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Personally Relevant Indoor Nature Imagery's Impact on Students' Well-Being,
Connection to Nature, and Eco-Conscious Behaviors

An Honors Paper for the Department of Psychology

By Sarena J.T. Sabine

Bowdoin College, 2019

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Connection to Nature, and Eco-Conscious Behaviors

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Abstract

Previous research has shown that experiences in nature are predictive of increased connection to nature, well-being, and pro-environmental behavior. The current study investigated whether daily exposure to indoor nature imagery would also improve well-being and eco-conscious behaviors, and whether personally relevant images would enhance this hypothesized effect. Participants completed a test assessing baseline connection to nature and well-being, specifically satisfaction with life, positive and negative emotions, and stress. In the 2 (Nature vs. Built) X 2 (Familiar vs. Unfamiliar) study design, 125 participants either received a poster from a photo that they submitted (a personally-relevant nature scene or personally-relevant built scene) or a poster of an unfamiliar natural or built scene. After four weeks of daily exposure to this new poster in their home, participants completed a post-test which included the same measures of well-being and connection to nature, along with a novel eco-conscious behaviors measure involving environmental petitions. The nature intervention significantly improved participants' satisfaction with life. The personal relevancy of images did not enhance well-being, either alone nor in interaction with image content. The finding that daily exposure could lead to improved well-being has implications for addressing mental health concerns.

Personally Relevant Indoor Nature Imagery's Impact on Students' Well-Being,
Connection to Nature, and Eco-Conscious Behaviors

People are more disconnected from nature now than at any other time in our evolutionary history. For example, adults in North America spend 90% of their time indoors (Leech, Nelson, Burnett, Aaron, & Raizenne, 2002). Our alienation from the natural environment has led to many unhealthy outcomes, such that it has been proposed that we are suffering from a “nature-deficit disorder” (Louv, 2008). According to Wilson’s biophilia hypothesis, humans have an inherent inclination to affiliate with nature (Wilson, 1984). Even though many have disconnected from nature, and some even fear the outdoors (Herzog & Kutzli, 2002), humans still have an underlying evolutionary desire to feel connected to the natural world and may experience psychological and health benefits from spending time in nature (Keniger, Gaston, Irvine, & Fuller, 2013; Van den Berg, 2005).

In response to concerns about our increased separation from the natural world, researchers have explored whether modest exposure to nature-based stimuli might be beneficial. The current study investigated the effect of indoor nature imagery on well-being and eco-conscious behaviors. As shown in Figure 1, indoor nature imagery was hypothesized to increase one’s connection to nature. Connection to nature, in turn, was hypothesized to mediate nature imagery’s beneficial impact on participants’ well-being and eco-conscious behaviors. Additionally, personalization was hypothesized to improve well-being. If the nature imagery depicts a personally meaningful scene, it was hypothesized that these images would cause the greatest enhancements in connection to nature, and thus greatest increases in both well-being and eco-conscious behaviors.

Psychological Correlates of Nature Exposure

Well-Being. In response to our increased separation from the outdoors, researchers have begun to address how nature impacts our psychological and physical health and why exposure to nature is often beneficial. Nature can provide us with a wide range of benefits including psychological benefits such as improved well-being, mood, and emotions; cognitive benefits such as improved attention, creativity, and academic performance; and health benefits such as decreased mortality rates, blood pressure, headaches, and healing times from accidents (Keniger et al., 2013; Van den Berg, 2005).

Immersing oneself in natural environments helps reduce stress. For instance, people who were randomly assigned to take walks in the forest felt significantly less stressed than those assigned to take walks in urban settings (Lee, Park, Tsunetsugu, Kagawa, & Miyazaki, 2009). Proximity to neighborhood green space is also associated with reduced stress, as assessed by both physiological (salivary cortisol) and self-report measures (Thompson et al., 2011).

The natural world also improves our positive affect, well-being, and overall happiness. Taking a walk in nature made people feel happier than taking a walk in an urban setting or passively relaxing indoors (Hartig, Mang, & Evans, 1991). MacKerron and Mourato (2013) had participants download a smartphone application, *Mappiness*, on which at random times during the day they rated their happiness and a GPS tracked their location. Participants were significantly happier when outdoors in green and natural environments compared to when they were in urban environments. Similarly, Richardson and McEwan (2018) required that all participants engage in routine experiences in nature every day for 30 days. Daily interactions with nature included noticing nature, sharing

nature experiences, doing activities in nature, and connecting to nature, such as nature-based art. Although the study did not have a control group, participants' happiness was significantly higher after nature intervention in comparison to their baseline happiness levels before the intervention.

Given that individuals gain positive psychological benefits from being outdoors in nature, studies have also investigated whether indoor exposure to nature would also induce positive benefits. Having "indoor nature exposure" means encountering a nature-based space within a built environment (McSweeney, Rainham, Johnson, Sherry, & Singleton, 2015). Examples of this include window views of nature, videos of nature, potted plants and flowers, and photographs of nature. Since we are spending the majority of our time indoors, it is relevant to study whether indoor nature exposure will have positive impacts similar to exposure to outdoor natural environments. McMahan and Estes (2015) conducted a meta-analysis of 32 studies in which participants experienced brief exposure to natural environments. They compared the effects of real nature and laboratory simulations of nature, such as viewing nature images, on positive affect. Although exposure to real nature had a larger effect on positive affect, laboratory-based nature exposure significantly improved people's positive affect. Additionally, general exposure to nature slightly, but significantly, decreased negative affect.

Window views of nature have been shown to provide a positive impact. Hospital patients with a window view of nature had faster recovery times and requested less pain medication than patients who viewed a brick wall (Ulrich, 1984). Chang and Chen (2005) had participants view different rooms: either one with a window view of nature, one with a window view of a city, or one without a window view. Both physiological as well as

state-anxiety measures indicated that participants in the window view of nature condition were the least nervous and tense (Chang & Chen, 2005). A window view of nature also has been shown to increase subjective well-being (Kaplan, 1993). Additionally, individuals' pleasure and energy level increased, and tensions decreased, when they were exposed to natural elements, including window views of nature or potted plants (Beute & de Kort, 2017).

Watching nature videos can have a similar effect on our well-being. Mayer, Frantz, Bruehlman-Senecal, and Dolliver (2009) found that participants' positive emotions significantly increased after watching a nature video that simulated a walk through an arboretum, and that negative emotions marginally significantly increased when participants watched a city walk video. Nature videos can also reduce stress (Brown, Barton, & Gladwell, 2013; Jiang, Chang, & Sullivan, 2014; Ulrich et al. 1991). For example, participants in Ulrich et al., (1991) first watched a video to elicit stress, which led to increased skin conductance, blood pressure, muscle tension, and higher self-ratings of fear and anger. Those who then viewed videos of nature recovered more quickly and completely than those who viewed videos of urban environments.

Even something as small as momentarily viewing images of nature can increase positive affect. For instance, Pretty, Peacock, Sellens, and Griffin (2005) had participants run on a treadmill in a lab while they watched a sequence of natural or urban landscapes. Participants' mood improved while watching natural, but not urban, landscape images. One does not need to be active while looking at images of nature to experience positive benefits: simply viewing a slideshow of nature photos increased the positive affect and

well-being of mildly stressed college students, while a show of urban photos diminished their subjective well-being (Ulrich, 1979)

Research has also found that even briefly noticing nature in one's daily life is beneficial. Passmore and Holder (2017) conducted a two-week intervention in which participants continued their normal routines but were instructed to pay more attention to, as well as photograph, either nature or human-built objects. Participants who were assigned to notice nature had significantly higher positive affect and well-being scores after the intervention compared to those in the human-built and control groups. Thus, simply noticing nature can improve one's well-being. Since many people may not have the time nor opportunity to spend as much time outdoors as they would like, it is important to test how exposure to long-term indoor nature might impact people's well-being and stress.

Eco-Conscious Behavior. In addition to previous research showing that nature improves well-being, many studies have shown that exposure to natural environments also increases tendencies to care for the environment and to engage in eco-conscious behaviors. Borrie and Roggenbuck (2001) found that after visiting a wilderness area, visitors' levels of respect towards nature increased. Positive experiences in outdoor recreation, such as hiking, also appear to increase environmentally-friendly activities such as volunteering for an environmental group and contacting governmental agencies about environmental problems (Nord, Luloff, & Bridger, 1998; Tarrant & Green, 1999) and support for conservation groups (Zardiac, Pergams, & Karieva, 2009).

