Because the distant or background trees (on the outmost edge) are smaller in absolute size, the relative depth would be increased.
- (3) A third type of cue that is used to perceive depth is occlusion. Occlusion is a category of events wherein objects (e.g., smaller background trees) occasionally disappear and reappear when overlapping with other objects (e.g., larger foreground trees) or as they become wiped away or hidden from our peripheral view during human movement (Strickland and Scholl, 2015). Our visual systems make effective use of these monocular interpositions (overlapping objects) to deduce the depth relations among objects (Kaplan, 1969). This impression can be magnified by transitioning from large to small trees, wherein a larger number of background trees are hidden.
- (4) Linear perspective is a fourth type of depth cue that can enhance the impression of receding landscape scenery. The technique involves using parallel lines (like railroad tracks) that converge in a

single vanishing point, and it is often used by artists and architects. In theatre, it is used to make small spaces appear larger. In our Christmas tree display example, trees can be presented in such a way (V-shaped or triangular pattern) as to create linear perspective (convergence of landscape pattern near the horizon or background) and enhance the perception of depth of an otherwise small space.

Compatibility was a significant predictor ( $p < .001$ ) for the restorative quality perceived during both videos, but it was notably larger (about 3 times larger) for artificial/indoor Christmas trees (Table 8). Analogs of compatibility include Csikszentmihalyi's (1975) "flow" experience which is an optimal experience that involves becoming immersed or feeling "in the zone". It can occur when the degree of challenge is balanced with one's skillfulness (physical or mental). The real Christmas tree industry should continue to find ways to improve services (e.g., tree delivery and set-up) that can reduce the challenge of purchasing a real Christmas tree or increasing the perceived self-efficacy of some prospective customers. For example, 27.6% of study respondents of Kansas households listed allergies or health problems as a reason for purchasing an artificial tree (Hilderbrandt, 1991). Providing allergy-friendly trees might help those customers perceive compatibility.

### 3.5. Top ten restorative scenes of the real/outdoor Christmas trees video

Fig. 1 shows the evaluation timeline and the top ten scenes with peak restorative quality that were perceived in the real trees video. Those scene snapshots are provided in Tables 9. Some recommend that landscape architects and service design researchers try to better understand the specific types of natural elements (e.g., certain types of trees and plants, forms of water displays, or the presence of small animal life such as birds and butterflies) that evoke positive consumer responses (Rosenbaum et al., 2018). This study helps address this call for additional research and offers propositions and recommendations about how to improve the biophilic design of real Christmas tree farms and lots (e.g., choose and cut farm, garden centers, Boy Scout lot, and home

