

# Mechanisms of Children's Exposure to Nature: Predicting Adulthood Environmental Citizenship and Commitment to Nature-Based Activities

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## Abstract

Childhood-nature experiences have lifelong effects on environmental citizenship and commitment to nature-based activities. But, it is unclear whether, and to what extent, the different mechanisms through which children and youth experience nature are associated with these outcomes. To test these associations, an online questionnaire assessing mechanisms of childhood exposure to nature, adulthood environmental citizenship and commitment to nature-based activities, and demographic variables was sent to the email addresses of 509 employees of the United States Department of Agriculture, Forest Service, Northern Research Station. The 236 completed surveys indicated four mechanisms of children's exposure to nature. Children's self-exposure to nature was the strongest predictor of a number of aspects of adulthood environmental citizenship and of behavioral and

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attitudinal commitments to nature-based activities. Exposure through school-related programs had less predictive value for these outcomes. Implications for pathways to enhance the benefits of childhood-nature experiences are discussed.

### **Keywords**

affective commitment, normative commitment, continuance commitment, political-ecological citizenship, environmental advocacy and activism

## **Introduction**

Human-nature experiences have several short- and long-term benefits to children and adults (Liddicoat & Krasny, 2013). In the short term, exposure to nature improves several aspects of human health (Floyd et al., 2011; Hartig, Mitchell, de Vries, & Frumkin, 2014). Exposure to nature enables children and youth to engage in activities that foster the development of personal and social capabilities (Chawla, 2015). Children and youth who experience nature display improved test scores, self-discipline and cognition, and reduced behavioral problems and symptoms of attention-deficit/hyperactivity disorder (Seltenrich, 2015). Children in greener neighborhoods have been shown to have fewer emotional problems compared with children of similar demographics in less green settings (Flouri, Midouhas, & Joshi, 2014). Exposure to nature increases children's and youth's emotional affinity toward nature, their ecological beliefs, and their willingness to engage in proenvironmental behaviors (Collado, Staats, & Corraliza, 2013).

In the long term, childhood exposure to nature leads to adulthood commitment to nature-based activities, adulthood proenvironmental behaviors such as environmental citizenship, and the pursuit of careers in the environmental field (Chawla, 1999; James, Bixler, & Vadala, 2010; Wells & Lekies, 2006). Ward Thompson, Aspinall, and Montarzino (2008) showed that adults who were more likely to visit natural areas on a daily basis, visited such areas when they were children. The more nature-based activities children experienced, the more often they, upon becoming adults, overcame perceived barriers to participating in nature-based activities and the more often they participated in such activities (Asah, Bengston, & Westphal, 2012). Clearly, children's exposure to nature shapes their adulthood commitment to nature-based activities. Commitment to nature-based activities is an antecedent of proenvironmental attitudes and behaviors of children and adults (Chawla, 1999; Kaiser, Hartig, Brügger, & Duvier, 2013). Thus, it is worthwhile to

explore further how childhood exposure to nature influences adulthood commitment to nature-based activities and adulthood environmental citizenship. In this article, we examine whether—and to what extent—the mechanisms through which children and youth experience nature matter regarding the long-term outcomes of adulthood commitment to nature-based activities and of adulthood environmental citizenship.

### *Environmental Citizenship*

Environmental citizenship could be viewed as various actions that people take in favor of environmental conservation, mostly in the public sphere (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). According to Stern et al. (1999), four major aspects of environmental citizenship are discernible. The first aspect, environmental advocacy and activism, entails direct involvement in advocating for environmental causes, such as contacting public officials to express concern about an environmental problem or participating in public demonstrations in support of proenvironmental causes. The second aspect of environmental citizenship, volunteerism, depicts voluntary actions, taken in public, to improve the condition of the environment. The third aspect of citizenship, environmental literacy, is about manifestations of learning, and knowledge, about environmental phenomena. And finally, the fourth aspect, political-ecological citizenship, is comprised of public sphere proenvironmental actions such as voting for political candidates because of their proenvironmental inclinations (Stern et al., 1999).

Childhood exposure to nature constitutes foundational experiences with major influences on the formative development of adult environmental educators, and adults' knowledge about and concern for the environment (Chawla & Derr, 2012; Palmer, Suggate, Robottom, & Hart, 1999). Environmental citizenship behaviors are essential for the success of the environmental movement. Public sphere proenvironmental behaviors influence the behaviors of people and organizations that are actively engaged in shaping environmental policies (Dietz & Rycroft, 1987). Environmental citizenship behaviors also influence the actions of the broader population (Stern et al., 1999). Thus, it is additionally important to explore whether and to what extent different mechanisms of children's exposure to nature relate to adulthood environmental citizenship.

### *Commitment to Nature-Based Activities*

Commitment is the force that binds someone to entities, causes, or a course of action, even in the face of fluctuating attitudes (Brown, 1996). Commitment has

behavioral and attitudinal elements (Johnson, 1973). Attitudinal commitment performs the function of stabilizing individual behavior under circumstances where the individual would otherwise be tempted to change that behavior (Meyer, Stanley, Herscovitch, & Topolnytsky, 2002). Behavioral commitment is the actual enduring engagement with the behavior to which the individual is attitudinally committed—the behavioral manifestation of attitudinal commitment.

Attitudinal commitment has three dimensions: normative, affective, and continuance commitment (Allen & Meyer, 1990). In the context of this study, normative commitment reflects a perceived obligation to continue to participate in nature-based activities. Affective commitment is the emotional attachment to, identification with, and involvement in nature-based activities, whereas continuance commitment signifies the perceived cost associated with withdrawing from participating in nature-based activities (Meyer & Allen, 1984). These distinct dimensions of attitudinal commitment have been shown to operate differently in psychologically binding people to organizations, causes, and behaviors, and hence, in influencing desirable outcomes such as behavioral commitment to nature-based activities (Meyer et al., 2002). Thus, these multiple dimensions of attitudinal commitment may help us better understand how childhood exposure to nature influences the forces that bind them to nature-based activities during adulthood.

Although commitment is increasingly being used to explain proenvironmental actions and people's relationship with nature, it is rarely applied to the particular context of nature-based activities. Affective and normative commitments to environmental volunteerism have been shown to be positively associated with frequency of participation in proenvironmental volunteerism (Asah & Blahna, 2013). Commitment to nature is known to predict proenvironmental behavioral intentions and behaviors (Davis, Green, & Reed, 2009; Davis, Le, & Coy, 2011). However, commitment to nature and to proenvironmental volunteerism are not the same as commitment to nature-based activities. For adults who were exposed to nature as children, participation in nature-based activities is a behavioral manifestation of their attitudinal commitment to such activities. But, we know little about how mechanisms of children and youth exposure to nature may explain adulthood behavioral and attitudinal commitment to nature-based activities. We also do not know whether the various dimensions of attitudinal commitment to nature-based activities are associated with behavioral commitment to such activities.

