

Natural History Museums May Enhance Youth's Implicit Connectedness with Nature

Coral M. Bruni,¹ Matthew T. Ballew,¹ Patricia L. Winter,² and Allen M. Omoto¹

¹Claremont Graduate University, Division of Behavioral and Organizational Sciences, Claremont, California.

²US Forest Service, Pacific Southwest Research Station, Riverside, California.

Abstract

The present research examines the impact of visiting natural history museums on implicit connectedness with nature among youth. FlexiTwins, a computer-based game version of the Implicit Association Test (IAT), was used to measure implicit connectedness with nature among youth visitors to two natural history museums in the Los Angeles area of Southern California. Overall, there was a marginally significant difference between pretest and posttest FlexiTwins scores. That is, implicit connectedness with nature increased after spending time in a natural history museum, although follow-up analyses revealed a significant increase at only one of the two museums. Change from pretest to posttest was not related to age, grade, gender, time spent in the museum, or number of exhibits visited. The findings have implications for understanding how different nature experiences, from remote wilderness experiences to curated nature-based experiences, can affect connectedness with nature. This type of research can inform youth-focused programs to more effectively enhance connectedness with nature. Key Words: Connectedness with nature—Natural history museum—Curated nature-based experiences—Implicit associations—FlexiTwins—Children.

A cumulative range of experiences contributes to the development of environmental perceptions, attitudes, and relationships with nature (Chawla, 1999; Chawla & Cushing, 2007; Clayton & Saunders, 2012; Wells & Lekies, 2006). However, children may be increasingly missing out on ex-

periences that take place in nature (Aaron & Witt, 2011; Louv, 2005). Children are spending less time outdoors than previous generations despite proximity to nature (Faber Taylor & Kuo, 2006; Maclean, 2010), with today's youth spending approximately 7 hours a day consuming media (Rideout, Foehr, & Roberts, 2010). That is not to say that youth today do not enjoy spending time outdoors. The Nature Conservancy (2011) found that most American youth enjoy being outdoors; they just do not spend as much time outdoors in nature as they do indoors. Decreased time in nature makes it difficult to maintain awareness of connections with and reliance on the natural environment (Schultz, 2002). In an age wherein children are spending less time outdoors, programs and interventions are incorporating other activities to help establish and maintain youth's connections to the natural world. The goal of the present study is to examine the effect of visiting a natural history museum, a curated nature-based experience, on youth's connectedness with nature.

Connectedness with nature

Connectedness with nature is an individual's beliefs about the extent to which he or she is part of the natural environment (Schultz, 2001, 2002). Connectedness with nature is related to an individual's environmental attitudes, concerns, intentions to act in proenvironmental ways, and the extent to which proenvironmental behaviors are actually undertaken (Mayer & Frantz, 2004; Schultz, 2001, 2002; Schultz, Shriver, Tabanico, & Khazian, 2004). Thus, it is important to understand the ways in which youth establish connectedness with nature across different settings.

Multiple studies suggest that exposure to a variety of different nature settings strengthens connectedness with nature (Arbuthnott, Sutter, & Heidt, 2014; Bruni, Fraser, & Schultz, 2008; Hinds & Sparks, 2008; Kals, Schumacher, & Montada, 1999; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Schultz & Tabanico, 2007). In one study, for instance, visitors exiting a zoo reported significantly higher connectedness with nature than visitors entering the zoo (Schultz & Tabanico, 2007). In addition, people who spend time in natural

environments (on a hiking trail or the beach) also reported higher connectedness with nature. Similarly, spending time walking in a natural setting (15 min) has been shown to increase connectedness with nature (Mayer et al., 2009).

