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Children's connection to nature as fostered through residential environmental education programs: Key variables explored through surveys and field journals

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ABSTRACT

Children's connection to nature increasingly is of interest in education, psychology, urban planning, and other related fields. Research findings emphasize the central importance of early connections due to resulting benefits for environmental awareness, knowledge, social-emotional learning, health, and wellbeing. To more clearly conceptualize the process by which connection to nature occurs, we studied fifth-grade students ($n = 317$) from three California schools (12 classrooms) participating in a four-day residential field-study program in different times of the year. The most revealing finding was the influence of weather on developing connection to nature. On average, students participating during inclement weather had significantly lower connection to nature scores on the post-experience than on the pre-experience measures. This insight into the influence of weather led to suggestions about program design, planning, and management of expectations. Although mild weather did not cause an issue for participants, severe weather interfered with developing and maintaining strongly connected nature-related relationships, suggesting that field studies be undertaken with caution during extreme weather.

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Introduction

The term *nature connectedness* describes the human-nature relationship, which researchers envision as having three core components: 'cognitive (connectedness), affective (caring), and behavioral (commitment)' (Schultz 2002, 61). The cognitive component refers to how people conceive of themselves as a part of nature. The affective defines the extent to which a person cares about nature, and the behavioral addresses how committed a person is to protecting nature. Within this framework, we have evidenced a growing worldwide dialogue related to the need for (re)connecting children, in particular, to nature and nature-rich settings. That burgeoning dialogue is partially motivated by an overall sense of concern about the loss of direct experience

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coupled with the diminished access to nature-rich and green spaces in close proximity to where many youth live (Chawla 2007, 2009).

Relatedly, researchers recognize that this phenomenon is particularly challenging to study as the variables that may influence the relationship between children and nature are numerous and occur at various individual as well as societal scales. Yet environmental educators are committed to developing programs that nurture this nature connection, and researchers to creating better measures for characterizing it and measuring the effects, in part because 'the battle for the environment cannot be won unless it is based on a new ethic of the relationship of human beings with nature' (UNESCO-UNEP 1989, 2).

Measuring connection to nature among children

A number of approaches and instruments have been developed to measure humans' connection to nature. Among the most widely used are Clayton's (2003) environmental identity instrument and Mayer and Frantz's (2004) connection to nature measure, both of which initially focused on adults. To measure connection to nature among children ages 8 to 12, Cheng and Monroe (2012) adapted measures from these two instruments (Clayton 2003; Mayer and Frantz 2004), combining and re-validating them in the Connection to Nature Index (CNI), which includes 16 items, based on Schultz's (2002) definition of nature connection. They emphasize four similar components to Schultz: *enjoyment of nature*, *empathy for creatures*, *sense of oneness*, and *sense of responsibility*. Cheng and Monroe (2012) and others have applied the CNI instrument in natural settings as, traditionally, connection to nature has been conceptualized as motivated by interaction with the "natural environment," through a process whereby an individual comes in direct contact with "nature" (Chawla 1988; Collado, Staats, and Corraliza 2013; Duerden and Witt 2010).

In such settings and using the initially developed measure, Cheng and Monroe (2012) found that children's connection to nature could be predicted by that child's 'interest in participating in nature-based activities' (46). Relatedly, and in support of this finding, Liefländer et al. (2013) found that 'strengthening connectedness to nature is more sustainable before the age of 11' (370). Wells and Lekies (2006) found positive childhood experiences with 'wild nature before age 11 [to be] a particularly potent pathway' to enhance stewardship in adulthood (13). Building on and aligned with these earlier studies, researchers have found that residential field-study programs, in which students are immersed in natural settings for at least one, if not multiple, nights can help increase children's sense of connection with nature and nature-rich settings (Ardoin et al. 2016; Ernst and Theimer 2011; Frantz and Mayer 2014; Hinds and Sparks 2008; Liefländer et al. 2013; Stern, Powell, and Ardoin 2008).

Cheng and Monroe (2012) used Schultz's (2000) description of *empathy* as 'other-oriented feelings of concern about the perceived welfare of another' (402). The researchers also employed Mayer and Frantz's (2004) definition of *oneness with nature* as 'sense of kinship with animals and plants, and sense of equality between the self and nature' (Mayer et al. 2009, 614). Although Cheng and Monroe did not provide definitions for *enjoyment of nature* and *sense of responsibility* from the literature, definitions of these terms are implied in the items in the CNI instrument they developed. They characterized *enjoyment of nature* as a series of statements expressing positive emotions such as "I like" or "makes me happy" or "is fun" related to spending time in nature. The researchers characterized *sense of responsibility* with the series of statements reflecting understanding of how human actions affect the environment both positively and negatively (41).