### *Mechanisms of Childhood-Nature Exposure*

There are a variety of mechanisms through which children and youth are exposed to nature. Childhood-nature exposure mechanisms may include

programs with schools, extracurricular organized programs such as through churches and Scout groups, with family, on one's own, and with friends. Each exposure mechanism is characterized by a unique sociocultural setting and set of amenities through which children and youth experience nature (Asah et al., 2012; Bell, Phoenix, Lovell, & Wheeler, 2014; Waller, 2014). For example, whereas school-based programs might focus on formal educational programming on learning about nature, Scout programs may be more oriented toward developing nature-survival or nature-smart skills, such as orienteering, backpacking, and extractive uses such as fishing. Thus, important attributes of childhood-nature experiences, such as the intensity, duration, and discretion with which children interact with nature, may differ with the foci of the exposure mechanism.

Aspects of childhood and youth exposure to nature, other than program focus, may also differ among exposure mechanisms. For example, the social and economic circumstances of parents, and of school-based and other organized programs, may influence the type of amenities for nature-based activities and consequent nature-based experiences of children and youth. Nature-based recreational settings are not equally available to all. Participation in nature-based activities may demand considerable resources, including time, which may be more or less affordable depending on the mechanism of exposure (Kemperman & Timmermans, 2011). In a study of museum visitors, family groups were shown to spend more time at exhibits and at the museum as a whole than nonfamily groups (Sandifer, 1997). Consequently, different exposure mechanisms may entail differences in the nature-based experiences of children and youth and consequent different effects on outcomes such as adulthood environmental citizenship and commitment to nature-based activities.

Sociocultural and material arrangements of the mechanisms of children's exposure to nature impose different degrees of freedom with which children and youth interact with nature and with others. Factors such as safety regulations and consequent liability concerns associated with exposure mechanisms such as school programs may impose some restrictions on how children experience nature (Saylan & Blumstein, 2011). The presence or absence of adults and the extent of adult supervision are other important differentiating socio-psychocultural aspects of childhood-nature exposure mechanisms, and consequently of how children experience nature. When children are exposed to nature with adults, children's experiences of nature may be more on terms defined by adults (Ginsburg, 2007; Padilla-Walker & Nelson, 2012). The accompanying adults' attitudes toward nature, child play, and safety may shape childhood-nature experiences (LeMoyne & Buchanan, 2011; Padilla-Walker & Nelson, 2012). For example, free-choice learning experiences—where learners exercise a

large degree of discretion over their learning choices—are known to play major roles in lifelong learning (Falk, 2005). Regarding immediate benefits to children, the presence of adult—parents or others—has been shown to be associated with decreased intensity of children’s physical activity in nature parks (Floyd et al., 2011). Conversely, when children and youth expose themselves to nature without adult supervision, they are likelier to experience nature with more freedom and choice, which may lead to different experiences and consequent outcomes.

The distinct influences of structured versus free play in general, and in nature in particular, on children’s development and health have been emphasized (Burdette & Whitaker, 2005; Ginsburg, 2007; Louv, 2008). Free play enables children to learn how to share, negotiate, resolve conflict, work in groups, and exercise self-advocacy (Ginsburg, 2007; Pellegrini & Smith, 1998). By so doing, undirected play allows children to develop leadership, creativity, and social group skills (Ginsburg, 2007; MacDonald, 1993). Thus, different mechanisms of childhood-nature exposure have different influences on children’s and youth’s physiologic and mental health, as well as development of their emotional and social capabilities (Chawla, 2015).

Differences in exposure mechanisms may also facilitate different levels of manifestations of cognitive and affective processes associated with environmental citizenship and commitment to nature-based activities (Selhub & Logan, 2012). For example, times spent playing with family members and friends in natural settings, during childhood, are among the most positive memories for adults who had such experiences (Spartz & Shaw, 2011). Such positive memories of family-related nature experiences undoubtedly inform adulthood commitment to nature-based activities, an antecedent of environmental citizenship (Wells & Lekies, 2006).

Even while exposing children to similar biophysical settings, Collado and others (2013) showed that differences in the social arrangements of the exposure mechanisms have different effects on children’s environmental citizenship and commitment to nature-based activities. In that study, children were exposed to two different summer nature camps—one with, and the other without, an educational component. Significant differences in children’s willingness to engage in proenvironmental behaviors, including environmental citizenship and intentions to visit nature in the future were observed between the two exposure mechanisms (Collado et al., 2013). The observation of different effects of otherwise similar exposure mechanisms—both were summer nature camps, with the major difference being the presence or absence of an educational component—is insightful. First, different mechanisms of childhood exposure to nature have different

effects on attitudinal commitment to nature-based activities and on environmental citizenship behaviors. Second, even for childhood exposures to similar nature settings, differences in the social arrangements associated with such exposures lead to different effects on attitudinal commitment to nature-based activities and on environmental citizenship. Thus, it is logical to posit that markedly different exposure mechanisms (e.g., self-exposure vs. exposure through organized programs) will have different effects on adulthood environmental citizenship and commitment to nature-based activities.

Another insightful aspect of Collado et al.'s (2013) findings is that they observed only short-term effects of type of exposure mechanism on commitment to nature-based activities and on proenvironmental behaviors. We know little about the effects of mechanisms of childhood exposure to nature on long-term outcomes such as adult environmental citizenship and commitment to nature-based activities. Furthermore, those interested in exposing children and youth to nature may prefer certain long-term outcomes to others. And, some exposure mechanisms may be more or less effective or efficient at attaining specific outcomes such as commitment to nature-based activities. Thus, understanding how different exposure mechanisms predict adulthood environmental citizenship behaviors and commitment to nature-based activities could be especially useful. In this article, we examine whether, and to what extent, different mechanisms of childhood exposure to nature predict adulthood environmental citizenship and commitment to nature-based activities. We test the following hypotheses:

**Hypothesis 1:** The following mechanisms of exposing children to nature—(a) self-exposure, (b) with family, (c) through school-related programs, and (d) through extracurricular organized programs—will each significantly predict, to different degrees, the four types of adulthood environmental citizenship.