Studies have also demonstrated that merely being encouraged to think about, learn about, or spend time in nature can increase connectedness with nature (Bruni, Winter, Schultz, Omoto, & Tabanico, 2017; Ernst & Theimer, 2011; Liefländer, Fröhlich, Bogner, & Schultz, 2013; Richardson, Cormack, McRobert, & Underhill, 2016; Wang et al., 2016). For instance, in a study evaluating the effect of youth engaging in a creative arts outreach contest on connectedness with nature, participants were instructed to draw inspiration for their artwork from the natural world and also encouraged to spend time in nature (Bruni et al., 2017). In this study, connectedness with nature was higher among youth who actively participated by providing one or more creative arts submissions to the contest than among youth who did not participate. Other studies suggest that environmental education or engagement campaigns can increase connectedness with nature (e.g., Ernst & Theimer, 2011; Liefländer et al., 2013; Richardson et al., 2016). However, not all forms of engagement with the natural world may be effective in increasing connectedness with nature. For instance, Arendt and Matthes (2016) found that watching a nature documentary did not significantly increase participants' connectedness to nature in comparison to watching a film on the theory of relativity.

Implicit connectedness with nature. Psychological studies of attitudes have distinguished between implicit and explicit attitudes. Explicit attitudes are attitudes that are readily available for recall. They can be thought of in terms of controlled processes in that they are slow and attention-demanding and they result in explicit memory (Andrade & May, 2004). Implicit attitudes, on the other hand, are attitudes that are not readily available for recall. They can be thought of as automatic processes, which are fast and efficient and usually lead to implicit memory. Both explicit (e.g., self-report scales and surveys) and implicit (e.g., reaction-time) measures of connectedness with nature in youth have been used to predict connectedness with nature. However, explicit measures are subject to social desirability bias and may inflate proenvironmental attitudes and behaviors (Bruni et al., 2017; Mitchell, Ho, Patel, & MacDorman, 2011). To address this issue, implicit measures of connectedness with nature have been developed (Bruni et al., 2008; Bruni & Schultz, 2010; Schultz & Tabanico, 2007; Schultz et al., 2004). These implicit measures are unlikely to be affected by social desirability concerns and may provide insight into connectedness with nature that is beyond the deliberate control of participants.

The role of natural history museums in connecting people with nature

With approximately 850 million visits each year to American museums (American Alliance of Museums, n.d.), museums play an important role in education (Ahmad, Abbas, Yusoff, & Taib, 2015; De Backer et al., 2015; Doğan, 2010; Falk, 2004; Falk, Moussouri, & Coulson, 1998; Falk & Storcksdieck, 2005; Swim, Geiger, Fraser, & Pletcher, 2017; Vartiainen & Enkenberg, 2013). They may also provide a place for recreation (Sheng & Chen, 2012) and restorative experiences (Kaplan, Bardwell, & Slakter, 1993a, 1993b). For instance, Kaplan et al. (1993a, 1993b) found that, among people who are comfortable in a museum setting, visiting a museum facilitated peace and calmness and helped visitors recover cognitive and emotional capacity.

Natural history museums are scientific institutions that house collections of current and historical records related to nature and may include animals, plants, fungi, ecosystems, geology, paleontology, climatology, and more (Dilli, 2016). The primary role of a natural history museum is to provide visitors with opportunities to increase their understanding of the natural world. Indeed, research suggests that natural history museums may play a role in developing a nature culture among primary school students and also in inspiring people to connect with natural objects (Dilli, 2016; Sakiñç, 2007, as cited by Dilli, 2016). For instance, in a study of Turkish school children visiting a natural history museum, students' knowledge of elephants in Turkey significantly increased after their visit (Dilli, 2016). In addition, students in this study were asked to express their feelings and thoughts by drawing a picture or providing short written works. These drawings and written products suggest that children were more knowledgeable and conscious of the environment after visiting the museum.

Thus, natural history museums may serve as an important source of connecting people, and especially children, with nature. However, available research on the impact of natural history museums on connectedness with nature is mixed and focused on adults. In one study, adult visitors to a Canadian natural history museum completed a questionnaire assessing their explicit connectedness with nature and subjective well-being either immediately upon entry into the museum or when they exited from the museum (Arbuthnott et al., 2014). No significant differences in connectedness with nature were found between visitors entering and exiting the museum. In addition, a second study revealed that connectedness with nature was statistically similar for museum visitors and people visiting outdoor locations (e.g., parks, outdoor sports facilities). However, findings from a third study showed that connectedness with nature was higher

among psychology undergraduate students who viewed slides of a natural history museum compared to students who viewed slides of a history collection at a public library. The present research extends these findings by examining change in implicit connectedness with nature among youth before and after a visit to a natural history museum.