Several subsequent studies with youth have employed the CNI instrument. Bragg et al. (2013) assessed the workability of the three most-used instruments to measure children's connectedness to nature, finding CNI to have the highest internal reliability, with a coefficient alpha of .82, based on Cronbach's (1951) reliability measure. In a 2015 study, in which 2,240 students from Ireland participated, Kerr (2015) found the same value as the coefficient alpha of 0.87 reported in the original study by Cheng and Monroe (2012).

Nature Connectedness Survey

Please say how much you agree or disagree with each of the following statements by checking the appropriate box.

Identification Number: _____

I am a boy ☐ I am a girl ☐

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I like to hear different sounds in nature					
I like to see wild flowers in nature					
When I feel sad, I like to go outside and enjoy nature					
Being in the natural environment makes me feel peaceful					
I like to garden					
Collecting rocks and shells is fun					
I feel sad when wild animals are hurt					
I like to see wild animals living in a clean environment					
I enjoy touching animals and plants					
Taking care of animals is important to me					
Humans are part of the natural world					
People cannot live without plants and animals					
Being outdoors makes me happy					
My actions will make the natural world different					
Picking up trash on the ground can help the environment					
People do not have the right to change the natural environment					

Thank you

Figure 1. CNI remodeled version for 8-to-12-year-olds (adapted from Cheng 2008; Cheng and Monroe, 2012; RSPB, 2013).

Although researchers have developed other instruments to measure children's nature connectedness, we employed the CNI instrument in this study for several reasons related to the intention of this research: to examine factors contributing to children's connection to nature while participating in a multi-day, field-based environmental-education program. First, researchers have repeatedly found the instrument to be highly reliable in terms of the total score and two components. Second, it has supporting validity evidence. Third, it is relatively straightforward to administer with children (Figure 1).

Setting and sample

Setting

We conducted this research in partnership with Walker Creek Ranch (WCR), which is operated by the Marin County Office of Education in Northern California. The site provides residential field-study programs to fourth- through seventh-grade students from the region. The ranch's objective is to help children reach their educational goals and encourage them to develop an appreciation of and a deeper connection with nature (Walker Creek Ranch 2016).

The ranch is located in a wilderness area in Petaluma, about 60 miles north of the Golden Gate Bridge in San Francisco, California. The site includes open meadows, forest, chaparral, and riparian ecosystems, as well as a variety of wildlife. Walker Creek provides numerous opportunities for students to interact with nature-based settings including, for example, a pond, a creek, several hiking trails, a barn with domesticated animals, a nature museum, a campfire site, and an organic garden.

At this residential nature center, students participate in various activities throughout the week, including hiking, observing wildlife, identifying plants, visiting a pond or a creek, studying and eating produce from the organic garden, singing nature-related campfire songs, and playing nature-related games and activities. To reinforce the importance of environmentally responsible behavior, students are taught to collect and measure the food they do not eat (i.e., the food they waste) after meals. They also are taught explicitly as well as by example how to compost and recycle.

Students are divided into trail/hiking groups of 20 or fewer; under the guidance of a naturalist, they work and learn with those groups throughout the week. The center provides students with field journals that include prompts to help children notice plants and animals and to consider interrelationships, habitats, and adaptation of those plants and animals to the environment. Site naturalists work with the groups to complete activities and capture their thoughts and observations in the journals. The analysis of students' journals has revealed a great deal of information about how, why, and in what ways the field trips may be influential for participants.

Walker Creek developed the field journals and the related activities; the ranch's naturalists implement the related activities each week with the students. Although the program purports to have the same goal for every participant, naturalists have discretion in choosing which activities to pursue, specifically, with their groups on a weekly basis. The naturalists take special care, and are supported by their managers and the accompanying teachers, to ensure that children spend most of their time outdoors to interact with and be immersed in nature-rich settings.

Sample

The sample of participants was drawn from among the schools that attended Walker Creek in Spring 2017. The selection criteria were then created to be more stringent and create comparability among and within the case (Yin 2017). The criteria applied were as follows: the participating students would be in fifth grade, from the same county, attending a four-day program, and on site at Walker Creek in Spring 2017 (January to June).

In the end, the final sample consisted of 317 fifth-grade students from three San Francisco Bay Area public schools scheduled to spend four days at Walker Creek: School 1 ($n = 150$), School 2 ($n = 70$), and School 3 ($n = 97$). The county in which the three schools are located has a fairly high socioeconomic level. In this county, residents have the opportunity and the means to visit parks, seashores, and open space relatively frequently. The sample includes all students whose guardians provided permission to participate and were present on the day when the CNI

instrument was administered before and after the field-study experience. The sample includes roughly an equal number of male and female participants. Demographic frequencies for gender were obtained from 164 matched pre- and post-surveys only (79 male and 85 female). Most collected journals ($n = 159$) did not have gender information, but teachers stated that their classes were fairly evenly split between boys and girls.

