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Biophilic Architecture, Connectedness to Nature, and the Importance of Environmental Issues

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Abstract

In today's world where climate change consequences are apparent, we need to be searching for ways to encourage more pro-environmental behaviors. Connectedness to nature, which is the sense of kinship and sense of community with the natural world, is one factor that has been shown to promote pro-environmental behavior. While architecture types have been tested with states of well-being, they have never been assessed to examine the effects on one's connectedness to nature. This study used Mudd and the AJLC at Oberlin College to determine whether biophilic types of architecture versus architecture without any natural aspects can heighten or lower ones sense of feeling connected to nature. Our findings suggest that the AJLC can heighten the participants' connectedness to nature, while Mudd can lower the participants' connectedness to nature scores. We also found that a person's state connectedness to nature partially mediates the relationship between building and ranking of environmental issues. Lastly, we found that there isn't any difference between actively and passively engaging with the architecture. This indicates that architecture with natural aspects can raise people's kinship with the natural world, which can promote more pro-environmental behaviors and concern for environmental issues.

Biophilic Architecture, Connectedness to Nature, and the Importance of Environmental Issues

In today's age, we are facing dire consequences from climate change. Anthropogenic actions have been linked with these consequences, harming environments, flora and fauna worldwide. Many approaches have been taken to try to address these environmental threats. In psychology, one approach has focused on Leopold's land ethic, where he argued that people will be more likely to help the environment when they feel in community with the natural world (Leopold, 1949). Operationalized as the Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004), a number of studies have now shown that individuals scoring higher on the CNS do in fact engage in greater proenvironmental behavior (Mayer & Frantz, 2004; Frantz & Mayer, 2013; Dutcher, Finley, Luloff, & Johnson, 2007; Perkins, 2010; Hedlund de Witt, Boer, & Boersema, 2014). Given the importance of this variable in promoting proenvironmental behavior, investigating factors that either increase or decrease individuals' feelings of being connected to nature is an important question. The present study investigates how architecture is related to this question.

Leopold's work consisted of being within nature, and how this grows our kinship with nature (Mayer et al. 2004). He believed that, "when we see the land as a community to which we belong, we may begin to use it with love and respect." This land ethic entails that feeling a sense of belonging to the natural world may be necessary for increasing environmental protection (Mayer et al. 2004). Leopold argued that in order for people to feel responsible for nature and to engage in eco-friendly acts, they need to feel connected to nature, since they are both members of the natural world (Mayer et al. 2004). Being around nature more would also heighten one's concern for the environment too, since they are spending more time interacting with the environment (Craik, 1973). This ideology can help us shift our worldview, and demonstrates that

being in an environment where there is nature around can help us feel connected to nature, as well as concerned for nature (Leventhal, Watts, Pagano, 1967). In order to feel connected to nature, we have to expand our sense of self in order to foster more sustainable behavior (Mayer et al. 2004).

The Connectedness to Nature Scale (CNS), created by Mayer and Frantz in 2004, acts as an operationalization of Leopold's land ethic. Items on the CNS, such as "I think of the natural world as a community to which I belong," "I often feel kinship with animals and plants," and "I feel as though I belong to the Earth as equally as it belongs to me," highlight the sense of oneness that we can feel with the natural world, as well as Leopold's egalitarian view of our relationship with nature. This scale also has a Cronbach's alpha of .84, which means there is high internal consistency between sample items (Mayer & Frantz, 2004).

Research has in fact shown that heightened CNS increases pro-environmental behavior (Mayer & Frantz, 2004; Frantz & Mayer, 2013) as well improving individuals' sense of well-being (Mayer & Frantz, 2004; Mayer, Frantz, Breuhlman-Senecal, & Dolliver, 2009). This research supports Leopold's assertion that a sense of ''we-ness'' makes protective behavior more likely, encouraging more proenvironmental behavior (Mayer & Frantz, 2004; Frantz & Mayer, 2013). For example, the extent to which one includes another person as part of the self is a core operationalization of relationship closeness (Aron, Aron, Tudor, & Nelson, 1991). As relationship closeness increases, so does empathy and willingness to help (Cialdini, Brown, Lewis, Luce, & Neuberg, 1997). Similarly, acts that lead to a greater self–other overlap, such as perspective taking, (Davis, Conklin, Smith, & Luce, 1996) also increase willingness to help (Coke, Batson, & McDavis, 1978). This work shows that the same operationalizations of relationship closeness and empathy also apply to nature: if we feel more connected to nature,