The present study is part of a program of research seeking to understand outcomes, primarily in youth, associated with engagement in various nature-themed and nature-based experiences from the virtual to the “wild.” Specifically, this study used a within-subjects design to examine the extent to which a voluntary visit to a natural history museum influenced implicit connectedness with nature among youth aged 8–15. We hypothesized that youth, on average, would score higher on an implicit measure of connectedness with nature after spending time in a natural history museum. Furthermore, we sought to explore several possible moderators of change, including participant gender, age, and time spent in the museum.

Method

Museums

Visitors were recruited to participate from two different natural history museums located in large urban centers in Southern California (Riverside and Los Angeles).

Riverside. The Riverside museum focused primarily on the natural ecology and cultural history of local and surrounding areas, but also had exhibits on contemporary conservation issues facing communities (e.g., natural hazards, endangered species). The museum had 12 exhibits at the time of data collection for this study, including a Nature Lab where visitors could interact with animals (e.g., reptiles, insects).

Los Angeles. The Los Angeles museum houses one of the world’s largest collections of natural and cultural history. It also curates immersive and interactive exhibits documenting the interconnectedness of nature and culture. Exhibits are laid out in corridors and rooms across multiple floors, presenting themes on history (e.g., early California), ecosystems (e.g., rainforests), gems and minerals, early mammals, and dinosaurs. The Discovery Center offers opportunities to learn about and interact with insects, and there is a Nature Lab where visitors can interact with nature and see live animals (e.g., turtles and newts). At the time of data collection, the museum had 32 separate exhibits. The Los Angeles museum also had multiple gardens and outdoor exhibits (e.g., butterfly sanctuary), where visitors could view and interact with nature.

Participants

A total of 238 youth participated in this study (Los Angeles: $n = 170$; Riverside: $n = 68$). The age of recruited participants ranged from 6 to 15 ($M = 10.33$, $SD = 2.14$), and grades ranged from 1st to 10th. Participants were 132 females and 105 males (one participant’s gender was not recorded).

Procedure

With permission from the cooperating museums, groups of visitors were intercepted upon arrival to the museum by members of the research team, provided with a verbal description of the study and procedures, and invited to participate. Youth whose parents/guardians provided permission and who indicated their own willingness to participate completed a game (FlexiTwins) that assessed implicit connectedness with nature at the beginning (pretest) and end (posttest) of their museum visit. Participants also marked the exhibits they visited on a map of the museum. Demographic variables were recorded through visual observation or parental response. Following completion of both the pretest and posttest games, children received a nominal prize (e.g., a colorful pencil or a bookmark). Upon completion of the posttest game, participants were entered into a raffle for a gift card, thanked for their time, and provided with a brief summary of the study’s purpose and anticipated use of the findings.

Measures

Implicit connectedness with nature. Implicit connectedness with nature was measured using a game version of the Implicit Association Test (IAT) known as FlexiTwins. FlexiTwins was administered on iPads¹, using the FlexiTwins app available through Apple iTunes, and participants were offered a choice to play in English or Spanish. Two participants asked for the Spanish version of FlexiTwins; however, one participant changed their mind and wanted the English version instead. The other participant’s request could not be met because the Spanish version was not loading properly, leading to use of the English version of the game (this score was excluded from analyses).

In FlexiTwins, youth are presented with four categories: two target discriminant categories (“Nature” or “Built”) and two attribute categories (“Me” or “Not me,” and specifically, the participant’s name and names of other participants). Target discriminant categories are paired with target attribute categories (e.g., “Nature”/“Me”) and

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contrasted with the opposite pairing of the target discriminant and attribute categories (e.g., “Built”/“Not me”). Once the categories have been established, youth are presented with a word and asked to decide to which category the word belongs. Words used for the built and nature categories were taken from Bruni and Schultz (2010). The participant’s name was used as the Me category, and a random list of other names was used as the Other category. The following words were used as the stimuli for the built category: car, chair, church, boat, and truck. The nature category used the following words as stimuli: flower, mountain, tree, butterfly, and waterfall. The reaction time of correctly categorizing stimuli is recorded, and these times are combined to create an overall association score. Information regarding calculations of association scores (D-scores), measures of internal consistency (D1 and D2 scores), and game settings can be found in Bruni and Schultz (2010) and Bruni et al. (2008).