Data collection methods

Data collection commenced in January 2017 and continued through June 2017. Data were gathered using the CNI survey instrument and students' field journals. The CNI was administered before and after the program to compare students' level of connection to nature before and after the four-day field-study experience; then data among the three schools were compared. Data from students' field journals were generated during the field study based on the provided prompts (Table 1). These included questions about students' thoughts and perceptions about nature as well as about students' favorite nature-related activities. All students received a journal when they arrived at WCR and all prompts were included in the journal; however, because the weather influenced the activities in which the students could participate, some of the prompts were more or less relevant than others to the different groups' experiences, and the naturalists made adjustments to ensure opportunities for learning. The journal responses were analyzed qualitatively/quantitatively to examine for the possible influence on attendees' experiences.

Because Cheng and Monroe (2012) originally asked participants to complete their CNI survey instrument online, a hard-copy version of the CNI instrument was created for this study. In creating this version, the exact wording for the terms *Strongly Disagree*, *Disagree, Neutral*, *Agree,* and *Strongly Agree* from Cheng's dissertation was used (Cheng 2008, 103), with the graphic

Table 1. Selected field journaling prompts from Walker Creek journal.

Journal Prompts
Outdoor School Pledge
I, _____, as a citizen of the Earth and new member of the Walker Creek Community, understand that I have a responsibility to treat our home the Planet Earth with care and respect. From this moment on, I pledge to:
I also understand how my actions affect other people. Therefore, I set the following goals to build positive relationships with others:
I notice, I wonder, it reminds me of
Explain the most interesting thing that you learned or experienced.
Describe your favorite campfire song.
If someone asked you where to see the best view at Walker Creek, where would you send them? What is the spot that you think is beautiful? Draw a picture of it.
Describe your night hike experience. What did you think it would be like before you ventured out into the night? What did you do and how did you feel?
Which of your five senses helped you the most at night?
Create your own creature of the night … don't forget its special adaptations!
What did you do today to help reduce, reuse, and recycle? Did you see any trash on the trail and pick it up to recycle or throw in the garbage?
What is the best memory you have from the week?
What was the most important thing you learned about yourself this week?
Did you learn something at Walker Creek that you can now apply at home, at school, or in your community?
What has changed in you?
Memories

layout from the Royal Society for the Protection of Birds (RSPB) (2013). Two sentences were added to obtain gender information. The created version was pilot tested.

Pilot study

A pilot study was completed with 79 fifth-grade students in Marin County to test for reliability of the CNI instrument in this setting with this population, as well as to confirm the clarity of the statements and the time required to complete. Two of the four components had a high measure of reliability with a coefficient alpha above 0.70; the other two components had low reliability, most likely attributable to the low number of items (three in each). Because the CNI had high reliability evidence, the total score was used with confidence. The first two components, which had high reliability (*enjoyment of nature* and *empathy for creatures*), were used in the data analysis, whereas the last two components (*sense of oneness* and *sense of responsibility*), which did not yield adequate reliability evidence, were omitted from the data analysis. It took students approximately 5 to 10 minutes to complete the CNI survey instrument.

Administration of pre- and post-experience surveys and journaling exercises

Classroom teachers were given copies of the CNI instrument, briefed on how to administer it, and provided instructions to read aloud to the students. They allowed students 10 minutes of class time to complete the CNI survey instrument, as established by the pilot study. Students handed the completed CNI survey to their teacher prior to arriving to the field-study site.

With regard to the journaling activity, classroom teachers and/or naturalists instructed students on the process of journaling.

After participating in the multi-day, residential course, teachers administered the CNI survey instrument again to measure students' post-experience. Pre- and post-experience surveys were matched by confidential numerical coding assigned and provided by the individual teachers. Upon receipt of the data, participants' identification was recoded in numerical sequence to ensure no numbers were duplicated.

Teachers also collected students' completed field journals and submitted them for data analysis purposes as well. Some journals were identified with names, some with numbers, some with both, and some did not have any identification. Students' journals were re-coded with a new identification number to address the issue of confidentiality. Field journals were scanned for analysis.

Students who were present to complete the CNI surveys, but did not attend the residential field-study program, were omitted from the dataset. Thus, the final sample sizes of students who had matched pre- and post-experience surveys were as follows: School 1 ($n = 71$), School 2 ($n = 74$), and School 3 ($n = 19$). School 3's post-experience data were collected during the last week of the school year, making it difficult for teachers to collect the data from students who participated in the program.

School 1 attended the Walker Creek program in February. Because of extreme storm conditions, students who participated at this time had to end their Walker Creek visit short of the four days. With their school closed due to weather, the children were not able to return to school for several days. Therefore, teachers had students complete the post-experience CNI surveys and parts of journals within two to three weeks after their Walker Creek experience.

School 2 attended the Walker Creek program in April. After students returned to school from Walker Creek, their district immediately transitioned to a weeklong Spring Break. Therefore, teachers had students complete the post-experience CNI surveys approximately a week-and-a-half after their Walker Creek experience.