then we are more likely to engage in environmentally responsible behaviors. One study by Tam, Lee, and Chao (2013) found that the CNS mediated the relationship between anthropomorphism of nature and several self-reported indicators of environmentally responsible behaviors, such as: the intention to use and promote green products, support for the use of environmental impact as a factor in policy decisions, and support for the environmental movement. Given the relationship between the CNS and pro-environmental behavior, investigating factors that increase or decrease CNS scores is important. Given the current environmental crisis, substantial changes in human behavior will be needed in order to transition into a sustainable society (Leventhal, Watts, Pagano, 1967).

There is a growing body of research on what can increase and decrease connectedness to nature. The primary emphasis of this research demonstrates how being outside in a natural setting increases CNS scores. This work shows that even spending a relatively brief time in nature will increase individual's' connectedness to nature scores (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). Other research also shows that the more time a person spends outside in nature, the greater likelihood that person will feel a sense of being connectedness to and in community with the natural world (Klassen, 2010; Martin, 2004; West, 2010). Scarborough (2013) found that people with a stronger focus on outdoor recreation programs involving certain outdoor skills could foster individuals' connections to nature. Among other outdoor activities, Brymer, Downey, and Gray (2009) found that many people who participate in extreme outdoor sports gain feelings of connectedness to nature through their sport (e.g. Building, Aerial, Span, and Earth jumping; extreme skiing; waterfall kayaking; big wave surfing; high-level mountaineering; or climbing without ropes) and sometimes even consider themselves to be part of nature during their sport experiences (Scarborough, 2013). This research suggests

different outdoor activities can foster connectedness to nature, including more dangerous outdoor activities. These studies indicate that being in a natural setting can help increase one's connectedness to nature.

Other factors that have been shown to increase CNS scores include watching a brief video of nature (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). There have also been studies that show pictures of nature, as well as time spent in a greenhouse can raise one's CNS (Frantz, 2016). Lastly, Oberlin's Environmental Dashboard, designed to make the invisible flows of water and electricity through communities visible and engaging, found that it can raise CNS scores of people that normally score low (Frantz, 2016).

There is also limited research as to what can decrease one's connectedness to nature. One study found that people situations that increase individuals' experience objective self-awareness tend to decrease individuals' experience of feeling connected to nature (Frantz, Mayer, Norton, & Rock, 2005). Some spaces such as urban environments tend to be full of demanding, stressful, under stimulating or boring features (Gillis & Gatersleben, 2015). Building occupants' need for human interaction with nature is so strong that office workers have been found to compensate for a lack of nature exposure by adding images of nature to the office environment (Gillis & Gatersleben, 2015). This implies that architecture with no windows, or opportunity to observe and be surrounded by nature can significantly decrease one's connectedness to nature. In this study, we will observe whether certain architecture can reduce one's connectedness to nature, in addition to investigating whether biophilic architecture can enhance one's emotional connection with the natural world.

Since we spend 90% of our time indoors (Evan & McCoy, 1998), architecture is a physical aspect of society that has the potential to greatly impact one's experience of feeling connected to nature. How a building is designed has the power to subconsciously relieve stress, and enhance well-being (Evan & McCoy, 1998). The physical environments in which we all interact provide the locus and definition of the human activities that characterize our day-to-day lives (Proshansky, 1977). One study found that people are significantly more likely to correctly choose the proper disposal bin (garbage, compost, recycling) in a building designed with sustainability in mind compared to a building that was not (Almusaed, 2010). While we know a lot about how ambient environmental conditions affect human health conditions, such as well-being, we still don't know about how our surrounding architectural environment can make us feel more emotionally connected to nature (Wu DW–L, DiGiacomo A, Kingstone A, 2013; Mayer & Frantz, 2004).