Exhibit stops and museum visit duration. Participants were given a modified map of the museum and were instructed to mark an X next to each exhibit they visited. Although some marks on maps were ambiguous as to specific exhibits visited, it appears that the majority (between 76% and 92%) of Riverside museum visitors stopped at 11 of the 12 exhibits and that the outdoor water wise garden was infrequently visited (19%). At the Los Angeles museum, the majority (75% or more) of participants visited the dinosaur hall, the mammal halls, the gems and minerals exhibit, and the insect zoo. Least visited were the outdoor garden exhibits (between 5% and 20%). Information from these maps was used to create a variable indicating the total of number of exhibits visited (Riverside: $M=9.53$, $SD=2.61$; Los Angeles: $M=13.29$, $SD=5.60$).

Time spent at the museum was computed for each participant using the difference between pretest and posttest times recorded on the FlexiTwins game (Riverside: $M=49.19$ min, $SD=19.20$; Los Angeles: $M=141.46$ min, $SD=62.21$).

Results

Two hundred thirty-eight youth completed the pretest; however, 34 youth did not return to complete the posttest. Of the 204 participants who completed both rounds of FlexiTwins, data for 15 were excluded for having a low percentage correct responses at pretest or posttest (< 65% correct), and one for having high inconsistency in their FlexiTwins D1 and D2 scores (> 1 or < -1). In addition, two participants were excluded for being outside the age range of 8–15 years, and 11 participants were excluded for other reasons, including being helped by an adult (e.g., the adult pushing buttons for them), reading problems, or already having visited some parts of the mu-

seum before completing the pretest. In total, data were excluded for 21 participants from the Riverside museum and 42 participants from the Los Angeles museum. There was not a significant difference in loss of participants between the museums, $\chi^2(1)=.95$, $p=.33$. Excluding these participants yielded a final sample of 175 participants. See Table 1 for demographic characteristics of the final sample overall and by museum.

FlexiTwins internal consistency

Correlations between FlexiTwins D1 and D2 scores suggested FlexiTwins had good internal consistency at pretest and posttest. At pretest, FlexiTwins D1 scores ($M=0.57$, $SD=0.65$) were significantly correlated with FlexiTwins D2 scores ($M=0.62$, $SD=0.47$), $r=.41$, $p<.001$. At posttest, FlexiTwins D1 scores ($M=0.70$, $SD=0.52$) also significantly correlated with FlexiTwins D2 scores ($M=0.64$, $SD=0.43$), $r=.21$, $p<.01$.

Implicit connectedness with nature

Descriptive statistics revealed that participants had stronger implicit connections with nature than built environments at pretest as well as posttest (see Table 2). To examine if visiting a natural history museum increased connectedness with nature, a paired samples *t*-test was conducted on participants’ FlexiTwins D-scores from pretest to posttest. This test revealed a marginally significant increase in scores from pretest to posttest, $t(174)=-1.95$, $p=.05$, $d=-0.15$. To further explore this finding, we conducted several repeated-measures analyses of covariance (ANCOVAs) from pretest to posttest including the following variables: age, gender, grade, number of exhibits visited, and time spent in museum. These variables were entered in as moderator variables in separate ANCOVAs to assess potential interactions with D-score change from pretest to posttest. Change from

Table 1. Demographic Characteristics of Participants

	<i>n</i>	<i>M</i> AGE (<i>SD</i>)	MEDIAN GRADE (RANGE)	GENDER
Total sample	175	10.41 (2.07)	4th grade (1st–10th)	54.9% girls 44.6% boys
Riverside sample	47	10.30 (2.18)	4th grade (2nd–10th)	59.6% girls 40.4% boys
Los Angeles sample	128	10.45 (2.04)	5th grade (1st–10th)	53.1% girls 46.1% boys

Note. Gender was missing for one participant at the Los Angeles museum.