Outdoor experiences do not have to be in pristine wilderness areas in order to impact one's nature-protective behaviors. Everyday experiences in nature can have a

similar effect. French adults who reported that they interact with nature as part of their daily routine were significantly more likely to be committed to biodiversity conservation and have a higher connection to nature than adults who did not routinely see nature (Prévot, Cheval, Raymond, & Cosquer, 2018). This was true even if their reported interactions in nature did not explicitly draw attention to biodiversity issues. Similarly, Richardson and McEwan (2018) found that after people interacted with nature every day for 30 days, their conservation behavior significantly increased compared to baseline levels before the intervention. Participants' conservation behavior remained at this elevated level one month following the experiment, indicating that the intervention had a lasting effect on pro-environmental behaviors.

In addition to past research that has examined how exposure to nature through outdoor recreation impacts pro-environmental behavior, researchers have also assessed how simply viewing nature impacts environmentally friendly behaviors. Whitburn, Linklater, and Milfont (2018) found that those who live in neighborhoods with more green space are likely to report engaging in pro-environmental behavior, such as recycling, transportation choices, waste avoidance, and energy consumption. Suggesting the validity of participants' self-reporting, unobtrusive observations of participants' recycling behaviors showed that the majority who said they recycle did truly recycle. Even indirect exposure, such as simply looking at the stars, appears to be predictive of increased ecological behavior, connection to nature, and personal well-being (Pensini, Horn & Caltabiano, 2016).

Researchers have also investigated whether virtual nature can influence sustainable behavior. Zelenski, Dopko, and Capaldi (2015) conducted three studies

suggesting that exposure to nature may increase cooperation and sustainable behavior. In their first two studies, participants watched either a 12-minute nature video (Planet Earth) or an architecture video. Next, participants engaged in a fishing-themed commons dilemma where they made decisions about how much fish to harvest across seasons. Those in the nature condition engaged in sustainable behavior: they harvested significantly fewer fish and had fisheries that lasted for more seasons than those who watched the architecture video. Thus, mere exposure to nature through a video appears to enhance sustainable behavior.

In Zelenski et al.'s (2015) third study, participants were randomly assigned to watch a video clip of one of the following environments: pleasant built (Las Vegas), unpleasant built (abandoned house), pleasant nature (forest scene), or unpleasant nature (a flood or wolves killing prey). They then filled out a questionnaire regarding their willingness to engage in eco-conscious behaviors. Those who viewed the pleasant built environments were least willing to engage in sustainable behavior. Viewing nature, regardless of whether it was pleasant or unpleasant, produced a higher willingness to engage in sustainable and cooperative behavior than viewing built scenes. Zelenski et al. (2015) suggest that short-term indoor nature exposure will likely not permanently change one's environmental attitudes and behaviors. Increasing one's eco-conscious behaviors will likely require more time and repeated exposure to nature.

However, Weinstein, Przybylski, and Ryan (2009) examined whether nature imagery impacts generosity. Participants viewed images of either natural or built environments. Before and after this manipulation, they answered questions about their aspirations for generosity and intrinsic goals, which satisfy basic psychological needs

such as closeness and community, and their extrinsic goals, which satisfy selfish desires and rewards such as fame and fortune. Participants' extrinsic aspirations decreased after viewing nature photos, and their intrinsic aspirations and generosity increased. For those who viewed built environments, their extrinsic aspirations increased and their intrinsic goals did not change. Thus, brief exposure to virtual nature appears to increase intrinsic aspirations and care for others. Although Weinstein et al. (2009) did not measure pro-environmental behaviors, such behaviors are often associated with community improvements and can be in opposition to one's self-interest. Thus, intrinsic aspirations may likely be related to one's opinions and care for the natural world. Therefore, the results of Weinstein et al.'s (2009) support the hypothesis that viewing nature imagery will increase pro-environmental behavior.

No studies found to date have examined the effect of daily exposure to nature photographs on eco-conscious behaviors. Studies involving exposure to nature photographs have been typically carried out in lab settings and for short periods. The current study was a four-week intervention in which participants experienced daily exposure to indoor nature through posters. If the poster were placed in a prominent place, one would notice it every day. This type of exposure may be more contextually valid than brief, lab-based manipulations. The pervasiveness of decoration is such that if individuals and groups decide to imbed more indoor nature into their schools, offices, and homes, people could see this indoor nature every day for weeks, and even years.

Connection to Nature. Viewing nature improves our well-being and appears to increase pro-environmental behaviors. One proposed mechanism explaining why nature has these effects is that exposure to nature increases our connection to nature. Mayer and

Frantz (2004) describe one's connection to nature as representing one's trait levels of feeling emotionally connected to, or a part of, the natural world, and assess this through their connection to nature scale (CNS). This connection to nature subsequently has been shown to improve our psychological well-being as well as our eco-conscious behaviors.

Nature Exposure and Connection to Nature. Although connection to nature can be viewed as a trait, one's connection to nature can change throughout one's life due to new experiences. For example, spending more time in outdoor environments can elevate one's personal connection to nature. Nisbet, Zelenski, and Murphy (2009) had participants monitor the frequency of time they spent outdoors in nature over eight weeks. The frequency with which one went into nature was positively correlated with connection to nature. Connection to nature was also positively correlated with increased commitment to environmental issues. Similarly, Prévot et al. (2018) found that those who had routine experiences in nature were more likely to be connected to nature and engage in conservation behaviors than those who did not routinely interact with nature.

In addition to these correlational studies, experimental studies have also examined whether a nature intervention can enhance one's connection to nature (Mayer et al., 2009; Richardson & McEwan, 2018). After interacting with nature daily for 30 days, participants' nature connectedness, along with happiness and conservation behaviors, significantly increased compared to their baseline levels (Richardson & McEwan, 2018). Mayer et al. (2009) found that even a single 10-minute walk at a nature preserve can enhance one's positive affect and connection to nature in comparison to taking a walk in an urban area devoid of nature.

Exposure to indoor nature can enhance one's connection to nature as well.

Weinstein et al. (2009) had participants view slides of images of natural settings or urban environments, and then completed the Connection to Nature Scale (CNS; Mayer & Frantz, 2004). Participants exposed to natural scenes had higher connection to nature (CNS) scores than those who viewed urban scenes. Mayer et al. (2009) also compared how walking in natural and urban environments influenced one's connection to nature compared to viewing videos of those walks. Even though those in the outdoor nature condition had higher CNS scores than those in either of the virtual conditions, CNS scores were significantly higher in the virtual nature condition than the virtual urban condition. Thus, although exposure to indoor nature may not have as strong an influence on connection to nature as going outdoors, indoor nature still has power to boost one's connection to nature.

Nature Connection and Well-Being. Connection to nature may have contributed to our early ancestors' ability to survive and flourish as well as to their well-being (Kellert & Wilson, 1993). Due to our growing disconnection to nature, it is important to study whether connection to nature impacts individuals' well-being. Some researchers found that connection to nature reduces stress, which improves well-being. One's trait-level connection to nature appears to be linked with reduced overall anxiety (Martyn & Brymer, 2016) and increased psychological resilience (Ingulli & Lindbloom, 2013). In order to be psychologically resilient, one must be able to protect oneself from the psychologically harmful effects of trauma and stress. Thus, connection to nature is likely associated with stress reduction.

Nisbet, Zelenski, and Murphy (2011) conducted a quasi-experimental study with participants who were either in environmental courses or not, and measured connection to nature and vitality, meaning how energetic and lively they felt, over time. CNS scores decreased for students who were not enrolled in environmental courses, yet CNS remained constant for students in an environment-related course. As the semester progressed, becoming more stressful, students who were not in environmental courses experienced greater decline in vitality than those in environmental courses. Since vitality can be an indicator of well-being, this suggests that nature could help buffer against stress and improve our well-being.

For instance, in their meta-analysis of the relationship between nature connectedness and happiness, Capaldi, Dopko, and Zelenski (2014) found that those who are more connected to nature have higher positive affect and satisfaction with life than those who are less connected to nature. Since Capaldi et al. (2014) included correlational studies in their meta-analysis, this could indicate that higher nature connectedness causes increased happiness, that increased happiness causes increased connection to the natural world, or that a third variable causes both. However, experimental research has supported a causal relationship from nature exposure to increased connection to nature and happiness.