Biophilic design is a design philosophy that encourages the use of natural systems and processes in the design of the built environment (Gillis & Gatersleben, 2015). Bringing nature to architecture, or biophilic architecture, can play a vital role in creating a healthy indoor environment (Almusaed, 2010). The building environment has active environmental principles, which can influence a person to build their conscience around the environment (Smith, Beeck, Lommerse & Metcalfe, 2012). According to Kaplan and Kaplan (1989) and Ulrich and colleagues (1991), natural environments in particular contain elements that promote renewed directed attention by providing a sense of being away, fascination, extent and compatibility; and therefore positive appraisal (Gillis & Gatersleben, 2015). The idea behind biophilic design is to incorporate natural features and systems into the built environment in order to provide human beings with their much-needed exposure to nature (Gillis & Gatersleben, 2015). Studies have

also shown that architectural design could potentially increase our concern and awareness about the environment, even though there is limited literature on the subject (Craik, 1973). However, the idea that biophilic architecture can heighten one's connectedness to nature has never been tested. Socially responsive design, such as biophilic architecture, could heighten one's connectedness to nature, allowing people to encounter the benefits of being more integrated in the natural world (Almusaed, 2010). This study will test the effects of architecture on connectedness to nature to assess whether biophilic design has this impact, or if other types of architecture can decrease this impact.

This study will examine whether individuals in a building characterized as being high in biophilic design experience higher levels of connectedness to nature than individuals in a building characterized as being low in biophilic design. Given a pre-post design, we can also investigate whether non-biophilic design can decrease CNS scores. Additionally, we will be using an active/passive manipulation to test whether people need to engage with the architecture to feel more connected, or if passively being in the space can enhance their CNS. Participants in the passive study will read or do work for class, which is what students normally would do in such a building. Participants in the active condition have to look around the building for three minutes, and then draw their surroundings for seven minutes. This can help tell us whether people in the building need to actively engage with the building in order to connect to nature, or if passively being in the building can affect their connectedness to nature. Furthermore, this study investigates a form of caring for the environment. Specifically, the study investigates whether biophilic design cannot only impact CNS scores, but individual's ranking of environmental issues as being more important. Lastly, the study will measure participant's mood in these different architectural settings.

Methods

Participants

Data was collected from 48 Introductory Psychology students, 9 males and 38 females. Participants were awarded an SA credit (partial credit for Psychology 100) for participation in the study.

Materials

Connectedness to Nature Scale. The Connectedness to Nature Scale (CNS) is a measure designed to tap an individual's sense of feeling in community with nature (Mayer & Frantz, 2004). Participants responded to a 5-point scale, indicating how strongly they agreed with the statements like "I think of the natural world as a community to which I belong," and " I feel as though I belong to the Earth as equally as it belongs to me." This scale has been demonstrated by Mayer and Frantz to have a reliability of alpha = .83. This scale has both a trait and state version.

Political, Environmental, and Social Issue Ranking Task. This scale consists of a collection of eight items in which we asked participants to rate issues from least important to most important. These issues included political, environmental, and social issues both domestically and globally. This scale was placed after the CNS in our study. The environmental issues were placed randomly within political and social issues, so we were able to see whether participants ranked the environmental issues differently, depending on their condition. A "1" indicated it was the most important issue, and an "8" indicated it was the list important issue on the list.

State-Trait Anxiety Inventory (STAI). Developed by Spielberger, Gorsuch, Lushene, Vagg, & Jacobs (1983), the STAI is a commonly used 40-item scale designed to measure state

anxiety and trait anxiety. For the purpose of this study, a shortened version of the STAI was used in place of the original 40-item version. This shortened version consisted of 10 positive mood items, such as "I feel pleasant," and 10 negative mood items, such as "I lack self-confidence". After reading the instructions, participants responded to all 20 items on a 4-point Likert-type response scale (1 = "almost never", 4 = "almost always"). We will refer to this scale as the "mood scale," referring to either "positive mood" or "negative mood."

Psychology 100 prescreen. This is a general background screening questionnaire that all Psychology 100 students took during class in the beginning of the year. The CNS trait, the Political, Environmental, and Social Issue Ranking Task, and the State-Trait Anxiety Inventory were included in the prescreen measure. The prescreen was used to determine the participant's baseline of where they ranked environmental issues in the context of social and political issues, as well as what their overall feeling of connectedness to nature was.

Procedure

The study started with three participants meeting in the lobby of Dascomb. They were then randomly assigned to either the high biophilic architectural design condition or the low biophilic architectural design condition. The participants were walked to their conditions by an experimenter. Specifically, they were either led to the atrium of the Adam Joseph Lewis Center (AJLC) or to a study room in Mudd Library. The AJLC was designed to incorporate nature into the interior of the building, while the study room in Mudd was closed off from the outdoor world.