School 3 attended the Walker Creek program in June. The final week of the school year occurred the week after returning from the four-day residential experience. Therefore, the classroom teachers asked participating students to complete the post-experience CNI surveys the day following their return from Walker Creek. Because of this timing, only some teachers/classes were able to complete the post-experience surveys with their classes and collect the journals.

Data analysis

Data were analyzed using paired-sample *t* tests between pre- and post-experience measures (CNI) within each school. One-way analyses of variance (ANOVAs) were conducted to compare the differences among the three schools on the change from pre- to post-experience measures for the three scale scores. Descriptive statistics, including means and standard deviations, for each score were computed. Because the results of the one-way ANOVAs were statistically significant, Tukey post-hoc comparisons were made. (The level of significance was set at 0.05.) Cohen's *d* was computed to measure the effect size to address the issue of practical significance. (For the CNI instrument, only a few items had missing responses.) For all student responses, fewer than one percent included missing data. Regardless of how many items a student missed or did not respond to, we based the mean on the number of items to which the student responded.

Because the four components of CNI are particularly influential for children's connection to nature, as defined in this study, we selected those four components as the top-level coding themes. Those components built on the basic nature-connectedness components that Schultz (2002) describes: 'cognitive (connectedness), affective (caring), and behavioral (commitment)' (61). Emerging from the data, we found additional subcomponents, not covered in CNI; we added those emergent aspects to the four original components (Table 2).

We read each journal to identify activities and experiences in which the students engaged. Following Creswell's (2015) guidelines, we developed a codebook that contained a combination of predetermined and emergent codes. After reviewing the files, we coded relevant data into one of the four components of CNI. From students' journal entries, we identified appropriate subthemes and subcomponents. We created columns for each of the three schools and clustered data under the relevant columns. Columns were also created to classify students' statements as positive or negative, when applicable. We combined coding of themes and subthemes regardless of the prompt. To enhance qualitative validity, while coding, codes were refined iteratively, as appropriate. To ensure qualitative reliability, following Patton's (2002) guidelines, two subject-matter experts were engaged to review themes, subthemes, and their components. Based on their suggestions, we made revisions to the initial coding structure. The only recommendation was that two statements coded under *empathy for creatures* be included under *sense of responsibility* as well.

All coders followed a defined protocol based on the CNI. We thus worked to minimize the influence of coder bias through using such clearly defined protocols and consistent structures. In addition, none of the coders had contact with students before, during, or after their immersion-program experiences as the teachers collected all data.

Results

In total, we collected data from 159 field journals and 164 matched pre- and post-experience CNI surveys (Table 3).

Results of the analysis of change from pre-experience to post-experience surveys in terms of CNI were statistically significant for all three schools (Table 3). Specifically, the findings were as follows, based on Cohen's (1992) criteria: For School 1, a small negative effect size (Cohen's

Table 2. Summary of themes, subthemes, and components.

Theme 1: Enjoyment of Nature	**Theme 2: Empathy for Creatures**	**Theme 3: Sense of Oneness**	**Theme 4: Sense of Responsibility**
Subthemes	Subthemes	Subthemes	Subthemes
Nature Observations	**Empathy for Animals**	**Kinship With Nature**	**Practiced Environmentally Responsible Behaviors**
Animals	Love or Like Animals	Being Alone in Nature	
Plants	Touch Animals (pet or gently hold)	Being Out in Nature	Environmental Clean Up
Scenic Vistas	Feed Animals	Being Calm or Peaceful in Nature	*Compost*
Nature Sounds	Watch Out for (treat well, be kind, not hurt or disturb, respect, help)	Connecting With Animals	*Not Litter*
Nonliving Ecosystems such as Mountains, Rocks, etc.	Save Animals (not kill, not step on, look out)	Connecting With Plants	*Pick Up Trash*
Hiking	Sad, if Hurt	**Equality Between Self and Nature**	*Recycle*
Day Hike	**Empathy for Plants**	Importance of Animals	Reduce Waste/Not Waste
Night Hike	Love or Like Plants	Importance of Plants	*Not Waste Food*
Solo Hike	Hug a Tree	**Noticing Nature**	*Reuse Water Bottles*
Hiking on a Warm, Sunny Day	Water a Plant		*Save Energy*
Hiking in Cold, Rain, & Strong Wind	Protect Plants (treat right, take care, plant a plant, respect, garden)		*Save Water*
Getting Muddy, Dirty, & Wet	Save Trees or Forest (not pick, not pull)		Leave No Trace
Additional Nature Activities	Sad, if Hurt		**Commitment to Future Environmental Actions**
Visiting a Barn	**Empathy for Nature**		Environmental Clean Up
Visiting a Pond or a Creek	Love or Like Nature (empathy for, pledge to Earth)		*Compost*
Visiting a Garden & Sampling its Produce	Take Good Care of Nature or the natural Environment (protect, respect, help, kind)		*Not Litter*
Singing Nature Songs	Sad, if Hurt		*Not Pollute*
			Pick Up Trash
			Recycle
			Reduce Waste/Not Waste
			Not Waste
			Not Waste Food
			Save Energy
			Save Water
			Communicate or Encourage Environmental Awareness
			Leave No Trace
			Saving (protecting the life of) Plants or Animals

criterion for small $d = \pm 0.20$) for all three measures; for School 2, a moderately positive (Cohen's criterion for medium $d = 0.50$) for the CNI *Total* and the dimension of *enjoyment of nature*; and for School 3, largely positive (Cohen's criterion for large $d = 0.80$) for the CNI *Total* and moderately positive for *enjoyment of nature* and *empathy for creatures*.