**Hypothesis 2:** The following mechanisms of exposing children to nature—(a) self-exposure, (b) with family, (c) through school-related programs, and (d) through extracurricular organized programs—will each significantly predict, to different degrees, adulthood attitudinal commitment to nature-based activities, and its subdimensions.

**Hypothesis 3:** The following mechanisms of exposing children to nature—(a) self-exposure, (b) with family, (c) through school-related programs, and (d) through extracurricular organized programs—will each significantly predict, to different degrees, adulthood behavioral commitment to nature-based activities.

## Method

### *Developing a Scale to Measure Exposure Mechanism*

To the best of our knowledge, no instrument to measure mechanisms of childhood exposure to nature-based activities existed prior to this work. Hence, we conducted brief interviews to understand the various pathways of children's exposure to nature. The sole goal of these interviews was to develop a Likert-type scale to measure mechanisms of children's exposure to nature to be included in a subsequent questionnaire.

### *Interviewees and Procedure*

We politely intercepted 23 park visitors at three conveniently accessible city parks, two in Bothell and one in Seattle, Washington State, during summer weekend afternoons. Every third visitor was approached and asked permission to be briefly interviewed about nature-based activities. We asked interviewees two questions, the first, a criterion question to determine whether they were eligible for further interviewing, as follows: "Please, did you participate in nature-based activities during your childhood (age 0-18 years)?" Those who responded in affirmative to this question were asked one more question: "Please, describe the various pathways through which you, and others you know, got to participate in nature-based activities when you were children." Follow-up questions for clarification included how you got to nature, with whom you went, and on what occasions. Thirteen adults—six females and seven males—participated in these brief intercept interviews. Eight visitors declined to be interviewed whereas two visitors responded "no" to the criterion question and were not interviewed further.

Interviews lasted 10 to 15 min, and were audio recorded. We reached saturation after 13 interviews given that all we wanted to know was how people were exposed to nature as children. Audio records were transcribed word verbatim and basic thematic analysis was used to code the content of those transcripts into themes of major exposure pathways (Saldaña, 2013). Thematic analysis consisted of placing texts of interviewees' expressions of their childhood exposure to nature-based activities into emergent themes representing specific pathways of childhood exposure to nature.

### *Interview Results*

Ten themes, corresponding to 10 pathways of exposing children to nature, emerged from interview data. The 10 pathways of childhood and youth exposure to nature included the following: (a) by themselves, (b) with immediate



family, (c) with extended family, (d) with friends and neighbors, (e) through school programs, (f) through after-school programs, (g) through church programs, (h) through Scout programs, and (i) through summer camps. Some interviewees mentioned unique organized exposure pathways such as exposure as part of parents' work-related events, with baseball team coach, and so forth. We included a 10th theme labeled "other organized programs" to capture this unique variety of exposure mechanisms. These were fairly brief and straightforward listings of childhood exposure mechanisms, without much ambiguity to necessitate multiple coders. These 10 pathways through which interviewees were exposed to nature as children were listed as items in a 10-item Likert-type scale assessing childhood exposure mechanisms that was included in the survey questionnaire.

## Survey

*Sampling and administration.* We used a convenience sample of all 509 employees of the United States Department of Agriculture (USDA) Forest Service, Northern Research Station. The Northern Station is comprised of the 20-state region of the Northeastern and Midwestern United States. The research protocols were reviewed and approved by the Institutional Review Board (IRB) of the University of Washington, Approval No. 39120. The questionnaire was comprised of Likert-type scales measuring exposure mechanisms, environmental citizenship and its four aspects of environmental literacy, political-ecological citizenship, environmental advocacy and activism, and environmental volunteerism. The questionnaire also contained a Likert-type scale to measure behavioral commitment to nature-based activities. We also included another Likert-type scale measuring attitudinal commitment and the three subdimensions of affective, normative, and continuance commitment to nature-based activities. Respondents also reported sociodemographic attributes (Table 1). We sent the online questionnaire to the email addresses of all 509 potential respondents. We followed the initial survey request with three bimonthly reminders. We received 236 completed questionnaires for a response rate of 46.6%.

## Measures

*Exposure mechanisms.* The constituent items and item characteristics for the scale measuring childhood exposure mechanisms are shown in Table 2. A prelude to scale items read as follows: "Please estimate how frequently you participated in nature-based activities through the following means when you were a child (1-18 years old)." Sample items included exposure pathways

**Table 1.** Demographic Characteristics of Survey Respondents.

Demographic attribute	<i>n</i>	%
<b>Gender</b>		
Female	100	42.4
Male	119	50.4
NA	17	7.2
<b>Age</b>		
18-29	9	3.8
30-39	46	19.5
40-49	53	22.5
50-59	81	34.3
60+	37	15.4
NA	10	4.2
<b>Education</b>		
Graduated high school	16	6.7
Graduated college	70	29.6
Graduated graduate school	138	58.5
NA	12	5.1
<b>Ethnicity</b>		
American Indian or Alaska Native	6	2.5
Asian	3	1.3
Black or African American	7	3
White	205	86.9
Hispanic or Latino	2	0.8
Other race or ethnicity	6	2.5
<b>Household income (US\$)</b>		
≤39,999	9	3.8
40,000-79,999	84	35.6
80,000-119,999	60	25.4
120,000+	64	27.1
Other	2	0.8
NA	17	7.2

such as through school programs, by the self, with immediate family, and through church programs. The prelude was followed by the list of the 10 exposure pathways suggested by interviewees. Survey respondents rated—on a five-point scale from 1 = *never* to 5 = *very often*—how often they were exposed to nature as children and during their youth through each of the 10 distinct pathways. The Cronbach's  $\alpha$  value for the scale assessing mechanisms of childhood exposure to nature was .72.

**Table 2.** Exposure Mechanisms Scale, Item Characteristics, and Factor Loadings and Mean Scores for Each Exposure Mechanism.

Exposure mechanisms (dimensions) and pathways (items)	Item statistics	Factor loadings for exposure mechanisms		
	M (SD)	Extracurricular	School related	Family exposure
Extracurricular exposure mechanism (M = 1.18)				
With boy/girl Scouts	1.33 (1.39)	.84		
During summer camps	1.47 (1.33)	.81		
With church programs	0.75 (0.96)	.56		
School-related exposure mechanism (M = 1.06)				
As part of school programs	1.49 (0.87)		.83	
As part of after school programs	0.87 (1.01)		.82	
As part of other organized programs	0.81 (0.98)		.49	
Family exposure mechanism (M = 2.41)				
With extended family members (grandparents, uncles, aunts, cousins)	1.89 (1.07)			.86
With immediate family members (parents & siblings)	2.93 (1.00)			.81
Self-exposure mechanism (M = 2.52)				
Just by yourself	2.59 (1.05)			.83
With friends and/or neighbors	2.44 (1.07)			.70

Note. Item response range for exposure mechanism scale: 1 = never to 5 = very often.