Table 2. Descriptive and Inferential Statistics of FlexiTwins D-scores Pretest and Posttest

	<i>M (SD)</i>	RANGE	<i>t</i>	<i>d</i>
<i>Total</i>				
Pretest	0.59 (0.47)	-0.95 to 2.26	-1.95 [†]	-0.15
Posttest	0.67 (0.37)	-0.39 to 1.69		
<i>Los Angeles</i>				
Pretest	0.62 (0.48)	-0.95 to 2.26	-0.97	-0.09
Posttest	0.66 (0.37)	-0.39 to 1.69		
<i>Riverside</i>				
Pretest	0.53 (0.45)	-0.61 to 1.42	-2.25*	-0.33
Posttest	0.68 (0.36)	-0.39 to 1.48		

[†]Marginally significant at $p = .05$. *Significant at $p < .05$.

pretest to posttest was not significantly moderated by age, $F(1, 173) = 0.02$, $p = .90$; grade, $F(1, 173) = 0.10$, $p = .75$; gender, $F(1, 172) = 0.29$, $p = .59$; number of exhibit visits, $F(1, 173) = .06$, $p = 0.81$; or the time spent in museum, $F(1, 173) = 1.21$, $p = .27$.

Next, the difference in FlexiTwins D-scores from pretest to posttest was examined separately for each museum (see Table 2 for descriptive statistics). As seen in Figure 1, degree of change varied by museum. Among Riverside museum participants, there was a significant increase in FlexiTwins D-scores from pretest to posttest, $t(46) = -2.25$, $p = .03$, $d = -0.33$. However, among visitors to the Los Angeles museum, the increase in FlexiTwins D-scores from pretest to posttest did not approach significance, $t(127) = -0.97$, $p = .33$, $d = -0.09$.

To further understand this change in implicit connectedness with nature at the Riverside museum, we conducted repeated-measures ANCOVAs from pretest to posttest using the same demographic variables that were used with the full sample. Similar to previous results, there was no significant moderation by age, $F(1, 45) = 0.00$, $p = .95$; grade, $F(1, 45) = 0.12$, $p = .78$; gender, $F(1, 45) = 3.19$, $p = .08$; number of exhibit visits, $F(1, 45) = 0.11$, $p = .74$; or time spent at the museum, $F(1, 45) = 0.24$, $p = .63$ on FlexiTwins pretest to posttest scores at the Riverside museum.

Discussion

In the present study, we examined the extent to which a visit to a natural history museum, a curated nature-based experience, influences youth's implicit connectedness with nature. We hypothesized

that youth, on average, would score higher in their implicit connectedness with nature after spending time in a natural history museum. The findings suggest, in general, that this was the case. Visiting a natural history museum may be associated with increased implicit connectedness with nature overall. However, this museum effect contradicts previous findings of no difference in explicit connectedness with nature among adult visitors entering and exiting a natural history museum (Arbuthnott et al., 2014). While measurement and study design could account for these different results (e.g., explicit versus implicit connectedness with nature), one particular difference between the studies is age of participants. In the present study, participants were youth aged 8 to 15. Perhaps spending time in a natural history museum augments nature connections especially among youth relative to adults; this possibility awaits future research. This information is essential to understanding experiences that may encourage nature connections across different age groups. Our findings also suggest that engagement in various nature-themed and nature-based experiences outside of the "wild" may enhance connectedness with nature among youth, and in this case, spending time in a natural history museum (i.e., a curated nature-based experience) served this purpose.

The different findings by museum obtained in this study were also of interest. In the current study, increases in connectedness with nature were found from pretest to posttest at the Riverside museum but not at the Los Angeles museum (however, while not significant, the direction of the change from pretest to posttest was in the hypothesized direction). Although there was no statistically significant increase among participants at the Los Angeles museum, the null results may be due to a ceiling effect. That is, youth at the Los Angeles museum had relatively higher pretest connectedness with nature scores when compared to youth at the Riverside museum, although the difference between samples was not statistically significant. The higher initial scores among participants at the Los Angeles museum may have limited the ability to detect any significant increase in connectedness scores as a result of spending time in the museum.