For instance, Richardson and McEwan (2018) found that daily nature exposure for 30 days increased nature connectedness, happiness, and well-being. Weinstein et al. (2009) suggest that nature connectedness partially mediates nature's effect on well-being. Additionally, connection to nature mediated the relationship between both real and virtual nature's influence on positive affect in the Mayer et al. (2009) study. Lastly, increases in

connection to nature due to recent nature exposure has been found to predict both mental well-being and eco-conscious behavior (Pensini et al., 2016)

Nature Connection and Eco-Conscious Behavior. Individual differences in level of connection to nature have been shown in many cases to also predict eco-conscious behaviors. People who view themselves as part of the larger natural world feel more environmental concern, which spurs them to have a higher willingness to take action to protect nature (Schultz, 2002). Many studies have found that nature connectivity is positively correlated with increased engagement in sustainable activities (Mayer & Frantz, 2004; Nisbet et al. 2009; Prévot et al., 2018; Tam, 2013).

In a recent meta-analysis, Mackay (2018) reviewed both correlational and experimental studies regarding connection to nature's effect on promoting pro-environmental behaviors. For correlational studies, a strong correlation existed between one's connection to nature and engagement in environmentally friendly behaviors. For experimental studies, a small yet significant causal effect of nature connection increasing pro-environmental behavior occurred. Mackay (2018) only examined short-term experimental interventions with laboratory-based indoor nature. This short-term exposure to indoor nature might not be strong enough to produce profound changes in connection to nature, let alone changes in pro-environmental behavior. A multi-week exposure may be more effective in increasing connection to nature, which could then better increase pro-environmental behaviors.

Personalization and Place Attachment

Personalization. Personalization is a universal, symbolic, and communicative process. It is a type of a distinctively human behavior, in which humans have engaged for

over 50,000 years (Feber, 2016). Wells (2000) describes personalization as occurring when individuals deliberately decorate or modify their environment to reflect their identity. A common contemporary example of this is college students personalizing their dorm rooms (Hansen & Altman, 1976). During the first few weeks of college, blank dorm walls are often transformed to reflect the preferences, identity, and values of the person living inside. Vinsel, Brown, Altman, and Foss (1980) examined 83 college dorm rooms and found that students who displayed more personalized items reflecting their commitment to their university were less likely to drop out of college compared to their counterparts who did not display decorations signifying their commitment to their college.

Personalization enables one to regulate stress and emotions (Scheiberg, 1990). People personalize spaces with decorations that will elicit predictable emotional responses. Scheiberg (1990) found that personalizing one's office space often triggered participants' positive memories and feelings which relieved them from pressure, stress, and other negative state emotions. Personalizing one's workplace area decreases emotional exhaustion and acts as a calming stimulus (Laurence, Fried, & Sowik, 2013). Unlike people with low or minimal amounts of office personalization, those who had highly personalized spaces experienced less emotional exhaustion (Laurence et al., 2013). Thus, it appears that the personalized environment allowed and even enabled people to cope better with stressful interferences and distractions. In fact, individuals are more likely to feel stressed in indoor monotonous settings without any personalization, compared to when then they are in more visually appealing, personalized environments (Heerwagen, Heubach, Montgomery & Weimer 1995; Holhan, 1976). Thus, viewing

images that are positively personally meaningful would likely reduce one's stress more than viewing unfamiliar images.

In addition to influencing stress and emotions, personalized spaces influence self-esteem, quality of life, and satisfaction across multiple areas. Evans, Kantrowitz, and Eshelman (2002) suggest that personalization may allow individuals to recall old memories that they cherish, which may improve their well-being. Displays of personalization can improve children's self-esteem (Maxwell & Chmielewski, 2008). In an experimental intervention, Maxwell and Chmielewski (2008) manipulated the amount of personalization in kindergarten and first grade classrooms by making design changes such as posting every child's art project on the wall, and found that this personalization was associated with increased self-esteem. Personalization can help enrich the quality of life for patients undergoing end-of-life care (Zadeh et al., 2018), and improve the elderly's satisfaction and comfort with their nursing home (Kruzich, Clinton, & Keber, 1992).

Other studies have examined how personalization affects overall well-being. In a study on office personalization and employee well-being, Wells (2000) surveyed adults working at various companies. Personalization was found to be indirectly related to well-being: it increased satisfaction with the physical environment, which translated to increased job satisfaction and well-being. According to longitudinal data based on observed college student behavior, the amount of personalization in students' college dorm rooms was associated with positive student outcomes such as happiness, life satisfaction, decreased loneliness, roommate satisfaction, and university satisfaction (Benfield, 2008).

In past literature, the term “personalization” often includes any sort of decoration to modify one’s environment; the personal relevancy of the objects displayed is not specified. In contrast, the current study operationalized the effects of personalization by comparing the effects of displaying a poster to which one has a personal connection with a poster of an unfamiliar, non-personally relevant place.

Place Attachment. Place attachment is the emotional bond or positive connection formed between an individual and a particular place (Williams & Vaske, 2003). The concept of place attachment is relevant to the literature on personalization, for personalization can show places to which one is attached. Many researchers have used images taken by participants of a place, and then asked participants questions about their photographs to study their attachment to that place (Beckley, Stedman, Wallace & Ambard, 2007; Korpela, Hartig, Kaiser, & Fuhrer, 2001; Tonge, Moore, Ryan & Beckley, 2013). Thus, a photograph of a place can act a visual reminder of attachment to that place.

Place attachment has been shown to be positively associated with generating a positive sense of self (Golant, 1984; Wiles et al. 2009), quality of life (Gilleard, Hyde, & Higgs, 2007), and life satisfaction (Casakin & Reizer, 2017). Scannell and Gifford (2017) studied the wide range of psychological benefits related to well-being that place attachment can promote. Participants listed a place that they love, and the benefits they experienced from this place. Participants most frequently reported that place attachment supported and evoked memories. Roughly half of the participants said that their place attachment helped them relax and reduce their stress as well as increase their sense of

belonging, and over one third of participants indicated that they experienced positive emotions from being attached to this place.

Raymond, Brown, and Weber (2010) suggest that place attachment can improve one's connection to nature. They found that place attachment is a multi-dimensional construct, and "nature bonding" is a specific dimension. "Nature bonding" refers to "connection to the natural environment without human beings" (Raymond et al., 2010, p. 423). Viewing images of outdoor places to which one is attached will likely increase both place attachment and connection to nature.

One's attachment to a natural place can be predictive of place-protective environmental behavior. Walker and Ryan (2008) found that, for Maine residents, simply being highly attached to the regional rural landscapes was strongly correlated with higher level of support for conservation to protect these areas. Similarly, a high sense of place attachment to national parks positively predicted increased place-protective environmental behaviors (Halpenny, 2010).

Place attachment to natural environments can also increase one's general eco-conscious behavior. Halpenny (2010) found that, along with place-protective environmental behavior, intention for pro-environmental behaviors increased as one's attachment to place increased. Similarly, Vaske and Kobrin (2001) surveyed 14-to-17-year-olds who were in an outdoor natural-resource based work program and found that their emotional attachment to their program's location was positively predictive of their pro-environmental behaviors in everyday life. Additionally, attachment to one's local area can also be predictive of increased climate change engagement (Scannell & Gifford, 2013). Thus, there is evidence that exposure to a personally relevant stimulus may

reinforce one's attachment to a natural environment, which could more effectively enhance one's connection to nature and eco-conscious behaviors than exposure to an unfamiliar outdoor environment. In the current study, personally relevant images of both nature landscapes and scenes of built environments was expected to activate place attachment; thus it was hypothesized that this form of personalization would enhance well-being.

Personalization, Place Attachment, and Nature. Viewing personally relevant nature images to which one is attached could boost one's connection to nature and pro-environmental behaviors. When one personalizes an area such as one's home, that space "becomes an extension of the sense of self" (Harris & Brown, 1996, p. 188). Thus, personalization can be both reflective of one's identity, and also potentially help shape and reinforce one's identity. If individuals decorate their space with personally relevant nature images, they will be reminded often of their attachment and connection to that outdoor place. Additionally, seeing nature as part of their identity could provide motivation for behavior, as Shamir (1992) argued that identity often motivates behavior. In fact, Clayton and Opatow (2003) found that those who have an environmental identity and consider themselves to be a part of nature are more likely to report participating in eco-conscious behaviors.

The Present Study

In the current study, college students hung a poster in their dorm room for four weeks of either a nature or a built scene that was either personally relevant or unfamiliar to them. This study examined how exposure to this visual stimulus affected participants' well-being, (positive and negative emotions, life satisfaction, and stress), connection to

nature, and eco-conscious behaviors. Some studies have examined how individuals have used indoor nature as a form of decoration, but no research has directly examined how viewing personally relevant indoor nature would differ from viewing impersonal images of unfamiliar nature scenes. The personally relevant nature poster served as a tangible reminder of one's attachment to the photographed place.