*Environmental citizenship.* A total of 16 items measured four dimensions of environmental citizenship, using a modified version of Stern et al.’s (1999) environmental citizenship scale. A prelude to the environmental citizenship scale read as follows: “We recognize that opportunities to engage in some of the following behaviors may be rare. But we would like to know how often you engage in such behaviors when the opportunity arises.” We included items assessing four major aspects of environmental citizenship: environmental advocacy and activism (five items), environmental volunteerism (four items), environmental literacy (four items), and political-ecological citizenship (three items). Items such as, “I contact government agencies to get information or complain about an environmental problem” and “I participate in demonstrations on behalf of the environment” assessed environmental advocacy and activism. Sample items for volunteerism, literacy, and political-ecological citizenship include “I volunteer for environmental and natural resource courses,” “I take classes to learn more about environmental issues,” and “The environment is one of the most important issues I consider when voting for political candidates,” respectively. The constituent items, item statistics, and psychometric characteristics for each of these subscales are shown in Table 3. Respondents indicated—on a scale from 1 = never to

**Table 3.** Aspects of Environmental Citizenship and Item Characteristics.

Citizenship aspects and items	<i>M</i>	<i>SD</i>
Environmental advocacy and activism ( $\alpha = .71, M = 1.06$ )		
I attend public hearings or meetings about environmental issues	1.11	0.96
I contact government agencies to get information or complain about an environmental problem	1.07	1.03
I participate in demonstrations on behalf of the environment	0.52	0.92
I participate in park, river, or neighborhood cleanups	1.35	1.14
I advocate for reduced pollution in my neighborhood	1.23	1.35
Environmental volunteerism ( $\alpha = .67, M = 1.79$ )		
I contribute time or money to environmental or wildlife conservation group(s)	2.10	1.35
I participate in park, river, or neighborhood cleanups	1.35	1.14
I volunteer for environmental and natural resource courses	1.03	1.20
I seek out what I can do to minimize environmental problems	2.74	1.15
Environmental literacy ( $\alpha = .71, M = 2.35$ )		
I take classes to learn more about environmental issues	1.11	1.09
I read about environmental issues	3.07	1.11
I watch TV shows about environmental issues	2.47	1.16
I talk to other people about environmental issues	2.73	1.17
Political-ecological citizenship ( $\alpha = .87, M = 2.50$ )		
I vote for a political candidate, in part, because she or he was in favor of environmental protection	2.64	1.34
I examine how politicians vote on environmental issues	2.50	1.27
The environment is one of the most important issues I consider when voting for political candidates	2.35	1.30

Note. Item response range for environmental citizenship scales: 1 = never to 5 = very often.

5 = *very often*—the frequency with which they engaged in listed citizenship behaviors.

*Attitudinal commitment to nature-based activities.* Attitudinal commitment was measured by using the 18-item version of the Allen and Meyer's (1990) scale measuring all three dimensions of attitudinal commitment to the organization. A prelude to the scale assessing attitudinal commitment to nature-based

activities read as follows: “Please, indicate the extent to which you agree or disagree with the following statements.” All 18 items were modified by replacing the word “organization” or the phrase “working for my organization,” in the Allen and Meyer (1990) scale, with “nature-based activities” or “participating in nature-based activities,” respectively. The following are sample statements from the Allen and Meyer (1990) scale and the respective modifications. For affective commitment, we modified the Allen and Meyer (1990) item “I feel a strong sense of belonging with my organization” to “I feel a strong sense of belonging with nature-based activities.” For normative commitment, the item “I feel obligated to continue to work in my organization” was modified to “I feel obligated to continue to participate in nature-based activities.” And, for continuance commitment, the item “There would be too many consequences to me personally if I decided I wanted to quit working for my organization” was modified to “There would be too many negative consequences to me personally if I decided I wanted to quit participating in nature-based activities.” The constituent items and item statistics for the scale assessing attitudinal commitment to nature-based activities are shown in Table 4. Respondents rated—on a scale from 1 = *strongly disagree* to 5 = *strongly agree*—the extent to which they agreed or disagreed with statements about various aspects of their attitudinal commitment to nature-based activities. The Cronbach’s  $\alpha$  value of the scale assessing attitudinal commitment to nature-based activities was .95.

*Behavioral commitment to nature-based activities.* As a surrogate of behavioral commitment to nature-based activities, we included Likert-type measures of the frequency of adulthood participation in 37 nature-based activities common in the nature-based recreation literature (e.g., Kemperman & Timmermans, 2008, 2011; Virden & Knopf, 1989). A prelude to the list of nature-based activities read as follows: “Please, estimate the total number of days that you participated in the following nature-based activities over the last 12 months.” Sample nature-based activities included picnicking, bird watching, hiking, jogging, recreational vehicle camping, all-terrain vehicle riding, water rafting, kayaking, hunting, and fishing. The constituent items and item statistics for the scale assessing behavioral commitment to nature-based activities are shown in Table 5. The scale assessing behavioral commitment to nature-based activities was reliable with Cronbach’s  $\alpha$  value of .86.

## Data Analyses

All data were analyzed using the IBM SPSS software version 19. In preparation for regression analyses, we also conducted principal component analysis

**Table 4.** Affective Commitment (AC), Normative Commitment (NC), and Continuance Commitment (CC) Dimensions, and Item Statistics.