The greatest difference in change scores from pre- to post-experience surveys occurred between Schools 1 and 3. The results of one-way ANOVAs ($F(2, 161) = 15.84$, $\eta = 0.16$, Total CNI; $F(2, 161) = 14.60$, $\eta = 0.15$, Change in *enjoyment of nature*; $F(2, 161) = 7.50$, $\eta = 0.08$, Change in *empathy for creatures*) with post-hoc comparisons using the Tukey test indicated

Table 3. Pre- and post-experience survey means, standard deviations, dependent-sample *t*-test results, and effect sizes for total CNI and two components ($N = 164$).

		Pre-CNI		Post-CNI				
School	*n*	Mean	SD	Mean	SD	*t*	*df*	*d*
Total CNI								
1	71	3.88	0.52	3.78	0.59	−2.21*	70	−0.26
2	74	4.24	0.46	4.34	0.43	4.34*	73	0.50
3	19	4.00	0.42	4.28	0.41	4.41*	18	1.01
Enjoyment of Nature								
1	71	3.48	.71	3.31	0.78	−2.76*	70	−0.33
2	74	4.01	.66	4.13	0.59	4.06*	73	0.47
3	19	3.52	.54	3.82	0.73	3.05*	18	0.70
Empathy for Creatures								
1	71	4.26	0.59	4.12	0.65	−2.26*	70	−0.27
2	74	4.55	0.48	4.58	0.46	1.42	73	0.16
3	19	4.46	0.49	4.70	0.34	2.17*	18	0.50

*Statistically significant at the .05 level.

Table 4. Means and standard deviations for CNI change values reported by schools for total CNI and two components.

Variables	School	*n*	*M*	*SD*
Change in Total CNI	1	71	−0.10	0.38
	2	74	0.10	0.20
	3	19	0.29	0.28
Change in Enjoyment of Nature	1	71	−0.17	0.52
	2	74	0.11	0.24
	3	19	0.31	0.45
Change in Empathy for Creatures	1	71	−0.14	0.52
	2	74	0.04	0.26
	3	19	0.24	0.47

Note: CNI change is the difference between posttest and pretest averages. The range is −1.03 to 1.00

Table 5. Results of post-hoc comparison on mean change scores for total CNI and two components.

	School 1		School 2		School 3	
	M Diff	*d*	*M Diff*	*d*	*M Diff*	*d*
Change in Total CNI						
School 2	0.20*	0.67	–		−0.19*	−0.63
School 3	0.39*	1.30	0.19*	0.63	–	
Change in Enjoyment of Nature						
School 2	0.28*	0.68	–		−0.20*	−0.49
School 3	0.48*	1.17	0.20*	0.49	–	
Change in Empathy for Creatures						
School 2	0.18*	0.44	–		−.20*	−0.49
School 3	0.38*	0.93	0.20*	0.49	–	

*Statistically significant at the 0.05 level.

that the CNI means were statistically significantly different when comparing each school with the other schools. The mean change score for School 1 decreased, whereas the mean change score for School 2 and School 3 increased. Overall, students in School 3 experienced the largest positive change in their connection with nature (Tables 4 and 5).

Findings from journal data

We classified the data from students' journals into four CNI components. As applicable, we recorded the number and percentage of students' positive and negative responses. The

percentage for each component was based on the total number of responses for that specific component. Within the journal writings, School 1 students expressed the least positive connection to nature as measured by this index. On the CNI responses, those students also had lower scores, on average, on post-experience than on pre-experience surveys.

Weather

As noted, the post-experience CNI scores of the students attending in April (School 2) and June (School 3) were significantly higher, on average, than their pre-experience CNI scores; this is in contrast to the students attending in February (School 1). Students who attended in June (School 3) had the highest post-experience CNI scores, on average.

When examining for dimensions of the programs that may have differed among Schools 1, 2, and 3, one clear element was weather. The weather during the visit of students who attended the field trips in April and June was substantially "better" than that of the field trip in February in terms of being less rainy, warmer, and more comfortable for spending time in the outdoors. Relatedly, the students' post-experience CNI scores were higher, on average, than their pre-experience CNI scores. Students who attended the program in June (School 3) had the sunniest, warmest weather and also had the highest CNI scores, on average, on their post-experience CNI scores.