After arriving, the participants sat down in designated seating areas and were asked to fill out a consent form. To ensure that the participant's scores were not affected by their knowledge of the purpose of the study, they were told that this study focused on creativity and

contemplation. They were then randomly assigned to either the "active" condition or the "passive" condition. For participants in the "active" group, they were instructed to observe their surroundings for three minutes, followed by seven minutes of drawing. They were assured that the quality of drawing would not be evaluated and that their materials would be thrown away soon after the study. For participants in the "passive" group, they were instructed to study on either their computer or with a reading for ten minutes. All participants were told that their personal information would not be attached to any of the materials.

After the ten minutes, participants were instructed to take a survey which included the Connectedness to Nature state measure, a Ranking task of Political, Social and Environmental issues, and the State-Trait Anxiety Inventory. Once the study was completed, they were debriefed about the true purpose of the study.

Results

Preliminary Analysis

Scale Reliability. For the CNS state, Cronbach's alpha = .762. For the CNS trait, Cronbach's alpha = .769. The test-retest reliability of these two scales (i.e., correlating CNS trait with CNS state) was r = .267. For average State-Trait Anxiety Inventory, Cronbach's alpha = .922. This is an even more reliable scale of general feelings within the moment. Both these scales are highly reliable. This means that all the items within the scale are consistent with one another, and there is high inter-correlation between the questions. For the issue ranking scale, Cronbach's alpha = .551, making it substantially less reliable than the other measures. However, since there are only 3 environmental issues on the ranking task, it makes sense that the inter-item reliability is lower since there are less items than most scales. We also found that Cronbach's alpha would rise a bit if we took out ranking of biodiversity. Since there were only 3 questions and the

reliability and it wasn't rising as much as we would hope when the biodiversity question was eliminated, we left all the questions in the survey.

Extraneous variables. We examined whether there were any main effects for experimenter, weather, race, gender, political orientation, year at Oberlin, and sexual orientation on CNS scores and the environmental issue ranking measure. We found that there was no experimenter effect on any of the scales (CNS = $p > .8$; IR = $p > .4$), meaning participants were not affected by which experimenter was running the study. There was also no main effect for gender, weather, political orientation, and year at Oberlin. For sexual orientation, the issue ranking scale was not affected ($p > .7$); however, it was significant for the CNS state ($p = .035$), with the Unsure/fluid group (M = 3.64, SD = .47) and the Heterosexual group scoring significantly higher (M = 3.63, SD = .47) than the homosexual group (M = 2.86, SD = .47), and the bisexual group non-significantly differing from all three groups (M = 3.34, SD = .47). These variables were not used in any further analyses.

Main Analyses

The main hypothesis was that participants in a building characterized as being high in biophilic design, the AJLC, would score higher on the CNS state than participants in a building characterized as being low in biophilic design (i.e., Mudd). Additionally, we investigated whether building would have an impact only when participants were actively involved in noticing their surroundings. In order to test this hypothesis, we conducted a two-way ANOVA using building (AJLC versus Mudd) and active/passive involvement as independent variables with CNS state scores as the dependent variable, and controlling for CNS trait as a covariate. Consistent with our hypothesis, we found that building had a significant effect on CNS ($F = 58.03$, $df = 1, 41$, $p < .001$). Participants in the AJLC scored higher on the CNS (M =

3.78, SD = .41) than participants in Mudd (M = 3.17, SD = .40). There was also no significant difference between the active (M = 3.56, SD = .50) and passive (M = 3.42, SD = .51; $F = .60$, $df = 1, 41$, $p > .4$) conditions, meaning that CNS scores did not significantly vary as a function of whether participants were actively engaging with the architecture or simply reading a book. The building by active/passive interaction was also nonsignificant ($F = .24$, $df = 1, 41$, $p > .6$). The CNS trait, used as a covariate, was found significant ($F = 2.93$, $df = 1, 41$, $p < .001$).