Commitment dimension and item	M (SD)	Factor loadings		
		AC	NC	CC
<b>AC (M = 4.27)</b>				
Participating in nature-based activities means a lot to me	4.36 (0.85)	.85		
I feel some kind of attachment to nature-based activities	4.27 (0.86)	.84		
I am very happy to continue to participate in nature-based activities for many years to come	4.47 (0.77)	.84		
If I were to relocate to another community, I will still participate in nature-based activities as much as I currently do	4.23 (0.79)	.80		
I feel a strong sense of belonging with nature-based activities	4.16 (0.95)	.79		
I owe a great deal to nature-based activities	4.21 (0.93)	.77		
I enjoy discussing nature-based activities with other people	4.15 (0.87)	.77		
I think that people these days do not participate enough in nature-based activities	4.26 (0.82)	.51		
<b>NC (M = 3.28)</b>				
I feel obligated to continue to participate in nature-based activities	3.12 (1.14)		.87	
I will feel guilty if I do not participate in nature-based activities at all or for a while	3.19 (1.25)		.81	
Nature-based activities deserve my loyalty	3.57 (1.12)		.76	
Even if it were to my advantage, I do not feel it would be right for me to quit participating in nature-based activities	3.25 (1.08)		.73	
<b>CC (M = 3.44)</b>				
There would be too many negative consequences to me personally if I decided I wanted to quit participating in nature-based activities	3.49 (1.11)			.86
Right now, participating in nature-based activities is a matter of necessity as much as desire	3.12 (1.16)			.75
There would be real consequences to me personally if I quit participating in nature-based activities	3.49 (1.17)			.73
I am concerned about the consequences of not participating in nature-based activities	3.41 (1.11)			.72
It would be very hard for me to quit participating in nature-based activities even if I wanted to	3.34 (1.13)			.72
One of the reasons I continue to participate in nature-based activities is that I could not obtain the same benefits from any other activity	3.76 (1.05)			.72
Mean of overall commitment scale	3.77			

Note. Item response range for commitment scale: 1 = *strongly disagree* to 5 = *strongly agree*. AC = affective commitment; NC = normative commitment; CC = continuance commitment.

(PCA) to obtain a more concise elucidation of how respondents conceptualize the pathways through which they experienced nature as children. Because use of attitudinal commitment to nature-based activities is novel, we explored

**Table 5.** Item Statistics for the Behavioral Commitment to Nature-Based Activities Scale.

Activity	<i>M</i>	<i>SD</i>
Tent camping or backpacking	1.15	1.21
RV, motorhome, and/or trailer camping	0.27	0.76
Hiking	2.31	1.18
Walking	3.11	0.96
Bird watching	1.68	1.27
Fishing	0.90	1.11
Leisure biking	1.43	1.36
Scuba diving or snorkeling	0.21	0.58
Picnicking	1.33	1.07
Hunting	0.55	1.11
Motor boating or jet skiing	0.40	0.85
Rafting	0.09	0.35
Water skiing	0.13	0.47
Scenic driving	1.91	1.20
Sledding or snow tubing	0.60	0.95
Mountain biking	0.40	0.86
Snowshoeing	0.62	1.02
Visiting archaeological and historical sites	1.37	1.03
Gathering berries or other wild foods	1.37	1.24
In-line skating/rollerblading	0.13	0.48
Swimming in a lake or river	1.34	1.20
Taking naturalist-led programs	0.67	0.88
Snow sports such as skiing (downhill or cross country) and snow boarding	0.94	1.31
Horseback riding	0.18	0.57
Geo-caching	0.16	0.51
Running or jogging	1.18	1.48
Viewing nature/wildlife	2.56	1.11
Photographing nature	1.68	1.27
Kayaking	0.60	1.05
Canoeing	0.78	1.10
Visiting zoos	0.65	0.94
Off-road ATV riding	0.23	0.67
Relaxing outdoors	2.77	1.03
Ice skating outdoors	0.33	0.67
Visiting nature centers	1.24	0.96
Sailing/sail-boarding	0.20	0.66
Snowmobiling	0.10	0.40
Mean of behavioral commitment scale	0.96	

Note. Item response for scale: number of days of participation in listed activities in the 12 months preceding the study. ATV = All-Terrain Vehicle; RV = Recreational Vehicles.

the factorial structure of that scale issuing PCA. The four aspects of environmental citizenship are self-standing independently used measures. In addition, all four dimensions were highly internally consistent and hence, did not require exploration of the factorial structure of the overall scale. We used PCA, with varimax rotation because initial interfactor correlations were predominantly less than the .32 cutoff criterion (Tabachnick & Fidell, 2013). Components were extracted using the criteria of eigenvalues  $\geq 1.0$  and the leveling point of the scree plots of eigenvalues. We excluded loading scores  $\leq .50$  to enhance accuracy in the representation of components (Tabachnick & Fidell, 2013). Four dimensions, corresponding to four mechanisms of childhood exposure to nature, explaining 65.9% of variance, emerged from PCA of the exposure mechanisms scale (Table 2). We labeled those mechanisms as follows: school-related exposure, extracurricular exposure, family exposure, and self-exposure mechanisms. The aggregate scores (means) of each dimension of the exposure mechanisms were computed and used as predictors in subsequent regression analyses testing the three stated hypotheses for this study (Spector, 1992).

A one-component solution emerged from PCA of the behavioral commitment scale suggesting that respondents conceptualize behavioral commitment as a unidimensional construct (Tabachnick & Fidell, 2013). Three components, explaining 72.7% of variance, emerged from PCA of the overall attitudinal commitment scale. Those components corresponded to Allen and Meyer's (1990) established dimensions of affective, normative, and continuance commitment to nature-based activities (Table 4). All three dimensions of attitudinal commitment were highly reliable, with Cronbach's  $\alpha$  values of .94, .88, and .91 for affective commitment (AC), normative commitment (NC), and continuance commitment (CC), respectively. The mean scores of the scales assessing behavioral commitment; overall attitudinal commitment and its subdimensions of affective, normative, and continuance commitment; overall environmental citizenship and its subdimensions of environmental advocacy and activism, volunteerism, literacy, and political-ecological citizenship were computed. We used these mean scores as dependent variables in subsequent regression analyses to test stated hypotheses.

### *Hypotheses Testing*

We used a linear regression model to test Hypothesis 1—that different exposure mechanisms will each significantly predict, to different degrees, adulthood environmental literacy, environmental advocacy and activism, environmental volunteerism, and political-ecological citizenship. In the first through fourth models, we entered all four mechanisms of childhood



exposure to nature as predictors of environmental advocacy and activism, environmental volunteerism, environmental literacy, and political-ecological citizenship, respectively.

We used four linear regression models to test Hypothesis 2—that different exposure mechanisms will each significantly predict, to different degrees, adulthood overall attitudinal commitment to nature-based activities, and its subdimensions of affective, normative, and continuance commitment to nature-based activities. In each of these four models, we entered all four mechanisms of children's exposure to nature as predictors of overall attitudinal commitment to nature-based activities, and then of affective, normative, and continuance commitment to nature-based activities, respectively.