Previous findings suggest that indoor environments which are personalized, and indoor environments which have elements of nature, both enhance well-being; thus, it was expected that personalization and nature exposure would have independent additive effects on participants' well-being. Although all personally meaningful images were expected to improve participants' well-being more than unfamiliar images, personally meaningful nature images were expected to have the greatest impacts on well-being. Biederman and Vessel (2006) suggest that images of nature that are associated with memories, and thus personally relevant, will most likely have greater effects on positive emotions compared to nature images that are unfamiliar.

Exposure to nature has been shown to increase one's connection to nature, and connection to nature has also increased well-being. It was hypothesized that the positive effect on well-being from viewing nature images will be mediated by connection to nature. Viewing indoor nature can also increase eco-conscious behaviors, and having a greater connection to nature is predictive of increased eco-conscious behaviors. Thus, connection to nature was hypothesized to mediate the effect of viewing nature imagery on eco-conscious behaviors.

Remembering places in nature to which one is attached can increase one's connection to that place, as well as enhance one's connection to the natural world, which

can then lead to elevated pro-environmental behavior. Thus, it was hypothesized that an interaction would occur such that exposure to nature would increase connection to nature and eco-conscious behavior and that this would be enhanced by personalized stimuli.

Method

Participants

Undergraduate students (N = 130) at a small liberal arts college in rural New England were recruited for the study through email. Roommates who shared a one-room dormitory room were not both allowed to participate. Roommates with separate bedrooms were allowed to participate as long as they hung their poster in their own separate rooms. Three participants dropped out after the pre-test, and two failed to keep their poster up for the full four weeks, leaving 125 participants. Sixty-eight percent identified as female, 30.4% identified as male, and 1.6% identified as other. The mean age of participants was 19.44, with students from all class years: first-years (53.6%), sophomores (17.6%), juniors (15.2%), and seniors (13.6%). Students from urban areas or cities (21.6%), suburban areas or large towns (53.6%), and rural or small towns (24.8 %) took part in the study. Thirty-eight participants (30%) reported no existing nature imagery in their room before the study; the other 70% reported having at least one nature image in their room. Fifty-two participants (42%) were in an introductory psychology class and received course credit for participating. The other 73 participants were compensated with a five-dollar gift card for ice cream from a local business.

Materials

Posters. Each participant was asked to submit two “*personally meaningful*” photos of scenes that they had taken themselves. They were instructed that “*no people or*

pets can be in either photo,” “one photo must have little to nothing that is manmade,” which implies a photograph of nature, and *“items in the other photo should be nearly all manmade.”* These photos were then printed onto 11-inch by 17-inch poster paper.

Scales. To assess well-being, participants completed the Scale of Positive and Negative Experience (SPANE, Diener & Biswas-Diener, 2009) and the Satisfaction with Life Scale (SWLS, Diener, Emmons, Larson & Griffin, 1985). For the SPANE, participants rated adjectives on a Likert Type scale from 1 (*very rarely or never*) to 5 (*very often or always*) to describe feelings they had experienced during the past four weeks. This 12-item scale was used to measure positive feelings (*positive, good, pleasant, happy, joyful, and contented*) and negative feelings (*negative, bad, unpleasant, sad, afraid, and angry*). Positive Feelings Scores are calculated by summing the scores for six positive items. Cronbach’s alpha was .84 for the pre-test and .83 at post-test. Summing scores for the six negative items equals participants’ Negative Feelings Scores ($\alpha = .76$ on the pre-test, $\alpha = .76$ on the post-test). For SWLS, participants rated their agreement with five statements (e.g., *In most ways my life is close to my ideal*) on a Likert Scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Participants’ responses were summed to calculate their Satisfaction with Life Score. Higher scores indicated a higher satisfaction with life. Chronbach’s alpha equaled .81 at both pre-test and post-test.

To measure stress, participants completed the Perceived Stress Scale (PSS, Cohen, Kamark, & Mermelstein, 1994). They rated “how often they felt or thought a certain way” during the past four weeks on a Likert-type scale from 0 (*never*) to 4 (*often*) for 10 items (e.g., *In the last month, how often have you felt nervous and “stressed”?*). Participants PSS scores were calculated by reversing responses for positively stated

questions (e.g., *How often have you felt that things were going your way?*) and then summing across all items. Higher PSS scores indicate higher amounts of stress. PSS was found to be reliable ($\alpha = .84$ on the pre-test, $\alpha = .86$ on the post-test)

The Connection to Nature Scale (CNS) was used to measure participants' sense of connection and oneness with the natural world (Mayer & Frantz, 2004). Participants rated "the way [they] generally [felt]" over the last four weeks about 14 items (e.g., *I often feel a sense of oneness with the natural world around me*) on a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Participants' CNS scores were calculated by reverse scoring responses to questions which measure a lack of connection to nature (e.g., *I often feel disconnected from nature*) and summing these scores with the other items in the scale. Pre-test scores indicated an alpha of .83 and post-test scores showed an alpha of .87.

Behavioral Measures. Eco-conscious behaviors were measured through a novel task designed for this study, the Eco-Conscious Behavior Measure (ECB, see Appendix A). Participants were presented with a list of 12 environmental petitions with links and indicated on the survey if they signed each or not. These petitions came from three reputable national and international organizations: The Nature Conservancy, Environment America, and The National Resources Defense Council. The petition items included: land-related topics, water-related topics, topics on wildlife, topics on waste/toxins, and topics related to climate change. Participants' initial ECB scores equaled the number of total items they selected. Scores ranged from 0 to 12, with higher scores indicating more petitions signed to take part in eco-conscious behavior. An examination of score distribution indicated a bimodal distribution: many participants

endorsed no petitions, while several others endorsed them all. To yield data approximating a normal distribution, scores were rescored. Participants endorsing no petitions (18.4% of the sample) were given a score of 0; those endorsing less than half (1-5) of the petitions (32.8%) received a score of 1; those endorsing more than half (6-11) of the petitions (27.2%) received a score of 2; and those endorsing all petitions (21.6%) yielded a score of 3.

Procedure

A recruitment email advertising the study as examining the effects of art and visual processing on psychological functioning was sent to all students attending the college. The email informed students that they could earn a \$5 gift card in addition to acquiring a printed poster of two of their favorite photos by participating in the study. Students who responded to the email expressing their interest in participating received a separate second email containing additional information about the study's requirements, and a link to the informed consent form. The study requirements described how participants would be required to come to the lab to complete a questionnaire, to hang up their assigned poster for four weeks, and to return to the lab to complete another questionnaire following this four-week period. Those who gave informed consent received a third email, which instructed them to email the researcher two photos.

Many participants were then randomly assigned to receive either a personal poster (a photo that they submitted) or a non-personal poster (a photo that a different participant submitted). A number of the submitted photos were judged as problematic for use in the study. Photos of familiar scenes from the college campus or local surroundings, close-up photos, black and white photos, nature photos that displayed animals or manmade items,

and photos of built environments that had animals, writing, or prominent greenery were eliminated from consideration. As a result of rejecting a number of photos, the intended random assignment of personal versus unfamiliar photos was compromised, as participants could only be randomly selected to receive a personal photo if their photos were not excluded. 43% of the nature photos participants sent in were either unsatisfactory or submitted too late such that these participants could not be randomly assigned to the personal nature condition. 35% of the built photos that participants submitted were either unsatisfactory or submitted too late such that these participants could not be randomly assigned to the personal built condition.

Additionally, the personally relevant and unfamiliar conditions were designed to be identical such that each picture given to a participant in the personal condition would also be given to an individual in the unfamiliar condition. Difficulties in data collection due to individuals dropping out, individuals switching times to come to the lab at the last minute, and participants sending in photos late caused some photos to be only used once. Specifically, only 91% of the nature photos were used in the unfamiliar and personally relevant nature conditions, and 88% of the non-nature photos were given to one participant in both the familiar built and unfamiliar built conditions.

Participants visited the lab in groups from two to seven people. When participants arrived at the lab, they were instructed to complete a computer-administered survey with the SPANE, SWLS, PSS, and CNS scales, as well as distractor scales on art and aesthetics using their own laptops or a researcher-provided computer. Questions regarding art interest and art appreciation, as well as questions about the student's current room decorations, were included to diminish participant awareness of the research

question. One item asked students to report the number of nature images they already had in their room to measure pre-existing nature imagery, as it was believed that pre-existing nature imagery might interfere with the effectiveness of the nature intervention.