	Active	Passive
Mudd	M = 3.20 SD = .38	M = 3.15 SD = .42
AJLC	M = 3.81 SD = .42	M = 3.75 SD = .41

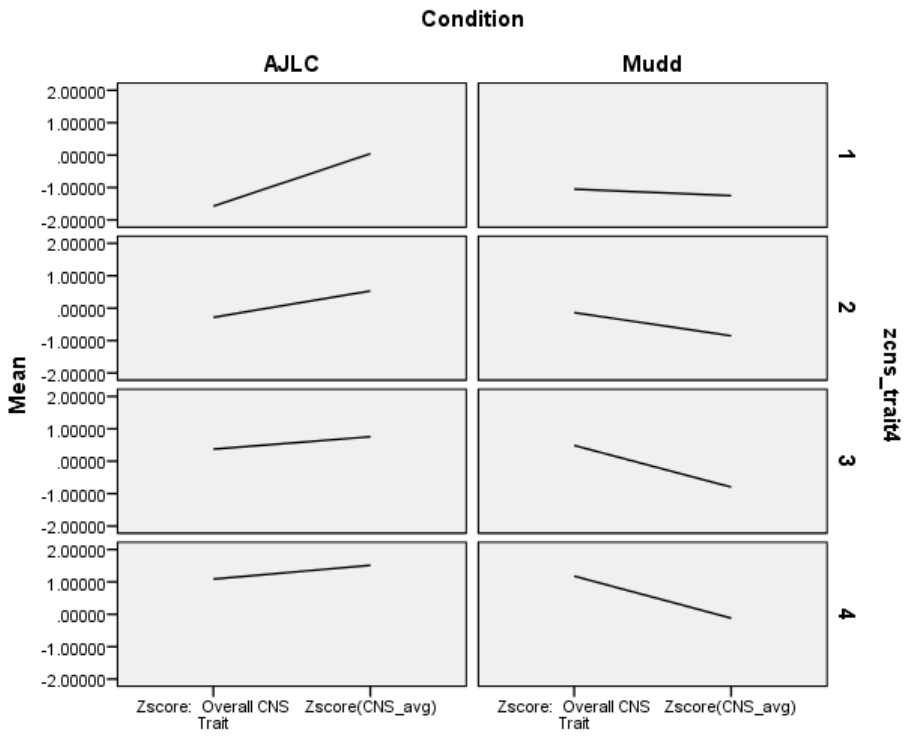
Examining whether the impact of building on CNS scores was due to the AJLC increasing CNS scores or Mudd decreasing CNS scores, a difference score was calculated by subtracting the CNS trait score from the CNS state score recorded in the study. Given that the CNS trait measure was a 7-point scale and the CNS state measure was a 5-point scale, these scores were initially transformed into Z scores. A difference score was then created by subtracting CNS state from CNS trait. A two-way ANOVA was conducted using building (AJLC versus Mudd) and active/passive involvement as independent variables with CNS difference scores as the dependent variable. For building, the CNS difference score was significant ($F = 64.34$, $df = 1, 42$, $p <. 001$), with participants in the AJLC (M difference = .90, SD = .79) showing an increase in CNS scores, and participants in Mudd (M difference = -1.00, SD = .77) showing a reduction in CNS scores. This finding shows us that the effect of the biophilic AJLC building was enhancing CNS scores, and that the less biophilic Mudd building was decreasing these scores. As to whether the increases in the AJLC and the decreases in Mudd were significant, a paired sample t-test was conducted within each building comparing pre-CNS

trait with post-CNS state. These tests indicate that the mean difference within the AJLC of .90 was significant ($t = 2.57$, $p = .017$) and that the mean difference within Mudd of -1.00 was also significant ($t = 16.13$, $p = .000$,). When conducting this analysis, however, we came upon a major problem: before transforming these scores, we found that the students that ended up in Mudd initially had a higher trait CNS than the students that were brought to the AJLC ($F = 5.89$, $df = 1, 44$, $p = .019$). This raises the question of whether these findings were due to the impact of building or a possible regression to the mean effect. As for the active/passive manipulation, there was no significant difference found between the two conditions ($F = .70$, $df = 1, 42$, $p > .41$). The building by active/passive interaction was also nonsignificant ($F = .46$, $df = 1, 42$, $p > .6$).

	Active	Passive
Mudd	M = -.97 SD = .92	M = -1.01 SD = .70
AJLC	M = 1.08 SD = .86	M = .72 SD = .68

We tried to test whether or not the change in scores was due to the building, or whether it was a regression to the mean effect. When the CNS trait and state scores were transformed to Z scores and divided into quarters, it was observed that there was no systematic difference. For there to be a true regression to the mean effect, we would see high CNS scores getting lower, and low CNS scores getting higher. However, inspection from this graph reveals quite the opposite. All the scores from the AJLC are getting higher, and all the scores from Mudd are getting lower.