The words and drawings from students' field journals provided evidence for the physical and emotional responses children expressed about their connection to nature, supporting the CNI survey results. Journal analyses revealed that the results, overall, were influenced by both the weather and specific activities in which students participated.

During School 1's visit, torrential rains and cold weather restricted students' outdoor activities, resulting in the group leaving after three days. Certain activities (e.g., Pond Study, Sit Spot, and Outdoor Campfire) were canceled. During School 2's visit, the weather included a mix of rain showers, wind, and sun. The students were able to participate in the majority of the outdoor activities and stayed the full four days. During School 3's visit, the weather was sunny and warm with a mild breeze. The students stayed the full four days and were able to participate in all planned outdoor activities.

The students documented the weather conditions in their journals (Figures 2–4). Notwithstanding the weather, all students participated in some form of solo hiking, and all students indicated in their journals that this activity presented notable, but also surmountable challenges, and that they experienced a sense of accomplishment after completing the hike. They expressed a sense of strengthened connection to nature after the solo hike.

Enjoyment of nature

Students participated in three types of hikes: day, night, and solo. In their journals, School 3 students had the highest percentage of enjoyment with 100% of students making positive references for all three hikes, whereas School 1 students had the lowest percentage of enjoyment with 67% positive references for the day hike, 87% positive statements for the night hike, and 96% positive responses for the solo hike. All three schools had greater than 95% enjoyment for the solo hike. Whereas Schools 2 and 3 had 100% enjoyment for the night hike, School 1 had the lowest with 87%. For School 1, the day hike was the least enjoyable. For School 2 and 3, the day hike had comparable responses (Table 6).

School 3 had the greatest percentage of positive responses for all three hikes and also reported having pleasant, warm, sunny weather. No one from School 3 commented negatively about the weather. Two-thirds of the students in School 1 had negative responses about rain,

Figure 2. School 1.

Figure 3. School 2.

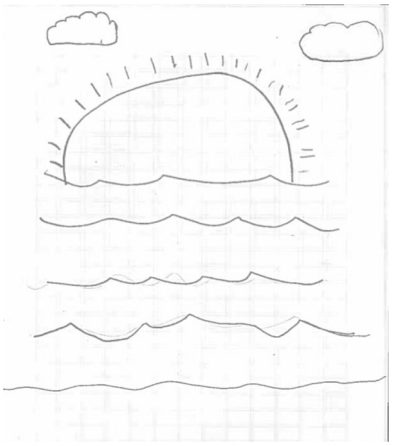

Figure 4. School 3.

wind, and cold weather, and no student wrote anything positive about the weather. Of all the students who wrote about the weather in their journals from School 2 ($n = 20$), 30% ($n = 6$) commented negatively about cold, windy weather.

Table 6. Frequency and percentages of positive and negative responses for subthemes and components broken down by school for Enjoyment of Nature.

		School 1 ($n = 79$)		School 2 ($n = 60$)		School 3 ($n = 20$)	
Subthemes		Positive	Negative	Positive	Negative	Positive	Negative
Hiking		**109**	**48**	**93**	**8**	**44**	**0**
Day Hike	*f* %	30	15	44	1	15	0
		66.67	33.33	97.78	2.22	100.00	0.00
Night Hike	*f* %	27	4	10	0	10	0
		87.10	12.90	100.00	0.00	100.00	0.00
Solo Hike	*f* %	40	2	25	1	16	0
		95.94	4.76	96.15	3.85	100.00	0.00
Hiking on a Warm, Sunny Day	*f* %	0	0	5	0	3	0
		0.00	0.00	100.00	0.00	100.00	0.00
Hiking in Cold, Rain, & Strong Wind	*f* %	6	12	6	4	0	0
		33.33	66.67	60.00	40.00	0.00	0.00
Getting Muddy, Dirty, & Wet	*f* %	6	15	3	2	0	0
		28.57	71.43	60.00	40.00	0.00	0.00

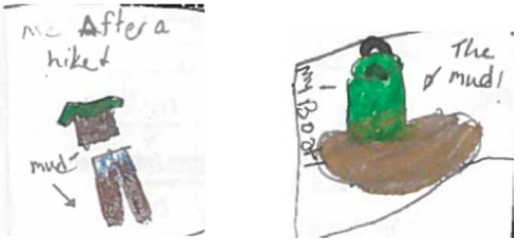

Figure 5. School 1.

School 1 students wrote negative responses in their journals about activities including hiking in the mud and rain and having to have an indoor campfire. A student recounted, for example, 'All day hike (ugh). Today we went on a [sic] all day hike and it was pouring. … We made sandwiches and mine got soggy.' 'It sucked. I got so muddy, dirty, and definitely wet. I didn't even eat the cookie I got. I dropped it in the mud.' One student drew pictures showing how muddy she was after the hike (Figure 5). One student, when questioned about learnings to apply later, wrote, 'Don't go back when it rains there.'