Participants were assigned a 0 if they had no pre-existing nature imagery and a 1 if they had existing nature images in their room. After finishing the pre-test, participants were shown their assigned poster and asked to rate “how personally relevant, or personally meaningful” this photo was to them on a scale from 0 (*not at all*) to 10 (*extremely*).

Along with their poster, participants were given wall putty and instructions for hanging up the poster. The instructions asked participants to hang up the poster for four weeks in a prominent location in their dorm room to ensure that they would have daily exposure to the poster. Two days after participants received their poster, they received an email from the researcher asking them to send in a photo of their poster up on the wall. Participants who did not respond within 48 hours were sent daily reminders until they complied. All complied within seven days.

After four weeks, participants came back to the lab to again complete the SPANE, SWLS, PSS and NCS scales, the distractor questions on art interest, as well as provide demographic information. They were also asked whether they had kept their poster up for the entire four weeks. Additionally, they were asked to describe any thoughts, emotions, and/or reactions they had in response to seeing this poster these past four weeks for exploratory purposes and to identify potential limitations or problems with the manipulation. Afterwards, participants completed the eco-conscious behaviors measure.

Results

Manipulation Check

The personal relevance manipulation was confirmed, as participants rated their own poster ($n = 62$, $M = 8.44$, $SD = 1.72$) as more personally relevant than participants who received unfamiliar photos ($n = 63$, $M = 3.02$, $SD = 2.72$), $t(123) = 13.28$, $p < .01$. Even though some participants did rate their own photo below 5 on the 1-10 scale, and others rated an unfamiliar photo above 5, because these ratings were less than three standard deviations from the mean, these participants were not excluded from analysis.

Descriptive Statistics and Bivariate Tests

As shown in Table 1, individual differences in all dependent variables were relatively stable, with correlations from pre to post-test ranging from 0.61 to 0.84, $ps < .01$, with negative emotionality demonstrating less stability than positive emotionality, satisfaction with life, perceived stress, or connection to nature. Mean scores did not change between pre and post-test for positive or negative emotions, but did for satisfaction, stress, and connection to nature. Inspection of the means indicates that between the second and seventh week of the semester, participants reported increased stress, increased satisfaction, and felt more connected to nature.

Table 2 contains correlations between the dependent variables at pre- and post-test. At both times, all measures of well-being were significantly correlated with one another, such that high positive emotions, low negative emotions, high satisfaction with life, and low stress were linked. In addition, higher connection to nature was related to satisfaction with life at both times, positive emotions in the pre-test, and to eco-conscious behavior at the post-test.

It was investigated whether the presence of pre-existing nature imagery affected any of the variables. Participants with pre-existing nature imagery in their room tended to have a higher pre-test life satisfaction ($M = 26.93$, $SD = 5.12$) than those without nature imagery in their rooms ($M = 24.60$, $SD = 5.90$), $t(123) = 2.57$, $p < .05$. T-tests were also significant for pre-connection to nature, $t(123) = 3.13$, $p < .01$, and post-connection to nature, $t(123) = 2.00$, $p < .05$. Inspection of the means indicated that those who already displayed nature imagery had a higher pre-connection to nature ($M = 51.28$, $SD = 8.28$) than those without nature imagery ($M = 46.16$, $SD = 8.51$). Those with pre-existing nature imagery also had a higher post-connection to nature ($M = 52.07$, $SD = 8.90$) than those without pre-existing nature imagery ($M = 48.51$, $SD = 9.42$). Additionally, participants who already had pre-existing nature also engaged in more eco-conscious behaviors ($M = 1.66$, $SD = .99$) than those who did not already have nature imagery ($M = 1.19$, $SD = 1.04$), $t(123) = 2.36$, $p < .05$.

Unexpectedly, there was a significant positive relation between this pre-existing nature variable and the experimental condition, such that those who had nature in their room were more likely to be assigned to the nature condition rather than the built condition, $X^2(1) = 7.205$, $p < .01$. This confounding variable was therefore controlled in the subsequent analyses concerning the effect of condition upon life satisfaction, nature connection, and eco-conscious behaviors.

It was also investigated whether gender was associated with any of these variables using t tests. T-tests were significant for the pre-existing nature variable, $t(121) = 2.94$, $p < .01$; pre-test stress, $t(121) = 2.80$, $p < .01$; post-test stress, $t(121) = 2.60$, $p < .05$; and post-test CNS, $t(121) = 2.62$, $p < .05$. Inspection of the means indicated that women had

more nature imagery ($M = 1.74$, $SD = 1.14$) than males ($M = 1.08$, $SD = 1.19$); that pre-test stress was greater in females ($M = 16.33$, $SD = 5.67$) than men ($M = 13.39$, $SD = 4.60$); post-test stress was greater in women ($M = 17.05$, $SD = 5.77$) than men ($M = 14.21$, $SD = 5.14$); and there was a greater nature connection post-test in women ($M = 52.49$, $SD = 9.25$) than men ($M = 47.92$, $SD = 8.49$). In the subsequent ANOVAs, gender was entered as a covariate for analyses regarding stress and connection to nature.

T-tests also indicated that, before the intervention, those in the personally relevant condition were already significantly less stressed in the pre-test than those in the unfamiliar condition, $t(123) = 2.42$, $p < .05$.

Effect of Intervention on Well-Being and Connection to Nature

Two (Pre vs. Post-Test) X two (Relevant vs. Unfamiliar) X two (Nature vs. Built) repeated measures ANOVAs were conducted to analyze the effect of the four-week intervention on participants' well-being (positive and negative emotions, stress, and satisfaction with life) and connection to nature. As shown in Table 3, a significant pre-post effect was observed for satisfaction with life and connection to nature: both increased over time. Stress marginally may have changed, with students perhaps becoming more stressed over time.

Those in the personally relevant condition had marginally lower negative emotions, marginally lower stress, and marginally greater satisfaction with life than those in the non-personal condition.

For satisfaction with life, a significant pre-post X nature interaction occurred. As shown in Figure 2, satisfaction with life did not change for participants in the built condition, but increased for those in the nature condition.

For negative feelings, a marginal interaction of pre-post X nature occurred. Those given nature images perhaps might have experienced a decrease in negative feelings, while those given images of built scenes possibly experienced an increase in negative feelings.

Effect of Intervention on Eco-conscious Behaviors

A 2 (Personal Relevance) X 2 (Nature vs. Built) univariate ANOVA was conducted, with the pre-existing nature variable as a covariate, to examine whether the intervention influenced participants to take action and sign environmental petitions. A marginal effect of personal relevancy occurred, $F(1, 120) = 3.602, p = .060$. Examination of the means indicated that those given personally relevant images engaged in marginally fewer eco-conscious behaviors ($M = 1.34, SD = 1.02$) than those given unfamiliar photos ($M = 1.69, SD = 1.01$). There was no significant effect of nature condition on number of petitions signed, $F(1, 120) = 2.196, p > .10$, nor was there an interaction between the conditions $F(1, 120) = 0.047, p > .10$.

Discussion

Intervention Effects

The current study investigated the impact of daily exposure to familiar or unfamiliar images of nature or built scenes on participants' well-being, connection to nature, and eco-conscious behaviors. The personal relevancy manipulation did not boost well-being. The nature intervention increased one aspect of participants' well-being, satisfaction with life, but did not significantly enhance their connection to nature or eco-conscious behaviors.

Nature Intervention & Well-Being. Daily exposure to indoor nature significantly increased participants' satisfaction with life and marginally may have decreased participants' negative emotions. This occurred regardless of whether the nature imagery depicted a personally relevant or an unfamiliar scene. These results contribute to previous findings that daily exposure and experiences in nature improve well-being over time (Richardson & McEwan, 2018; Passmore & Holder, 2017). Findings from the current study suggest that one does not need to view only real nature to gain positive psychological impacts; rather seeing nature imagery can benefit one's well-being.

It was hypothesized that viewing nature imagery would improve participants' well-being through increasing their connection to nature. Since the intervention did not significantly increase one's connection to nature, mediation could not be explored. Several alternative reasons could explain why nature improves life satisfaction. Viewing nature imagery may fill people's innate desires to affiliate with nature, as proposed by Wilson's biophilia hypothesis (Wilson, 1984). Once people have met this need, it could be the case that they become more satisfied with their lives. Additionally, by viewing images of nature, participants could have been frequently reminded of positive experiences they had in the outdoors, which led to increases in their life satisfaction. Alternatively, perhaps seeing nature, rather than built scenes, might have changed what people value in their lives. Weinstein et al., (2009) found that viewing nature scenes decreased participants' selfish, extrinsic desires while viewing built scenes increased selfish aspirations. Additionally, previous literature has shown that those with extrinsic goals are less satisfied with their lives (Rijavec, Brdar, & Miljkovic, 2006; Sirgy, 1998).