Figure 1. Z-scores split into quartiles for the AJLC and Mudd



Our second main hypothesis concerned the issue ranking measure. Specifically, we hypothesized that participants in the more biophilic AJLC building would rank environmental issues higher than participants in the less biophilic Mudd building. In order to test this hypothesis, we once again conducted a two-way ANOVA using building and active/passive as the independent variables and now using the issue ranking scale scores as the dependent variable with the prescreen issue ranking scale scores as a covariate. Consistent with our hypothesis, we found that building had a significant effect on issue ranking ($F = 7.09$, $df = 1, 40$, $p = .011$). Participants in the AJLC on average ranked the environmental issues higher (M = 5.15, SD = 1.38), than participants in Mudd (M = 4.07, SD = 1.57). As for the active/passive manipulation, we found that there was no significant difference ($F = .67$, $df = 1, 40$, $p > .4$). The building by active/passive interaction was also nonsignificant ($F = .82$, $df = 1, 40$, $p > .3$). The environmental issue ranking average from the pre-screen, used as a covariate, was found nonsignificant ($F = .06$, $df = 1, 40$, $p > .8$). Lastly, it is important to note that In contrast to pre- and post-CNS scores

where preexisting differences were found between buildings, there were no pre-existing differences on the issue ranking measure ($p > .3$).

	Active	Passive
Mudd	M = 4.18 SD=1.64	M = 4.00 SD = 1.57
AJLC	M = 5.46 SD=1.38	M = 4.81 SD = 1.37

We also investigated whether the environmental issue ranking effect was due to the more biophilic AJLC building increasing environmental concern or whether the less biophilic Mudd building decreased environmental concern among participants. In order to examine this question, a difference score was created by subtracting the pre-screen environmental issue ranking measure from the post environmental issue ranking score. A two-way ANOVA was then conducted using building (AJLC versus Mudd) and active/passive involvement as independent variables with the issue ranking difference scores as the dependent variable. For building, it was found nonsignificant for predicting the difference score between these two ranking scores ($F = 1.54$, $df = 1, 41$, $p > .2$). This could be because of the large standard deviation. For active/passive manipulation, it was also found nonsignificant for predicting the difference score between the pre and post issue ranking scores ($F = 1.26$, $df = 1, 41$, $p > .2$).The building by active/passive interaction was also nonsignificant ($F = .16$, $df = 1, 41$, $p > .7$).

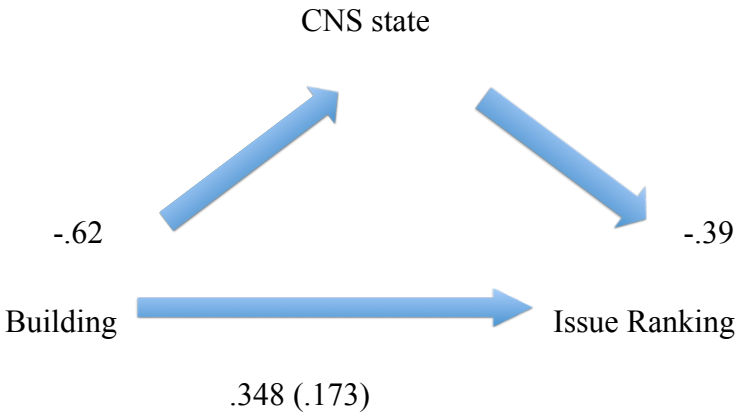
	Active	Passive
Mudd	M = .21 SD = 2.14	M = -.23 SD = 2.41
AJLC	M = 1.19 SD = 2.08	M = .28 SD = 1.09

To examine whether CNS scores mediate the impact of building on issue ranking, four conditions need to be met. First, building needs to predict CNS scores. Second, CNS scores need

to predict issue ranking. Third, building needs to predict issue ranking. Lastly, controlling for CNS scores, the building/issue ranking relationship should be weakened.