We used a linear regression model to test Hypothesis 3—that different exposure mechanisms will each significantly predict, to different degrees, adulthood behavioral commitment to nature-based activities. We entered all four mechanisms of childhood exposure to nature as predictors of behavioral commitment to nature-based activities. Significance tests were based on a cut-off probability value of .05. Values  $\leq .05$  were considered significant, values between .05 and .1 were marginally significant, and nonsignificant values were those  $\geq .1$  (IBM SPSS 19, Stepping Methods Criteria). All regression equations were diagnosed for multicollinearity, using tolerance coefficients, to ensure that there were no significant overlaps between any pair of exposure mechanisms (Leech, Barrett, & Morgan, 2005). To examine whether attitudinal commitments are associated with behavioral commitment to nature-based activities, we conducted a test of significant correlations between dimensions of attitudinal commitment and behavioral commitment to nature-based activities (Tabachnick & Fidell, 2013).

## Results

### *Hypothesis 1: Predicting Environmental Citizenship*

The four mechanisms of children's exposure to nature explained significant variance—moderate to low—in environmental advocacy and activism,  $F(4, 224) = 5.49$ , adjusted  $R^2 = .07$ ,  $p < .001$ ; environmental volunteerism,  $F(4, 224) = 4.26$ , adjusted  $R^2 = .05$ ,  $p < .01$ ; environmental literacy,  $F(4, 224) = 3.12$ , adjusted  $R^2 = .04$ ,  $p < .05$ ; and political-ecological citizenship,  $F(4, 224) = 2.35$ , adjusted  $R^2 = .02$ ,  $p = .06$  (Table 6). Exposure through school and school-related programs was the only significant predictor of environmental advocacy and activism, and of environmental volunteerism. However, exposure through school-related programs was not a significant predictor of environmental literacy and was only a marginally significant predictor of political-ecological

**Table 6.** Regression Analyses of Mechanisms of Children's Exposure to Nature as Predictors of Adulthood Commitment to Nature-Based Activities and of Adulthood Environmental Citizenship.

Exposure mechanism	Aspect of adulthood environmental citizenship									
	Environmental advocacy and activism		Environmental volunteerism		Environmental literacy		Political-ecological citizenship			
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
Extracurricular	.07	.07	.07	.07	.05	.07	-.01	.07		
School	.25**	.07	.22**	.08	.04	.08	.12 <sup>†</sup>	.07		
Family	.06	.07	.03	.07	-.01	.07	-.05	.07		
Self and friends	-.01	.07	.01	.07	.20**	.07	.14*	.07		

  

Exposure mechanism	Dimension of adulthood commitment to nature-based activities									
	Behavioral commitment		Overall attitudinal commitment		Affective commitment		Normative commitment		Continuance commitment	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
Extracurricular	.11 <sup>†</sup>	.06	.08	.07	.12 <sup>†</sup>	.07	.04	.07	.04	.07
School	.08	.07	-.04	.07	-.11	.07	.05	.08	-.01	.07
Family	.23***	.06	.03	.07	.08	.06	-.05	.07	.02	.07
Self and friends	.24***	.06	.36***	.07	.39***	.07	.22**	.07	.30***	.07

<sup>†</sup> $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

citizenship. Self-exposure was the only significant predictor of environmental literacy and political-ecological citizenship. Exposure through family, and through nonschool-related organized programs such as the Scouts and church programs, did not significantly predict any aspect of environmental citizenship (Table 6).

### *Hypothesis 2: Predicting Attitudinal Commitment to Nature-Based Activities*

The four mechanisms of childhood exposure to nature explained substantial variance in overall attitudinal commitment,  $F(4, 224) = 9.37$ , adjusted  $R^2 = .13$ ,  $p < .001$ ; and affective commitment,  $F(4, 224) = 12.46$ , adjusted  $R^2 = .17$ ,  $p < .001$ . Mechanisms of childhood exposure to nature explained low to moderate variance in normative commitment,  $F(4, 224) = 3.25$ , adjusted  $R^2 = .04$ ,  $p < .05$ ; and continuance commitment,  $F(4, 224) = 5.81$ , adjusted  $R^2 = .08$ ,  $p < .001$ , respectively (Table 6). Exposure to nature on one's own and with friends was

the only significant predictor of overall attitudinal commitment as well as affective, normative, and continuance commitment to nature-based activities. Extracurricular mechanisms of children's exposure to nature such as Scouts and church programs were marginally significant predictors of affective commitment to nature-based activities. There were no other significant relationships between children's exposure to nature and other aspects of attitudinal commitment to nature-based activities. Children's exposure to nature through school-related programs did not predict any aspect of adulthood attitudinal commitment to nature-based activities (Table 6).

### *Hypothesis 3: Predicting Behavioral Commitment to Nature-Based Activities*

The regression model with childhood exposure mechanisms as predictors explained considerable variance in adult behavioral commitment to nature-based activities,  $F(4, 231) = 14.39$ , adjusted  $R^2 = .19$ ,  $p < .001$  (Table 6). Childhood exposure to nature through immediate and extended family (family exposure), and on one's own and with friends (self-exposure), significantly predicted adulthood behavioral commitment to nature-based activities. Childhood exposure to nature through extracurricular organized programs such as summer camps, church-related and Scout programs was a marginally significant predictor of adulthood behavioral commitment to nature-based activities. Childhood exposure to nature through school-related programs did not significantly predict adulthood behavioral commitment to nature-based activities (Table 6). The minimum tolerance coefficient for all regression models was .76, well above the 0.64 (1-.36) cutoff criterion, further confirming that exposure mechanisms were sufficiently distinct from each other as previously indicated by the results of PCA (Leech et al., 2005). The Pearson's correlations between behavioral commitment and the dimensions of attitudinal commitment were .49, .39, and .30, respectively, for affective, continuance, and normative commitment to nature-based activities. All correlations were significant at  $p < .001$ .

## **Discussion**

In this study we, tested a series of hypotheses examining whether and to what extent different mechanisms through which children and youth experience nature predict various aspects of adulthood environmental citizenship and commitment to nature-based activities. We found support for our hypotheses, showing that type of exposure mechanism matters in several ways. First, all

the various exposure mechanisms, put together as predictors, explain considerable variance in adulthood environmental citizenship and commitment to nature-based activities. Second, different mechanisms of childhood exposure to nature have different significant associations with adulthood commitment to nature-based activities, and engagement in environmental citizenship behaviors in adult life. Childhood exposure to nature on one's own and with friends positively predicts both adulthood environmental citizenship and commitment to nature-based activities. Children and youth exposure to nature with family was a significant positive predictor of adulthood commitment to nature-based activities, but not of adulthood environmental citizenship. Children and youth exposure to nature through school programs was surprisingly not a significant predictor of environmental literacy and was also not a significant predictor of any aspect of adulthood commitment to nature-based activities. Children and youth exposure through nonschool-related organized programs did not have any effect on adulthood commitment to nature-based activities or adulthood environmental citizenship.