Speculations on the reason for this pattern of results include prior exposure to nature or other areas of the museum by participants at the Los Angeles museum, differential investment needed to visit the Los Angeles museum compared to the Riverside museum (e.g., cost of admission, time spent at the museum), or difference in focus of the museums. To consider this further, higher connectedness with nature pretest scores at the Los Angeles museum may have been due to exposure to other areas of the museum (e.g., exhibits, outside gardens) prior to encountering the research team. For instance, there are several garden exhibits surrounding the Los Angeles museum,

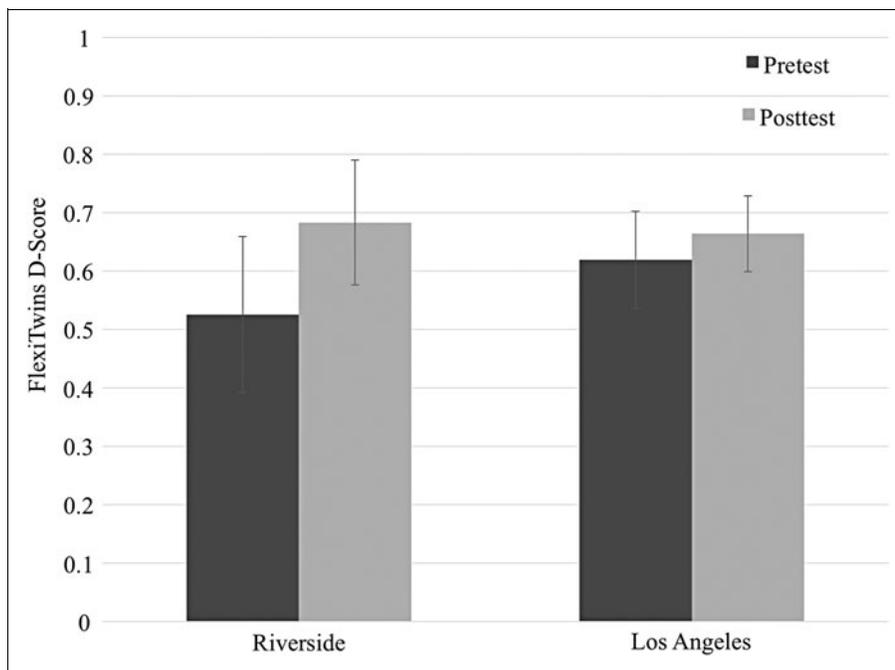


Fig. 1. Mean differences of FlexiTwins D-scores from pretest to posttest by museum. Error bars represent 95% confidence intervals.

including numerous trees, a bird-watching platform, hummingbird feeders, and a pond. At the Riverside museum, there is a smaller exterior garden; however, it is more akin to an exterior planting found on city streetscapes. In addition, at the Riverside museum, the participants were intercepted at the entrance and were more likely not to have been exposed to other areas of the museum prior to their participation. Conversely, at the Los Angeles museum, exposure to nature exhibits may have increased participants' connectedness with nature prior to our pretest assessment.

The initial higher connectedness with nature scores of participants at the Los Angeles museum may also be due to factors of investment. It is a larger museum than the Riverside museum, and visitors to the Los Angeles museum had to pay to visit the museum (as opposed to donation-based admissions at Riverside), spent more time at the museum than at the Riverside location, and may have commuted from farther away. Thus, the investment to visit the museum may be associated with higher initial connectedness with nature and explain the difference between museums. That is, people higher in connectedness with nature may be more willing to invest in a trip to the Los Angeles museum than those lower in connectedness with nature.

Finally, the increase in implicit connectedness with nature from pretest to posttest at the Riverside museum (but not at the Los Angeles museum) could be the result of differences in focus between the two museums. The Riverside museum is focused primarily on the natural ecology and cultural history of local and surrounding areas, whereas the Los Angeles museum has a broader range of exhibits with a North American focus in addition to information on local and surrounding areas. The local embeddedness of the Riverside museum could have had a stronger impact on the connectedness with nature of youth visitors. This suggestion is in line with previous research on environmental education programs and their effect on participants' connectedness with nature (e.g., Ernst & Theimer, 2011; Garner, 2012). For instance, in a study on the effectiveness of environmental education programs on increasing connectedness with nature, Ernst and Theimer (2011) found that two of seven environmental education programs were effective in increasing connectedness with nature and that both of the effective programs engaged youth in interactive activities focused on local habitats.