Four regression equations were run to test each part of the mediation analysis. The first equation tested whether building predicts CNS state, which it does (β = -.62, $t(48) = 5.30$, $p <$ .001). The second equation tested whether CNS state predicts issue ranking, which it does as well (β = -.39, $t(48) = 2.89$, $p <$. 01). The third equation found that building also predicts issue ranking (β = .348, $t(48) = 2.52$, $p <$. 02). A sobel test was conducted to see whether when controlling for CNS state scores the building/issue ranking relationship was weakened. The sobel test confirmed that the reduction of β from .348 to .173 is significant (z' = 2.54, SE = .29, p = .01)

Figure 2. Mediation analysis for CNS state predicting the relationship between Building and Issue ranking



Lastly, we examined whether participants in the more biophilic AJLC building experienced more positive mood and less negative moods than participants in Mudd. Examining whether the building and active/passive variables had an impact on positive mood, a two-way ANOVA was conducted using building (AJLC versus Mudd) and active/passive involvement as independent variables with positive mood scores as the dependent variable controlling for

prescreen positive mood. For building, it was found nonsignificant, meaning building does not affect positive mood ($F = .03$, $df = 1, 41$, $p > .8$). For active/passive, it was also found nonsignificant ($F = .29$, $df = 1, 41$, $p > .5$). The building by active/passive interaction was also nonsignificant ($F = .01$, $df = 1, 41$, $p > .9$). The positive affect score from the pre-screen, used as a covariate, was found significant ($F = 151.03$, $df = 1, 41$, $p > .001$).

	Active	Passive
Mudd	M = 2.36 SD = .53	M = 2.70 SD = .73
AJLC	M = 2.60 SD = .52	M = 2.45 SD = .50

Examining whether the building and active/passive variables had an impact on negative mood, a two-way ANOVA was conducted using building (AJLC versus Mudd) and active/passive involvement as independent variables with negative mood scores as the dependent variable controlling for prescreen negative mood. For building, it was found nonsignificant ($F = .24$, $df = 1, 41$, $p > .6$), meaning building didn't affect negative moods as well. For active/passive, it was also found nonsignificant ($F = .01$, $df = 1, 41$, $p > .9$). The building by active/passive interaction was also nonsignificant ($F = 2.21$, $df = 1, 41$, $p > .1$). The negative affect score from the pre-screen, used as a covariate, was found significant ($F = 108.29$, $df = 1, 41$, $p > .001$).

	Active	Passive
Mudd	M = 2.38 SD = .56	M = 3.03 SD = .52
AJLC	M = 2.80 SD = .58	M = 2.68 SD = .52

Finally, a difference score was created by subtracting negative from positive mood in the post test. Examining whether the building and active/passive variables had an impact on this difference score, a two-way ANOVA was conducted using building (AJLC versus Mudd) and active/passive involvement as independent variables with positive mood scores as the dependent

variable controlling for prescreen difference scores. For building, it was found nonsignificant ($F = .04$, $df = 1, 41$, $p > .8$). For active/passive, it was also found nonsignificant ($F = 2.49$, $df = 1, 41$, $p > .1$). It was also found nonsignificant for the building by active/passive interaction ($F = 2.73$, $df = 1, 41$, $p > .1$). The positive affect score from the pre-screen, used as a covariate, was found significant ($F = 4.50$, $df = 1, 41$, $p = .04$).

	Active	Passive
Mudd	M = -.03 SD = .38	M = -.33 SD = .41
AJLC	M = -.21 SD = .46	M = -.23 SD = .36

Discussion

Consistent with our hypothesis, the findings of this study showed that biophilic architecture, or lack thereof, can influence one's connectedness to nature. Controlling for prescreen CNS trait scores, participants in the AJLC scored significantly higher on CNS state than did the participants in Mudd. Examining difference scores between the CNS trait and state, it appears that the more biophilic AJLC positively impacted participants CNS state scores, while the less biophilic Mudd building negatively impacted their scores. This is an interesting finding. It is the first time that biophilic architecture has been positively linked with enhanced CNS scores. These findings are also interesting for they point out that non-biophilic design can potentially undermine CNS state scores and, by implication, negatively impact individuals' concern for the environment.

The other main finding of this study is that the more biophilic AJLC building and the less biophilic Mudd building were not only linked with CNS state scores, but with participants concern for environmental issues. Participants in the more biophilic AJLC ranked the

environmental issues as being more important than did the participants in the Mudd. Moreover, the mediation analysis revealed that participants' CNS state scores mediated the relationship between architectural design and environmental concern. It appears that by being in a more biophilic building, participants experienced a heightened sense of feeling connected to nature which then led them to place environmental issues as a higher priority.