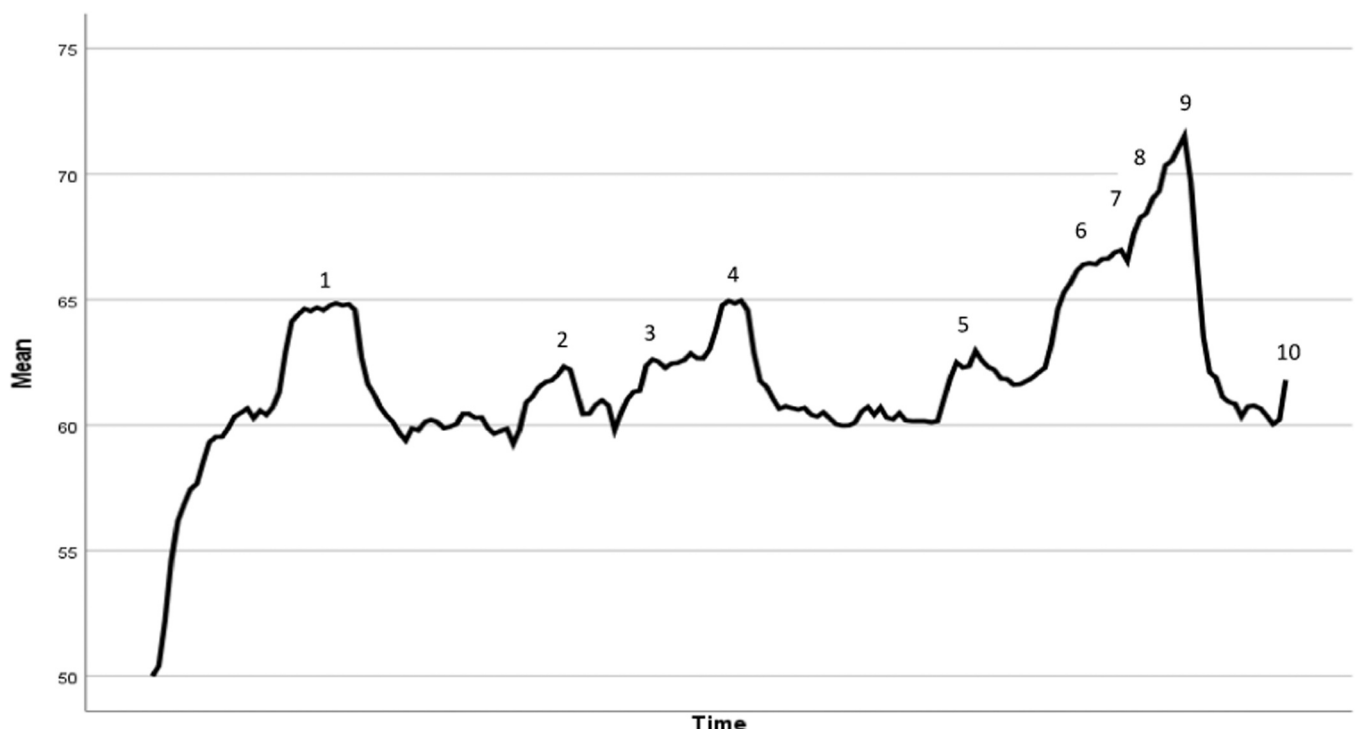












Fig. 1. Evaluation timeline for the real/outdoor Christmas trees video.

**Table 9**  
Peak restorative moments identified during the evaluation of real/outdoor trees video.

Timeline Position	Peak restorative video scenes	Timeline Position	Peak restorative video scenes
1		6	
2		7	
3		8	
4		9	
5		10	

improvement store).

Pictures 1, 3, 5, 6, and 9 are innovative tree displays that represent coherence and scope in varying degrees (Table 9). These pictures further support the importance of coherence (organized trees) and scope (a receding landscape or depth) as contributing factors of restorative quality and compliments the findings presented in Table 8. They represent a type of organized complexity (the right balance of order and variety or contrast) that affords an ideal perception of depth and spaciousness.

Pictures 2 and 10 represent large trees (Table 9). Although customers

tend to prefer purchasing smaller trees (6–8'), they perceive higher restorative quality when larger trees were presented in the video (pictures 2 and 10). The preference of large trees in studies of scenic beauty is well established. For example, based on preference rating (5-point scale) of 100 scenes, Herzog (1984) identified three dimensions or categories of scenes including one called, large trees, which received the highest scores among the dimensions (3.79 on a 5-point scale). The ratings increased to 4.0 when the trees were viewed in combination with pathways which can offer a pleasing effect as a boarder element or refuge. (Note: Similar to this study, Herzog, 1984, would sometimes



refer to the work of Kaplan and Gibson in his publications). Locating the larger trees near the pathway entrance (foreground or front row) might also enhance the impression of depth and scope of a place.

Picture 4 represents the positive effect of smell and pictures 7 and 8 represent the positive effect of tactual stimuli of both short and long needle trees on restorative quality (Table 9). There is evidence to suggest that biophilic store design can profit from these contributors of restorative quality. For example, natural tree buyers ranked fragrance as a top reason for their purchase and suggests that scents affect product and store ratings, shopping times, and sales (Larson, 2004). Furthermore, other researchers (Leenders et al., 1999) advise that at least 70 percent of shoppers should be aware of the scent. In summary, all these recommendations support the importance of multi-sensory stimuli, particularly the odorant stimuli from real trees in biophilic shopping environments (Dalton, 1999).