Not all School 1 students' comments were negative. In particular, we found that students who journaled about having had previous positive experiences in nature reported less negative feedback than those who did not claim earlier experiences. One student, for example, wrote, 'I felt great … because I am a person who likes outsides [sic] and mud and getting wet.' Another commented, 'Today was amazing. I felt so great to be out in nature. I loved putting mud on my face. … It was really fun. I got to get dirty and have some fun.' 'I'm excited about hiking at night and in the rain.'

School 2 journal entries indicated a greater influence from the wind than from rain. Comments suggested that, while students were aware of the wind, most did not mind it. Students wrote entries such as, 'It is windy up here, lots of wildlife, [and] sound of the wind.' Another wrote, 'The hike was windy and cold. We had lunch and it was windy. Then it was crazy windy when we walked up to the trail … When we reached the top, it was so windy I thought I was going to go flying. We walked down the hill and it was, in all, very fun.' One student who wrote about the rain expressed concern that 'the rain may get me muddy.'

Other students journaled positively about the hike including, 'Today we went on a hike … It was super fun … The solo hike was so fun. I enjoyed reading the facts and quotes on the papers. I enjoyed listening to the birds and trees.' Another student noted, 'Today I went on a [sic] all day hike. It was tiring but fun.' Another wrote, 'One of my favorite memories is when we

went on the dark night hike, which was so very calming, relaxing, and elusive …. It was such an amazing trip with so many memories and I hope I can experience something like it again.'

From School 3, all of the students enjoyed the hikes and wrote only positive comments. One student observed, 'The hikes are so much fun and beautiful … I can really enjoy hikes … everything is perfect and everyone is happy.' 'We went on a solo hike and it was really cool to experience all the nature around me.' Another wrote, 'I really enjoyed the solo hike and would love to do it again.'

A School 3 student drew a picture of a giant sun, showing how sunny the weather was with two fluffy clouds over the mountains and mini waves from the breeze (Figure 4). In addition to journaling positively about the hike, students' comments included, 'I felt good in the breezy air … I smelt the fresh animal habitat.' 'I see … the water traveling lightly down the creek with the sun reflecting … as I kept moving, the sun, birds, and [a light pleasant] wind made me feel calm.' No negative comments on the weather were recorded in students' journals.

Besides the three hikes (day, night, and solo hikes), the three schools participated in different activities depending on the weather conditions. School 1 visited a barn, whereas Schools 2 and 3 visited a pond or a creek. All students' comments were positive about their experiences at the pond or creek, whereas one student who visited the barn wrote that it 'smelled bad' and, 'I don't like the feel of sheep hair.' More than 90% of students liked seeing and interacting with animals. The weather did not appear to influence the students' enjoyment of experiencing animals, but it did affect the number and the types of animals they saw. All three schools visited the garden and sampled the vegetables grown there. All comments were positive. Students from all three schools enjoyed singing nature songs.

Empathy for creatures

Within the three subcomponents, students from all three schools expressed empathy for nature, with School 2 students having the largest number of positive responses. Students also expressed empathy for plants and animals, with Schools 1 and 2 expressing both negative and positive responses. School 3 had fewer responses, but they were all positive (Table 2).

Sense of oneness

Most students from all three schools responded positively to *sense of oneness*. The data showed that the participation in activities that allowed for being alone in nature was a strong driver for a positive response for kinship with nature. More than 95% of students from all three schools journaled that they liked being alone in nature. A School 3 student wrote, 'This afternoon I did a solo hike and loved it.' Three students from Schools 1 and 2 expressed anxiety about their solo hike with statements such as the following from a School 1 student: 'I felt kinda scared on the lone hike.'

Several students commented that they enjoyed being out in nature, because they were able to see animals and smell plants. Those who did not like being out in nature commented on getting wet and muddy. A student from School 1 wrote, 'I liked being outside. It was just muddy and I didn't like that. We saw no animals … I am feeling *eh* about going outside tomorrow because I was wet and muddy and mud is gross.'

Other students reported that they experienced a sense of equality between self and nature. In total, 95% of School 3 students journaled about noticing nature around them. That number dropped to 50% for School 2, and 22% for School 1. One possible explanation for this difference may be the weather. In addition to the students' feedback on noticing nature, the effect of the weather could also be seen in the *nature names* students selected for themselves. School 1 students selected names such as Rain, Mud, Dirty Plant, and Lightning Bolt, whereas Schools 2 and

3 students selected more plant and animal names, such as Woodpecker, Owl, Fox, Oak, and Wild Berry.

Students from all three schools journaled about how they connected with what they noticed in nature. A School 1 student wrote, 'I notice the raindrops falling. The water hitting the rocks, and the leaves hitting the tree. I wonder what kind of leaf it is. It reminds me of when the paint falls on the ground or when the raindrop hits the ground.' A School 2 student journaled, 'we went up to Walker Peak … [and saw] that crows glide in the wind,' and a School 3 student wrote, 'I hear … the birds and water flowing. I smell … nothing just clean fresh air. It's very quiet and soothing to watch the water flow. I see … the water traveling lightly down the creek with the sun reflecting … everything is perfect and everyone is happy.'