Thus, if exposure to nature caused participants to devalue materialistic and extrinsic desires, this may have led to increased life satisfaction.

The nature intervention may marginally decreased participants' negative emotions. Brooks, Ottley, Arbuthnott, and Sevigny (2017) similarly found that viewing nature images reduced negative affect. McMahan and Estes (2015) also reported that participants exposed to nature experienced slight, but significant decreases in negative affect. When people have negative thoughts, perhaps viewing nature was restorative in helping them diminish the associated negative emotions. Viewing nature can also shift one's attention away from oneself, to an external focus (Frantz, Mayer, Norton, & Rock, 2005). If one is experiencing rumination and negative feelings about oneself, then viewing nature may cause a decrease in negative thinking.

Analysis showed that the nature intervention did not appear to change participants' stress. This contrasts with prior research that exposure to natural environments reduces stress (Ulrich et al., 1991). Past research in this vein measured stress within seconds or minutes after participants viewed nature. However, in the current study participants completing the post-test may not have seen their poster since the morning of the test, or might not have even noticed it that day. Even though the stress measure asked participants to report on their stress levels during the four weeks of the intervention, participants' answers might have been affected largely by their stress level at that moment.

Although the nature condition did not significantly affect quantitative measures of stress and positive affect, many participants in the nature condition, when asked in the post-test to "describe any thoughts, emotions, and/or reactions you had in response to

seeing this poster these past four weeks,” wrote that the poster calmed them and made them feel happy and positive. Research from Ulrich et al., (1991), and McMahan and Estes, (2015) are consistent with these descriptive writings. An alternative explanation for the apparent disconnect between these qualitative statements and questionnaire scores may suggest that, even if participants became calm immediately after viewing the nature poster, this benefit was short-lived. Thus, the results of the current study suggest that the previously found positive relationship between nature imagery, stress, and positive affect may not be maintained over the long-term. Future studies should investigate the length of time that various positive impacts derived from nature imagery last, and if these benefits might diminish, or perhaps grow, over time.

This research is, in some ways, more externally valid than past research on viewing nature imagery, which has been typically carried out in lab settings and for short periods of time. This study illustrates that seeing nature imagery in everyday life is beneficial in helping people become more satisfied with their lives. This has profound implications: simply adding nature imagery to one’s home positively enhances one’s well-being. Adding nature imagery in other settings such as schools, hospitals, and offices would likely also be beneficial. The study took place in a small town where there is abundant access to nature. Future research should examine whether the psychological benefits of a nature intervention could be stronger in areas devoid of nature, such as in cities. Future follow up studies could examine the number of days it takes to become more satisfied and experience fewer negative emotions after placing nature imagery indoors. These future studies, along with the current study, can be used to help

individuals, groups, and organizations make informed decisions on how to design indoor spaces which maximize people's satisfaction with life.

Future research should also investigate whether an indoor nature intervention would effectively help those with mood disorders or other mental health problems. Beute and de Kort's (2017) findings suggest that this could occur; they found that those with higher depressive symptoms benefitted more than those without these symptoms from looking at nearby real nature, such as indoor and outdoor plants and trees. The nature intervention used in the current study may similarly improve the well-being of those who are less satisfied with their lives and frequently experience negative affect to a greater extent than those in a clinically healthy sample. Adding nature imagery to one's personal space is a very easy step that could supplement other clinical treatments or therapy that these people might be undergoing and should be seriously considered.

Nature Exposure and Eco-Conscious Behaviors. Bivariate tests indicated a marginal effect of the nature condition leading to increased eco-conscious behaviors, but they were diminished to non-significance when factors, including the existing amount of nature imagery in participants' rooms, were taken into account. The pre-existing nature imagery likely negated the effect of the intervention, presumably because the two were confounded variables. Those who already had nature images in their room likely noticed their nature imagery everyday, and were more likely to sign more environmental petitions than those without any nature imagery in their room. Due to the confounding variable that those in the nature condition were significantly more likely to have pre-existing nature imagery in their room, it was unclear whether people in the nature condition signed more petitions because of the intervention or because of their pre-existing nature.

Once accounting for the greater pre-existing nature imagery in the nature condition, the effects of the nature intervention were no longer sufficient to affect eco-conscious behaviors.

Adding a nature poster to a space already containing nature imagery is a less powerful manipulation than adding nature to a space previously devoid of nature imagery. Future research should test whether implementing nature imagery in areas lacking nature may increase pro-environmental behavior.

In addition to the confounding nature imagery, the location of where the nature posters were displayed might have been a weakness. Most students spend time in their room working, socializing, and sleeping. When looking at the nature image on their wall, they likely were not also trying to make environmental-related decisions. Perhaps the nature intervention did not work because the nature posters were not placed in a location that would prompt reflection about environmental behaviors. If nature imagery were displayed in places where people needed to make a decision of whether to perform an eco-conscious behavior, then perhaps people might have been more likely to engage in pro-environmental behaviors. For example, nature images could be displayed next to light switches or alongside trash and recycling bins. Perhaps this immediate exposure of nature could lead people to think about how their environmental actions impact the natural world and subsequently increase pro-environmental behaviors of turning off the lights and recycling. Additionally, if the study instructions required participants to display images of nature or built scenes in their car instead of their room, perhaps people would have thought more about how their behaviors like driving impact the environment, and subsequently engaged in increased eco-conscious behaviors.

Personalization and Eco-Conscious Behaviors. Unexpectedly, those who were given an unfamiliar image engaged in marginally more eco-conscious behaviors. However, this is not a significant finding, so replication is crucial to understanding personal relevancy's impact on eco-conscious behaviors. It was not hypothesized that the personalization manipulation on its own would affect pro-environmental behavior, and it is particularly surprising that those in the unfamiliar condition possibly signed more environmental petitions than those in the familiar condition. Other research suggests that one could expect the opposite to occur. For instance, Gino and Desai (2012) found that reminding participants of childhood memories promoted pro-social behavior. Since many participants in the current study submitted photos from places where they grew up, many of these personally relevant images could have evoked childhood memories, causing participants to be more helpful and sign more petitions.

However, it could be argued that when a person looks at a familiar picture and is reminded of memories, they may not pay as much attention to the physical components of the scene compared to those who have never seen the image before. Instead of focusing on nature or buildings, people might have only relived the memories they had associated with the scene. Participants given unfamiliar scenes would spend longer looking at and imagining what the scene is illustrating and where it might be. Their reactions to the photo would be mainly due to looking at the physical elements illustrated in the image.

Perhaps focusing on the physical elements of different places makes people want to protect these locations, regardless of whether nature is present. Many of the environmental petitions will also benefit and improve built areas, which would explain

why unfamiliar scenes in general, regardless of whether nature is present, might lead to increased environmental action. For example, climate change may threaten coastal cities and towns more than inland nature preserves, since coastal cities are more at risk from sea-level rise. It is possible that viewing unfamiliar coastal scenes would make viewers more aware of biophysical threats, such as impending sea-level rise in coastal areas, while seeing familiar coastal areas would only evoke positive memories associated with that place. Future researchers comparing imagery of built and natural scenes may wish to match imagery to include coastal scenes in each condition, for both are similarly vulnerable to climate change driven risks. If people become attached to these unfamiliar photos, they might sign petitions that will help protect places shown in the photos.

Personalization and Well-Being. Personally relevant stimuli were expected to reduce stress and improve well-being; however, the personal relevancy manipulation did not impact participants' well-being, unlike previous studies on personalization and place attachment. Although some participants in the personal condition commented that looking at their poster reminded them of positive memories, even if these positive thoughts were indeed inspired, they were likely short-lived and insufficient to impact well-being.

Another reason why relevant images failed to increase well-being is that viewing an image of a place to which one is attached might elicit nostalgia, which can be bittersweet and also cause one to feel homesick if the image was taken in one's hometown (Batcho, 2013). If participants longed to be at the place displayed in the poster rather than in their dorm room, perhaps some of them became less satisfied with their present reality and life. Since Batcho (2013) found that reliving memories and

experiencing nostalgia could be maladaptive as well as beneficial, depending on a variety of both social-cultural and personal factors, having a daily reminder of place-attachment to an inaccessible place might elicit both positive and negative emotions and thoughts, thus explaining why it does not impact well-being.

Unmoderated Pre-Post Effects. Unexpectedly, over the first weeks of the second semester leading to spring break in Maine between early February and March, participants become significantly more connected to nature. It was hypothesized that this would only happen to those in the nature condition.