The main limitation of this study is that there were preexisting differences between the conditions in terms of participants' initial CNS trait scores. This preexisting difference makes is especially difficult to interpret the CNS state minus CNS trait difference scores. In particular, were the observed findings due to the impact of architecture or could these findings be interpreted as a regression to the mean effect? Several things argue against the later interpretation. First, when the CNS trait scores were transformed to Z scores and divided into quarters, it was observed that the participants in all the quarters, even the groups scoring closer to the mean, changed in the expected direction given the building. Instead of low CNS scores getting higher, and high CNS scores getting lower, the high scores kept getting higher and the low scores kept getting lower. This argues against a regression to the mean effect. Second, if the CNS state scores were more a reflection of a regression effect than a building effect, then you wouldn't expect these state scores to be impacted by building in such a way that they mediated the building/environmental issue ranking relationship.

Another limitation is that the use of the AJLC could have primed participants early on to think more about the environment. The AJLC is the environmental studies building on campus, and it is where a lot of the environmental studies classes are. This is common knowledge to the student body, and perhaps while walking over to the AJLC participants were primed to think "environment" since it is related to "environmental studies," which is what the AJLC is for.

Could this priming have impacted participants' CNS state scores? Possibly, but it is also important to remember that the participants were for the most part first year students in their first semester at Oberlin, so while the AJLC as an environmental studies building is common knowledge to the student body, it is less so for newly arrived students. Similarly, given that there is no sign designating the AJLC as an environmental studies building when entering it from the back door would also lessen the likelihood that "environment" was primed for these participants. We also made a cover story for the participants by telling them the study was about "creativity and contemplation" to try and correct for this limitation. We also added questions about drawing in the CNS so they wouldn't think all the questions were about one's connectedness to the natural world. Lastly, that the findings were not sole due to an increase in CNS state score in the AJLC, but also a decrease in these scores in Mudd, where priming seems highly unlikely, argues that it was the architectural features and not priming that led to these findings.

One other limitation concerns what aspect of the biophilic design in the AJLC might have impacted the participants' CNS state scores. The lobby of this building has natural elements incorporated into this space. The water feature and the greenery certainly may have impacted participants' CNS state scores. Alternately, given that the lobby is surrounded by windows looking out onto the outside world, this is another aspect of this architectural design that might have impacted participants' CNS state scores. At this time it is impossible to separate out which aspect of the design had the greatest impact.

It is interesting to consider that the windows looking out onto the external world might account for why participants in this building did not experience greater positive affect. The relationship between CNS state scores and well-being has been demonstrated time and time again, but why not in this study? Perhaps given that the study was conducted during a season

when the weather was becoming increasingly cloudier, colder, and overall less pleasant, participants exposure to this led the typical findings to be negated. Future studies might consider separating out solely indoor effects of nature from the combination of indoor and outdoor effects that were present in this study.

That the active/passive manipulation did not play a prominent role in this study is interesting. It suggests that people do not need to be actively involved in examining their environment in order for these effects to be present. That simply studying in the AJLC impacted participants' CNS state and environmental concern scores suggests that no special interventions are necessary in order to make more biophilic type buildings effective in impacting individuals' sense of feeling connected to nature and more concerned about environmental issues.

This study opens a lot of opportunities to study how architecture can manipulate connectedness to nature. For example, using different type of buildings that are not the environmental studies building. In this study, we used the environmental studies building to use the most biophilic type of architecture, and hope the most extreme version of biophilic architecture we have will give us an effect. However, it's possible that other types of biophilic architecture, such as the science center or the psychology lounge could heighten one's CNS. Design features that include artwork of nature, sounds and scents of nature, natural light, and other types of water features might be examined.

With the focus so much on the impact of biophilic design, this study also points out that researchers need to consider how architecture can negatively impact individuals' experience of feeling connected to nature and their concern for the natural world. This flip side of architecture, windowless rooms devoid of natural elements, may be of equal importance to examining the more positive aspects of biophilic design.

Clearly we are at a historic moment when the issue of climate change threatens our way of life. Figuring out ways to increase the public's concern for the natural world and to increase the extent to which they place environmental issues as a priority should be a top priority. Given that people spend the large percentage of their time indoors, examining features of buildings that might promote environmental concern is a critical issue. The present study suggests that if people are not going out to nature, nature can be brought to them in their living spaces and that by doing so climate issues might play a greater role in their life.

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