Being able to categorize the peak restorative moments into categories based mostly on factors of ART provides face validity for this study. The authors also tried to minimize the presence of people in the video unless they were intentionally highlighting the non-visual stimuli (i.e., smell and touch) of both environments captured in the video.

### 3.6. Top seven restorative scenes of the artificial/indoor Christmas trees video

The evaluation timeline and the top seven scenes with peak restorative quality that were perceived in the artificial trees video are provided in Fig. 2. Those scene snapshots are provided in Table 10. Despite the diversity provided in the video (large to small displays with varying sized trees), the artificial tree evaluations have less variability, and the timeline is flatter when compared to real trees (e.g., the difference between scene 1 and 6 in Fig. 2 is 4.20 on a 100-point restorative scale). It seems that shopping for artificial trees is less eventful (i.e., affording fewer awe-inspiring opportunities) when compared to shopping for real

trees.

## 4. Conclusion








This study helps fill several voids in the literature by examining overall restorative quality (two dependent variables) and individual factors of ART (five independent variables) associated with different Christmas tree shopping environments (outdoor biophilic designs offering real trees vs. indoor stores offering artificial trees). It also identifies the specific natural elements that contribute to perceived restorative quality.

The key finding indicates that real/outdoor tree store displays have a higher perceived restorative quality (two dependent variables measured as real-time and post-video evaluations) when compared to artificial/indoor trees, especially for those that are likely more neutral in their preference of trees (i.e., did not have any real or artificial tree in their home). Therefore, this study provides the first empirical evidence to support public health recommendations to forest bathe in Christmas tree displays at local choose and cut farms, garden centers, Boy Scout lots, home improvement stores, or other type of outdoor tree lots, especially for customers seeking recovery from mental fatigue. This can be the beginning of a promising line of research if additional situational variables such as type of tree display are considered in future research. The main study findings also provide support for a recent CNN article's (Marples, 2021) proposition that real Christmas trees can provide important health benefits such as the reduction in anxiety, psychological stress, and depression. The Mayo Clinic (2020) and American Psychiatric Association (2021) recognize that many people experience stress around the holidays. For example, households with children and those that are living alone during the Christmas holiday might be feeling mentally fatigued or maybe they simply want to improve their mental state. The outdoor biophilic designs that are common at retail tree farms and lots can help those customers recover from mental fatigue, improve



Fig. 2. Evaluation timeline for the artificial/indoor Christmas trees video.

**Table 10**  
Peak restorative moments identified during the evaluation of artificial/indoor trees video.

Timeline Position	Peak restorative video scenes	Timeline Position	Peak restorative video scenes
1		6	
2		7	
3			
4			
5			

their ability to concentrate, restore their capacity to focus their attention, and help them feel less irritable as they recover from mental and attentional fatigue. In essence, real Christmas tree displays and farms make a convenient forest bathing opportunity for people, even for those that do not purchase a tree.

The examination of independent variables (i.e., five factors of ART) also led to important findings. The potential lure of artificial tree displays and their sometimes flashing (e.g., fast movements), bright and high value, and even clashing colors of lights (Fig. 2) should be questioned by customers seeking attention restoration and the recovery from

mental fatigue, and it should be further examined in future research. The findings from this study suggest that this type of fascination might be like other “hard” fascinations such as fast movements and loud noises including watching sports games on television or visiting amusement parks, and they do not contribute to overall restoration at a level similar to real Christmas tree displays. Stimuli categorized as “hard” fascination forcefully grab customers’ attention and are difficult to resist or let go. In fact, there was very little variability (fewer awe-inspiring moments) in the relatively flat or uneventful evaluation timeline for artificial indoor trees. “As a result, they tend to fill the mind, leaving little room for more

peripheral mental activity or reflection” (Basu et al., 2018, p. 1057). Hard fascination “eventually leads to mental fatigue and symptoms such as distractibility, impulsivity, and irritability” (Basu et al., 2018, p. 1056). On the other hand, the biophilic nature of outdoor tree displays appear to offer the “soft” fascination that reduces the internal noise and mental burden for customers much like the effect of wind blowing through leaves or ripples of water traveling across a pond. It is this “soft” fascination that contributes more to restoration because it captures attention effortlessly. Our study’s finding is especially important and interesting considering it can be connected to William James’ (1962) discussion of attention (later referred to as fascination) that was published over 130 years ago and more recently by Kaplan (1995) and others.