We know that childhood participation in nature-based activities is associated with more behavioral commitment to such activities and more environmental citizenship behaviors in adult life (Chawla & Derr, 2012; Larson, Whiting, & Green, 2011; Ward Thompson et al., 2008; Wells & Lekies, 2006). Childhood-nature experiences are known to be strong formative experiences that shape people's desire to become environmental educators, and to care for the environment (Palmer et al., 1999). But, until this study, it was unclear whether and to what extent the various mechanisms of children and youth exposure to nature were related to those outcomes. It is also known that differences in the mechanisms of childhood exposure to nature lead to different degrees of proenvironmental behaviors and commitment to nature-based activities in the short term (Collado et al., 2013). But, until this study, little was known about such differences for long-term effects. Our findings are a contribution to evidence that the mechanisms through which children experience nature have differential long-term relationships to aspects of environmental citizenship and commitment to nature-based activities. Some exposure mechanisms may be more or less effective and efficient in attaining desired long-term outcomes such as adulthood environmental citizenship and commitment to nature-based activities. In the following sections, we discuss how the phenomena of nature-acculturation and degree of structure in exposure mechanisms help explain the differential relationships to adulthood environmental citizenship and commitment to nature-based activities. Given the relative novelty of the concept of commitment to nature-based activities, we also discuss how exposure mechanisms may shape such commitments.

### *Nature-Acculturation and Childhood-Nature Exposure*

The concept of nature-acculturation (Asah et al., 2012; Bell et al., 2014) sheds some light on our findings. Nature-acculturation, like other learned behaviors, posits that social and material arrangements of childhood exposure to nature shape how children and youth interact with nature and their consequent behaviors. Strong memories of the relational basis of children's nature-acculturation, such as time spent playing with family and friends in nature-based settings, has been underscored (Chawla, 2007; James et al., 2010; Spartz & Shaw, 2011). The behavioral foci of nature-acculturation might explain why childhood exposure to nature through family predicts adulthood behavioral, but not attitudinal, commitment to nature-based activities. In addition, childhood exposure to nature through family included measures of exposure with immediate and extended families. Immediate and extended families may have different psycho-cultural dynamics, and the effect of the interactions between nuclear and extended families on outcomes of interest depends on those unique psycho-cultural differences (Akcinar & Baydar, 2016). Hence, it could be that the two distinct pathways of exposure—through immediate family and through extended family—have counterpoising effects on adulthood attitudinal, but not behavioral, commitment to nature-based activities. For example, it is quite possible to frequently attend family reunions, a manifestation of behavioral commitment, yet hold unfavorable attitudes—lack of attitudinal commitment—toward those reunions. How the interplay of these two exposure pathways—nuclear and extended family—shapes the observation of effect on behavioral, but not attitudinal, commitment to nature-based activities is an interesting area of future empirical observation.

### *Degree of Structure and Childhood-Nature Exposure*

Researchers point to the influence of structure, different degrees of restrictions on play, and interactions with nature, on children's play within and beyond nature-based settings (Floyd et al., 2011; Ginsburg, 2007; Louv, 2008). But, the long-term effects of such structure on outcomes such as environmental citizenship and commitment to nature-based activities were unclear. Our findings initiate bridging of that knowledge gap. Different nature-acculturation mechanisms entail different social and material arrangements and associated degrees of structure, relational play, and free-choice informal learning. These differences undoubtedly have different effects on the cognitive and affective antecedents of adulthood environmental citizenship and commitment to nature-based activities (e.g., Asah et al., 2012; Bell et al., 2014).

Although participation in environmental education programs has been shown to have robust positive influences on childhood connectedness to nature (Liefländer, Fröhlich, Bogner, & Schultz, 2013), no follow-up observations were conducted to confirm that such influences lasted into adulthood. Our findings shed some light on this phenomenon. We expect less structure, and consequently, freer interactions with nature through self-exposure to nature-based activities than when children and youth experience nature through more organized pathways such as school-based or Scout group programs (Ginsburg, 2007). Hence, less structure, and consequently, freer nature experiences might explain why self-exposure predicted all dimensions of adulthood commitment to nature-based activities whereas school-related exposure had no relationship to any aspect of adulthood commitment to nature-based activities. Of all four exposure mechanisms, we expect school-related exposure pathways to be the ones with the most structure. More structure, and consequently, lesser discretion to explore nature during childhood may undermine the psychological fortitude needed to resist the urge to withdraw from participating in nature-based activities in adult life. Hence, it is possible that with freer play, children have much deeper interactions with nature and hence cultivate stronger and more enduring connections with nature. For example, compared with when adults are absent, the presence of adults—parents or other adults—has been shown to be associated with lower intensities of children's physical activity in nature parks (Floyd et al., 2011). These findings, in light of the differences between free and structured play, are additionally insightful because commitment to nature-based activities is not only associated with improved health but also with enhanced environmental citizenship (Liddicoat & Krasny, 2013; Wells & Lekies, 2006).

Less structure and the consequent freer exploration of nature associated with the mechanism of childhood exposure also present opportunities for more free-choice informal learning. Free-choice informal learning contributes significantly to lifelong learning (Dierking & Falk, 1994). Most pertinently, it is argued that most environmental learning is acquired outside of school through free-choice learning experiences—where learners use considerable discretion and control over their learning (Falk, 2005). These insights constitute plausible explanations of two important findings from this study. First, that school-related exposure mechanisms did not significantly predict environmental literacy, and were only marginally predictive of political-ecological citizenship. Second, and in contrast, self-exposure to nature was the only significant predictor of adulthood environmental literacy and the strongest predictor of political-ecological citizenship. Of all four mechanisms of exposure, we expect children and youth to experience the least structure, and hence more discretion and opportunities for informal learning, when they

expose themselves to nature. It is logical to think that freer exploration of nature enables much deeper interactions with nature, and hence, the acquisition of more knowledge about nature. A consequence is the observation of a more enduring effect of childhood self-exposure to nature on adulthood environmental literacy. Therefore, our findings may be suggesting that free-choice learning, through self-exposure to nature, might be the most effective approach to fostering not only environmental literacy but also political-ecological citizenship. The importance of political-ecological citizenship to conservation policy making in functioning democracies cannot be overemphasized (Latta, 2007).