Future research might use experimental research designs and include additional proenvironmental metrics to assess potential causal effects of natural history museums. For instance, studies could randomly assign youth to visit a natural history museum or a control activity and measure their connectedness with nature before and after. Related research with random assignment to different exhibits also could be conducted; such work would allow for better understanding of the types of exhibits or activities (e.g., more vs. less interactive exhibits) at the natural history museums that promote connectedness with nature as well as those that do not. These suggestions for experimental studies would allow museum curators to better understand the impact of their museum and exhibits on their patrons' connections with nature, which in turn might lead to more proenvironmental attitudes and sustainable behaviors. Along similar lines, future research could examine youth on field trips to museums using both observational and experimental approaches. Youth on field trips may spend designated or more time at museums, have an explicit topic focus for their visit, or may engage in more participatory activities during their visit. Careful study of this subset of

museum visitors and examining different museum experiences may allow for more focused, controlled gathering of information regarding the impact of specific exhibits or activity types on connectedness with nature.

The need for comparison groups is highlighted by a recent study suggesting that a mediated nature experience does not elicit increases in connectedness with nature but can increase actual donation behavior for animal and environmental protection organizations (Arendt & Matthes, 2016). In addition, in a study on nature-based museums and climate change education, Swim and colleagues (2017) found that visitors, compared to nonvisitors, of nature-based museums were more concerned, hopeful, likely to take personal and community-based actions, and knowledgeable about climate change. In short, including additional measures and other conditions in future research is essential in helping determine potential causal pathways for the effects of different museums, exhibits, and activities on environmentally relevant outcomes including connectedness with nature.

Future research should also explore the mechanisms responsible for increased implicit connectedness with nature among youth who visit natural history museums. For example, certain features of museums (e.g., varying levels of intensity and interactivity) may be especially impactful on connectedness, such as nature lab exhibits where youth can interact with nature in a domesticated setting. Past research suggests that domesticated activities (e.g., picking flowers, planting trees or seeds, or caring for plants) may influence environmental attitudes and behaviors, but these effects are typically smaller than effects associated with less developed and wilder natural activities (e.g., hiking, playing in natural areas; Wells & Lekies, 2006). In addition, appreciative outdoor experiences (e.g., bird-watching, hiking, star-gazing) tend to show this positive effect relative to consumptive outdoor experiences (e.g., hunting, fishing), which tend to be negatively related to environmental concern, proenvironmental behavior, and broad-based measures of environmentalism (Ewert, Place, & Sibthorp, 2005). It may be that different types of nature activities have different impacts on youth's connectedness with nature. Thus, the types of activities that youth visitors to natural history museums participate in may serve as limited nature-based experiences and have relatively small effects on implicit connectedness with nature. For these reasons, a more nuanced exploration of museum offerings and individual interest and engagement with these offerings would enhance understanding of *how* natural history museums affect connectedness with nature and related outcomes.

With the reduction of youth's time spent in nature (Faber Taylor & Kuo, 2006; Maclean, 2010; Rideout et al., 2010; The Nature Conservancy, 2011), there need to be additional experiences designed to connect them with nature. This is especially important among youth who have little to no access to nature. In fact, there may be populations for whom curated experiences are likely to play significant roles in fostering and maintaining connectedness with nature, such as populations who are underserved in terms of nature exposure and outdoor experiences (e.g., youth in urban areas). Research that explores differential patterns of effects and casual mechanisms for youth who have robust exposure to nature and outdoor experiences compared to youth who have fewer opportunities and experiences may be especially important.

Taken together, the results of the current study suggest that spending time in a natural history museum, as a curated nature-based experience, can positively affect youth's implicit connectedness with nature. Educators developing programs designed to connect youth with nature may find this information helpful in making decisions about the role of natural history museums and using museums and exhibits as a resource for building connections with and appreciation for nature. Continued research on these programs and the impacts of curated nature-based experiences may lead to more effective programs to connect youth with nature and potentially enhance youth's commitment and engagement in caring for nature and the natural world.

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Address correspondence to:
Coral M. Bruni
Claremont Graduate University
150 E. 10th Street
Claremont, CA 91711

E-mail: coral.bruni@cgu.edu

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