Perhaps participants spent more time outdoors as the semester progressed, which then increased their connection to nature, although the weather was consistently cold with snow on the ground during the four weeks of the study. This study took place at a college whose outing club consistently ranked by students as one of the most popular clubs on campus. With the long-term presence of snow during this time, more students may have participated in snow-related activities with the outing club, or in other ways, thereby increasing their connection to nature.

An alternative explanation is that connection to nature could have increased as students were planning and awaiting spring break, which occurred right after the post-test. Most students leave campus over break; many travel home or vacation to places with warmer weather where they could spend more time outdoors. The anticipation of planning to travel to a place where one can soon get outdoors could have caused people to report greater connection to nature in the post-test compared to the pre-test.

Correlational Effects

In support of previous research, participants who were more connected to nature had higher well-being, specifically a higher satisfaction with life (Capaldi, et al., 2014; Mayer & Frantz, 2004). Curiously, before the intervention, connection to nature was positively correlated with positive emotion; however, after the intervention this was no longer significant. Perhaps earlier in the semester, those who were more connected to nature were happier about the snowy weather, and those who felt happy viewing the snow would feel more connected to nature. Yet right before the spring break at the time of the post-test, snow was still on the ground. Perhaps, those who were more connected to nature would not feel as happy looking at the lingering March snow as they had been in response to the fresh winter snow, dampening the link between connection to nature and positive emotions in the post-test.

Those who were more connected to nature were significantly more likely to take pro-environmental action. This is unsurprising, in light of previous findings that greater connectivity to nature increases engagement in pro-environmental behavior (Mackay, 2018; Mayer & Frantz, 2004). Participants who see themselves as a part of nature will more likely want to take action to protect the natural world. This current study expands past findings to show that connection to nature enhances engagement in a novel environmental task: specifically in signing real environmental petitions

Before and after the intervention, those who already had nature imagery in their room were more satisfied with their lives and connected to nature. The direction of these correlational findings is ambiguous. Pre-existing nature imagery decorations may have increased participants' life satisfaction. Additionally, people who were more satisfied

with their lives might be more likely to display nature in their room. Alternatively, a third variable might be impacting both of these variables. When considering that the results of the study intervention suggested that displaying nature imagery improves one's satisfaction with life, it is likely that this pre-existing indoor nature exposure increased participants' life satisfaction.

Having indoor nature in their dorm rooms may have increased participants' connection to nature, and those who felt a part of nature may have been more likely to display nature, or additional nature images in their rooms. Additionally, people who previously had nature images in their dorm room signed more environmental petitions than those who previously did not have nature imagery in their dorm room. While one's level of connectedness to nature can change, it is also a trait. The correlational relationships between pre-existing nature imagery, connection to nature, and eco-conscious behaviors are bidirectional and dynamic. As one experiences an increase in one of these listed areas, then the others are likely to also increase.

Limitations

The process through which participants were assigned to one of the four conditions proved to be a major limitation of the study. Even though participants sent in two photographs of natural and built scenes, sometimes their photos disqualified them from receiving a personally relevant photograph, due to the inclusion of elements such as animals, universally familiar locations, or built objects in purportedly natural photos. Additionally, participants who submitted their photos late were often assigned to the unfamiliar condition because time constraints did not allow enough time to print their photos. Even after reminders, many participants sent their photos the evening before they

came to the lab. These problems caused participants to be assigned to groups nonrandomly. In particular, results from the pre-test indicated that those in those who were highly stressed were more likely to be assigned an unfamiliar image. As such, there was less room for well-being to improve in the personally relevant group. Directions should have been clearer so that participants would have strictly adhered to the recommended guidelines.

In addition to these problems with the personal condition, participants' amount of pre-existing nature was a confounding variable in the nature condition. This unanticipated problem can be explained perhaps by the fact that those who already had nature imagery were more connected to nature, went outdoors more, and thus were more likely to have good quality photographs of nature without people or manmade objects. People who had no nature imagery in their living space were more likely to take a photo of nature on the college campus or submit a scene with nature and manmade objects, disqualifying them from receiving a personally relevant nature photo.

The eco-conscious behaviors measure was a newly created measure for this study and could be improved in the future. Participants were asked to report if they signed the petitions, but since this is a self-report measure it is unknown whether participants told the truth and actually signed the ones they said they signed. The eco-conscious behaviors measure was not given in the pre-test, since a person cannot sign a petition twice. Thus, since a baseline could not be established for this measure, it is unclear how much eco-conscious behaviors would have changed over time in the various conditions. Despite this limitation of the measure, the study's novel measure is a creative method to measure actual pro-environmental behavior. Since self-report measures of environmental behavior

are not as valid as behavioral measures, using the newly devised eco-conscious behavior measure of showing participants current petitions from real organizations could be a new method researchers could use to study eco-conscious behaviors in the future.

Conclusion

Aside from these limitations, the present work had many strengths. It examined the effects of a nature imagery intervention that is seen daily in one's room over time; it is the first known study to test how personal relevancy of nature images might alter the images' impact on participants; and it used a novel eco-conscious behavior measure with real pro-environmental actions.

The finding that such a simple exposure to indoor nature could cause real improvements in individual's life satisfaction is important and has wide-ranging implications. According to the Blue Cross Blue Shield Health Index, which measures the health of 41 million Americans who are insured by BCBS (2018), mental health problems are rising in the US. For instance, depression rates have risen by 33% since 2013. Millennials, or those 18-34 years old, experienced the greatest increases in depression rates over this time compared to other age groups. Exposure to something as simple as a nature photo might help combat these issues if it allows people to gain a sense of purpose in their lives. While it is very unlikely that only viewing images of nature could be used as treatment for those with depression, some therapists engage in ecotherapy, which uses nature and green space to improve psychological functioning (Burls, 2007). If nature imagery were to be installed within therapists' offices, and in the homes of those suffering from mental health problems, it could enhance clients' satisfaction with life. Adding a nature poster to one's room is an easy, inexpensive way to incorporate nature

into a built environment, and the benefits would likely surpass the minimal costs of acquiring and hanging the nature image. Overall, individuals, families, and institutions have the power to reimagine and redesign their indoor spaces to incorporate nature imagery to boost the well-being of viewers.

Although the current study's manipulation did not substantially increase participants' connection to nature, it did confirm prior research findings that connection to nature is predictive of both elevated well-being and increased eco-conscious behaviors. It is vital that environmental psychologists continue researching the topic of nature connectivity, for increasing this improves people's wellbeing, as well as the wellbeing and future of our planet. Improving individuals' environmental behaviors is necessary to combat anthropomorphic climate change, and improving individuals' well-being can help individuals, as well as society as a whole, flourish.

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Table 1

Descriptive Statistics for dependent variables across pre and post-tests

| | Pre-Test | | Post-Test | | t | r |
|------|----------|------|-----------|------|--------|-------|
| | M | SD | M | SD | | |
| PosE | 22.98 | 3.30 | 22.81 | 3.18 | .82 | .73** |
| NegE | 14.37 | 3.40 | 14.33 | 3.13 | .17 | .61** |
| SWL | 26.24 | 5.44 | 27.15 | 4.89 | 2.97** | .78** |
| PSS | 15.37 | 5.49 | 16.18 | 5.68 | 2.45* | .78** |
| CNS | 49.77 | 8.64 | 51.02 | 9.16 | 2.79** | .84** |
| ECB | | | 1.52 | 1.02 | | |

Note: † = $p < .10$, * = $p < .05$, ** = $p < .01$

PosE = positive emotions, NegE = negative emotions, SWL = satisfaction with life,

PSS=perceived stress scale CNS= connection to nature, ECB = eco-conscious behaviors

Table 2

Correlation Baseline Matrix

| | PosE | NegE | SWL | PSS | CNS |
|------|--------|--------|--------|--------|-------|
| PosE | | -.45** | .55** | -.47** | .20* |
| NegE | -.53** | | -.45** | .62** | -.00 |
| SWL | .44** | -.48** | | -.51** | .26** |
| PSS | -.53** | .66** | -.54** | | -.08 |
| CNS | .14 | .03 | .27** | -.01 | |
| ECB | .01 | .08 | .16† | .09 | .33** |

Note: † = $p < .10$, * = $p < .05$, ** = $p < .01$

PosE = positive emotions, NegE = negative emotions, SWL = satisfaction with life, PSS=perceived stress scale, CNS= connection to nature, ECB = eco-conscious behaviors
 Correlations above the diagonal are for pre-test correlation, and post-test correlations are under the diagonal. ECB only was tested in the post-test.