To the extent that structure is relevant, higher levels of structure in the mechanism of children's exposure to nature might enhance some aspects of adulthood environmental citizenship. School-related exposure to nature was the most prevalent predictor of aspects of adulthood environmental citizenship—the only significant predictor of advocacy and activism, and of volunteerism. But, our findings still suggest that exposure mechanisms that have less structure are more likely to achieve both adulthood environmental citizenship and commitment to nature-based activities. This is the case because behavioral commitment is an antecedent of environmental citizenship (Wells & Lekies, 2006). And, self-exposure to nature, the likely mechanism with the least structure, had the strongest relationship to adulthood behavioral commitment to nature-based activities.

### *Exposure Mechanisms and Commitment to Nature-Based Activities*

The concept of commitment is becoming a mainstay of efforts to understand how people relate to and act toward nature (e.g., Asah & Blahna, 2013; Davis et al., 2009; Davis et al., 2011). But, the concept of commitment had rarely been used in the particular context of nature-based activities. This study is a contribution to that understanding, by showing how mechanisms of childhood exposure to nature inform both behavioral and attitudinal commitment to nature-based activities. The importance of the mechanisms of childhood exposure to nature on the psychological bonds between adults and nature-based activities is especially telling with respect to how those exposure mechanisms are related to continuance commitment. Continuance or cost-benefit commitment indicates that such commitments exist only until a better alternative is identified (Meyer et al., 2002). Strikingly, self-exposure to nature was the only significant predictor of continuance commitment, and strongly so, suggesting that self-exposure to nature-based activities curtails the perceived suitability of alternatives to nature-based activities. Given the

cost–benefit calculative nature of continuance commitment, our results suggest that adults who exposed themselves to nature during childhood, unlike through other exposure mechanisms, are most likely to perceive a higher cost of not participating in nature-based activities.

The central role of childhood self-exposure to nature regarding adulthood commitment to nature-based activities is also insightful in view of the different roles that various dimensions of attitudinal commitment play in desirable outcomes in occupations and organizations. In a meta-analysis, affective and normative commitments were positively related to job performance and organizational citizenship behaviors, whereas continuance commitment was negatively correlated with performance, and had a near-zero correlation with organizational citizenship behaviors (Meyer et al., 2002). That is, affective and normative commitment are the more influential aspects of commitment in occupations and organizations (Meyer et al., 2002). Although all three dimensions of attitudinal commitment were significantly correlated with behavioral commitment to nature-based activities, affective and continuance commitments had higher correlations. And, self-exposure to nature was the only significant predictor of continuance commitment and the strongest predictor of affective commitment to nature-based activities. Hence, our findings may further underscore the importance of childhood self-exposure to nature to the development of emotional attachment to, identification with, and involvement in nature-based activities, as well as to the perceived higher cost associated with withdrawing from such activities in later life (Meyer & Allen, 1984).

### *Limitations*

Like most studies, this study has several limitations. Our findings could have been strengthened by an experimental observational approach where children and youth are exposed to nature-based activities through various pathways and then followed through adulthood to examine their environmental citizenship behaviors and commitment to nature-based activities. But the resource-intensive nature of such an approach is prohibitive. The approach used in this study—cross-sectional observation of exposure mechanisms—depends heavily on respondent recall, which may lead to respondent biases. But, respondent recall has been used to make insightful contributions to understanding the childhood-nature nexus. Moreover, the fairly high reliability of the scale assessing childhood exposure, in this and other studies (Larson et al., 2011), suggests that childhood-nature experiences are quite notable phenomena, which may moderate, but not completely eliminate, the drawbacks of memory on the cross-sectional observational approach.



Our study sample, with higher levels of education and higher proportions of Caucasians than the general public, is less representative of the general population. In addition, as natural resource professionals, USFS employees may presumably have higher tendencies to engage in nature-based activities and environmental citizenship behaviors. Further research using a more representative sample of the general public and across more diverse populations may shed additional light on the relationships between mechanisms of children's exposure to nature and desired outcomes in adult life. Our measures of adulthood environmental citizenship and behavioral commitment to nature-based activities used self-report rating scales. Although both scales were highly reliable, they are less precise measures of actual behaviors. Studies using more direct observations of actual behaviors might be more insightful. However, one size may not fit all; although a certain number, duration, and intensity, of engagement in particular behaviors may suffice for some, it may not be so for others. Thus, the human subjectivity that is captured in these measures is an important consideration in the study of human behavior (Stephenson, 1953).

## **Conclusion and Recommendations**

In summary, the various mechanisms through which children and youth are exposed to nature were considerably associated with environmental citizenship behaviors and commitment to nature-based activities in adult life. Childhood exposure to nature through school-related programs was most associated with environmental advocacy and activism, and with environmental volunteerism. However, school-related exposure to nature did not predict environmental literacy or any aspect of adulthood commitment to nature-based activities. But, self-exposure to nature during childhood was associated with improved adulthood commitment to nature-based activities and with enhanced environmental literacy and political-ecological citizenship behaviors during adult life. Hence, children's self-exposure to nature may be a more efficient exposure mechanism, if the interest is to realize both adulthood environmental citizenship and overall commitment to nature-based activities.

As reflected in the content of the measures of mechanisms of childhood exposure to nature, about 80% of the variance explaining observed effects on citizenship and commitment was constituted by exposure pathways for which informal learning is highly probable (Falk, 2005), and known to be important for lifelong learning (Dierking & Falk, 1994). Hence, informal pathways of childhood exposure to nature are especially important for adulthood commitment to nature-based activities and for environmental stewardship in later

life. Thus, efforts aimed at achieving adulthood environmental literacy and commitment to nature-based activities may consider mechanisms of exposing children to nature that have less structure and more opportunities for free play and free-choice learning.

The observation of different effects of different exposure mechanisms on aspects of adulthood citizenship and commitment to nature-based activities is also noteworthy. Self-exposure to nature—on one's own and with friends—was most associated with psychological bonds that bind adults to nature-based activities from both behavioral and attitudinal standpoints. Exposure through family significantly predicts adults' tendency to continue to participate in nature-based activities. Clearly, multiple exposure pathways are needed to achieve the multitude of benefits of childhood exposure to nature. Efforts aimed at introducing children and youth to nature should consider diverse exposure mechanisms to achieve these different outcomes. These recommendations should be considered with caution given the limitations of our study and the paucity of studies of this type.

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