The display of real Christmas trees may also have an advantage over indoor displays of artificial trees because they offer a setting that is physically or conceptually large enough so that a customer’s mind can wonder and their thoughts can drift away from daily activities (i.e., scope). That type of setting can also offer coherence when there are orderly displays of trees with repeated themes and textures. In fact, most of the peak restorative moments identified during the evaluation of real/outdoor trees video involved innovative displays that had the characteristics of scope and coherence. Based on these findings, we provided some propositions on how to further improve the perception of depth, spaciousness, and the impression of a receding landscape, especially for small spaces. We suggest that tree displays can be enhanced by modifying the textural density, relative size, occluding events, and linear perspectives of trees. These propositions seem promising and deserve the attention of future research.

Other restorative design elements of real Christmas tree displays that were identified in the video evaluation include the presence of larger (or taller) trees. Based on the literature, these larger trees could be located near a pathway as a boarder element to the customers’ experience (even though they are not the most preferred size tree for purchase). And as we also proposed, they could be located near the pathway entrance (foreground or front row) to enhance the impression of depth and scope of a place which can also improve the perceived restorative quality.

Compatibility was a significant predictor of restorative quality for both real/outdoor and artificial/indoor trees, but the effect was about three times larger for the latter. This issue can be addressed by finding additional services that can reduce the challenge of purchasing a real Christmas tree for some customers. Some current examples include tree delivery and setup services.

The broader implications of this study can help designers of all types of open-air biophilic store designs, not just Christmas tree shopping environments. Marketing research on the restorative potential of commercial environments (a contemporary retail phenomenon referred to as ‘biophilic store design’ by pioneering marketing researchers) is often drawn from ART (Rosenbaum et al., 2018). Söderlund and Newman (2015) summarize research that indicates shoppers and shop employees were less stressed and there was increased retail potential when biophilic initiatives were used in a commercial context. More recently, Rosenbaum et al. (2018) conducted three studies that used ART and PRS to link biophilia design of lifestyle centers (a type of open-air retail setting) to the restoration from mental fatigue. Based on their research, they conclude that “when biophilic elements are incorporated into lifestyle center design, shoppers can sense the restorative potential of these centers. Resultantly, those who spend time in restorative lifestyle centers may experience catharsis from negative symptoms associated with mental burnout and fatigue” (Rosenbaum et al., 2018, p. 72). Landscape architects and service design researchers are trying to better understand the specific types of natural elements that evoke positive consumer responses (Rosenbaum et al., 2018). Our study supports this line of research by pinpointing aspects of popular biophilic store designs that help people recover from mental fatigue during the holidays.

## CRediT authorship contribution statement

**David McGill:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Writing – review & editing. **Jinyang Deng:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Writing – review & editing. **Shan Jiang:** Conceptualization, Funding acquisition, Methodology, Writing – review & editing. **Chad David Pierskalla:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Chad Pierskalla, Jinyang Deng, David McGill, Shan Jiang

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## Research in the News

- <https://www.womansworld.com/posts/home/when-to-decorate-for-christmas>
- <https://www.cbsnews.com/texas/video/shopping-for-christmas-trees-can-boost-your-mental-health/>
- <https://www.cbsnews.com/chicago/video/study-finds-real-christmas-trees-is-good-for-mental-health/>
- <https://www.kfyrtv.com/video/2023/12/21/can-real-christmas-tree-benefit-mental-health/>
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