Table 3

Repeated Measures ANOVAs

| | PosE | NegE | PSS | SWL | CNS |
|-----------------------|------|-------|-------|-------|---------|
| Pre-post | .74 | .00 | 3.29† | 5.20* | 14.78** |
| Personal | 2.08 | 3.55† | 3.10† | 3.78† | .63 |
| Nature | .55 | .32 | .04 | .12 | .76 |
| Pre-post x Personal | 1.17 | .52 | 1.28 | .61 | .10 |
| Pre-post x Nature | .33 | 3.14† | 2.59 | 3.97* | 1.80 |
| Nature x Personal | 2.46 | .91 | 1.28 | .21 | .22 |
| Pre-post x Nat x Pers | .14 | .73 | 1.01 | .01 | .20 |

Note: † = $p < .10$, * = $p < .05$, ** = $p < .01$

PosE = positive emotions, NegE = negative emotions, SWL = satisfaction with life, PSS=perceived stress scale, CNS= connection to nature.

Pre-existing nature was listed as a covariate for SWL analyses. Gender was listed as a covariate for PSS analysis. Pre-existing and gender were both listed as covariates for CNS analyses.

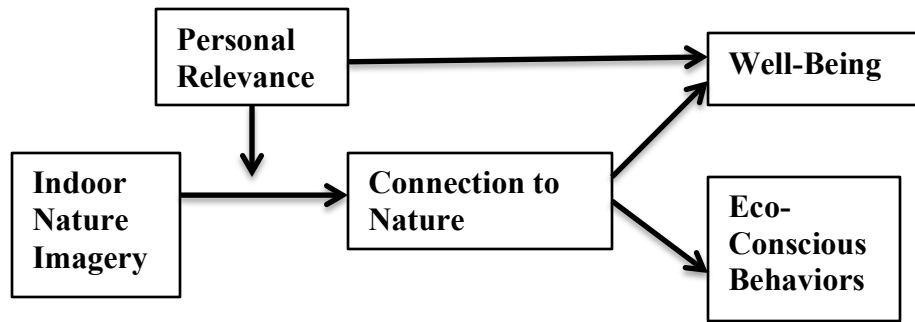


Figure 1. Conceptual model of current study.

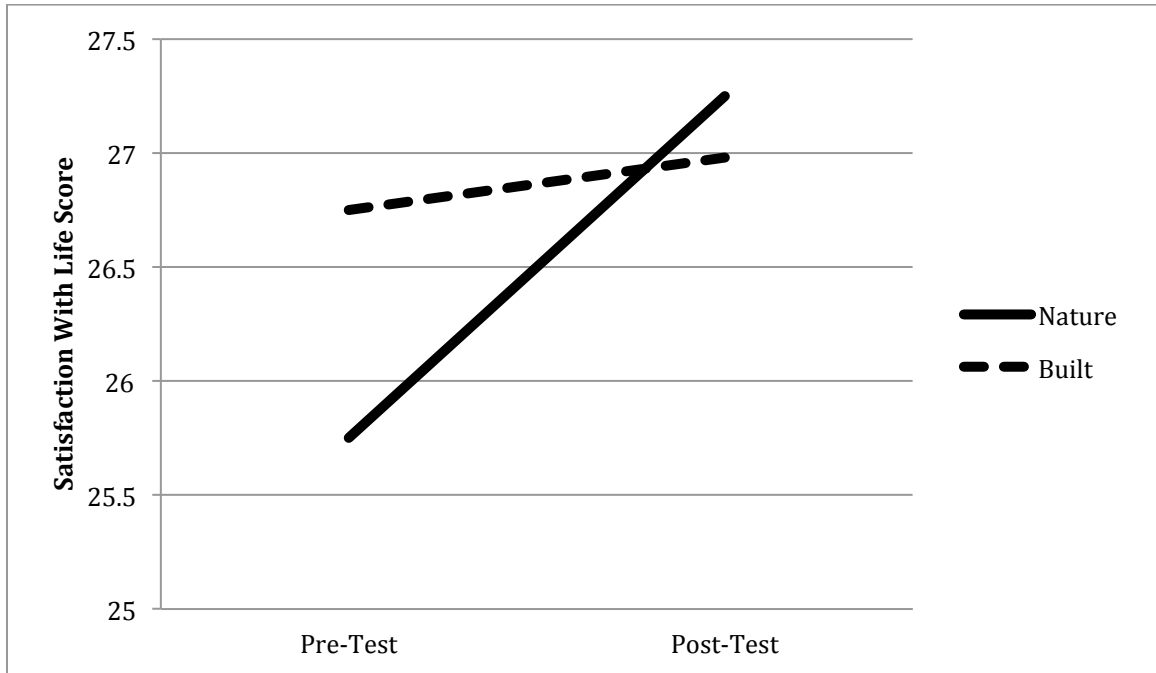


Figure 2. Marginal means of satisfaction with life in the nature and built condition at the pre-test and post-test.

Appendix A

Eco-Conscious Behavior Measure

Being both a psychology and environmental studies major, I wanted to invite you to take a look at some environmental-related actions below.

You do not have to read and sign these if you do not want to, I just wanted to spread the word about these. Please answer these honestly.

1. Please read this petition on "Make wildlife refuges safe for bees once again"

https://environmentamerica.webaction.org/p/dia/action4/common/public/index.sjs?action__KEY=29914

Then indicate if you signed it or not.

2. Please read this petition on "Act Now for Imperiled Reefs"

<https://support.nature.org/site/Advocacy?cmd=display&page=UserAction&id=244>

Then indicate if you signed it or not.

3. Please read this petition on "Tell the EPA to uphold strong protections against methane leaks"

https://environmentamerica.webaction.org/p/dia/action4/common/public/index.sjs?action__KEY=29820

Then indicate if you signed it or not.

4. Please read this petition on "Defend Funding for Public Lands"

<https://support.nature.org/site/Advocacy?cmd=display&page=UserAction&id=254>

Then indicate if you signed it or not.

5. Please read this petition on "Help Stop the Trump Assault on Marine Monuments"

<https://act.nrdc.org/letter/marine-monuments->

171025?source=WBSNOAPET&_ga=2.243341189.1811412492.1550613181-

177769763.1482544284

Then indicate if you signed it or not.

6. Please read this petition on "Oppose Rollbacks on U.S. Climate Action"

<https://support.nature.org/site/Advocacy?cmd=display&page=UserAction&id=158>

Then indicate if you signed it or not.

7. Please read this petition on "Tell your governor: Make your state monarch (butterfly) friendly"

https://environmentamerica.webaction.org/p/dia/action4/common/public/index.sjs?action__KEY=30795

Then indicate if you signed it or not.

8. Please read this petition on "Tell the EPA: Don't weaken protections from mercury pollution"

https://environmentamerica.webaction.org/p/dia/action4/common/public/index.sjs?action__KEY=30554

Then indicate if you signed it or not.

9. Please read this petition on "Stop Trump from Gutting the Endangered Species Act"

<https://act.nrdc.org/letter/endangered-species->

180806?source=WBSSESAPET&_ga=2.197286575.1811412492.1550613181-

177769763.1482544284

Then indicate if you signed it or not.

10. Please read this petition on "Tell Congress: Protect Conservation Funding"

<https://support.nature.org/site/Advocacy?cmd=display&page=UserAction&id=154>

Then indicate if you signed it or not.

11. Please read this petition on “Call on Your Governor to Lead the Way on Cleaner Transportation”

[https://act.nrdc.org/letter/transportation-mid-atlantic-](https://act.nrdc.org/letter/transportation-mid-atlantic-181207?source=WBSTCIPET&_ga=2.236732033.1811412492.1550613181-177769763.1482544284)

[181207?source=WBSTCIPET&_ga=2.236732033.1811412492.1550613181-](https://act.nrdc.org/letter/transportation-mid-atlantic-181207?source=WBSTCIPET&_ga=2.236732033.1811412492.1550613181-177769763.1482544284)

[177769763.1482544284](https://act.nrdc.org/letter/transportation-mid-atlantic-181207?source=WBSTCIPET&_ga=2.236732033.1811412492.1550613181-177769763.1482544284)

Then indicate if you signed it or not.

12. Please read this petition on "Tell the EPA: No Dirty Water Rule"

<https://environmentamerica.webaction.org/p/dia/action4/common/public/index.sjs?action>

[_KEY=3072](https://environmentamerica.webaction.org/p/dia/action4/common/public/index.sjs?action)

Then indicate if you signed it or not.