Sense of responsibility

School 1 students wrote more journal entries about their overall commitment to environmentally responsible behaviors than students from Schools 2 and 3. In addition, students from Schools 1 and 2 provided the most comments about *Currently Practiced Environmentally Responsible Behaviors*, and *Commitment to Future Environmental Actions*, whereas School 3 students provided the largest percentage of responses for *Communicating or Encouraging Environmental Awareness*. For example, from School 1, a student committed to 'not pollute,' another 'reused water bottle' to assure a sustainable lifestyle, and another one stated, 'I learned to eat the whole apple' to prevent food waste. From School 2, a student 'took only a 3 minute shower,' and another one 'turned off … cabin light before leaving.' From School 3, a student drew a picture of the recycling session, while another one would 'share ideas,' and another one posed the question, 'What can you do to save trees?'

Discussion

Similar to past studies, results suggest that participating in a residential environmental-education program, such as this one, can increase participants' connection to nature. What this study contributes is a deeper consideration of how the often-overlooked variable of weather may be particularly influential, especially when considered in combination with core programmatic aspects, such as educational activities and overall program length. Our data sources of surveys and journals provide evidence of variance in the quality and character of shifts in connection to nature among participating students. Although we did not initially plan to assess the effects of weather on nature connectedness, one of our most interesting findings related to how heavily weather could shift the overall program experience; thus, we conclude with an encouragement of careful consideration before undertaking such residential field-study programs during extreme weather.

School 1's residential session ended a day early, for example, due to torrential downpours and imminent flooding, and the children were evacuated from the site. The weather also greatly influenced the breadth and depth of outdoor activities in which the students were able to participate. Although students from all three schools participated in the same hiking-related activities, School 1 students did not participate in many of the typical environmental-education activities (such as Pond and Creek Visits, Sit Spot, and Outdoor Campfire) due to inclement weather conditions. As documented in their journal data, School 1 students complained of squishing in the mud, getting dirty and wet, and eating soggy food. In addition, they complained about having an indoor campfire due to extreme weather conditions.

Paired-sample *t* tests revealed that the School 1 students had a more positive perception of nature in all three areas assessed before they attended the field-study program, suggesting that the experience had a negative effect on their nature connectedness, at least in the short term.

On the CNI responses, School 1 students had the lowest average for nature connectedness pre-experience CNI scores and demonstrated a decrease in their post-experience CNI scores.

School 2 students had the highest average pre-experience CNI scores on the survey and demonstrated an improvement in their post-experience CNI scores, which may be explained by their participation in a range of outdoor activities (including Hikes, Pond and Creek Visits, and Sit Spot), facilitated by intermittent rain and sunshine. Although the program instructors had to make some adjustments, for the most part, the program was run as usual. Their students' increase in *enjoyment of nature* was statistically significant with moderate practical importance except for *empathy for creatures*.

School 3 students had the opportunity to participate in a full week of programing and experience the range of outdoor educational activities thanks to the sunny, dry weather. CNI survey scores of School 3 students improved the most on dimensions of *enjoyment of nature* and the *Total CNI*, but did not improve as much in *empathy for creatures*. The animal sighting expectations expressed in students' journal entries appeared reasonable considering the time of the year and the place they were visiting.

Enjoyment of nature

Our findings confirm that *enjoyment of nature* and, relatedly, *Connection with Nature*, is influenced by a number of emotional and physical factors. This aligns with the literature: Chawla (2009, 16) states that, when children engage in behaviors that give them 'a sense of power and maturity,' they are not only building their own competencies but also building positive memories of their time in nature. Based on journaling data, the three hikes seem to have been the most-influential activities with regard to *enjoyment of nature* and *overall Connection with Nature*. From journaling, we glean three particular dimensions that influence the students' *enjoyment of nature* related to the hiking activities: interest and engagement during the hiking experiences themselves, the sense of accomplishment upon completing the hikes, and the opportunity to share the hiking experiences with others. Students in Schools 2 and 3, for example, journaled about what they saw and experienced during the hike as well as the accomplishment of reaching the summit of a local mountain. Due to the weather, School 1 students were not able to hike to the summit, although they positively described hiking halfway up the mountain and negatively described their disappointment related to having to turn back before the summit. The Solo Hike gave students the opportunity to face, and then overcome, their fear of hiking alone by providing small challenges to complete while hiking, giving them a sense of fulfillment and reducing concerns they might have had about being alone. Activities such as listening to nature sounds and using all of their senses to learn about the natural world, as well as learning and singing nature-related songs, reinforced positive ideas about the natural world and positive images in children's minds. On balance, School 1 students spent more time inside journaling and less time outside interacting directly with nature than did School 2 and 3 students, which may explain School 1 students' relatively lower *enjoyment of nature* scores.

One area where changes to program content and length due to weather did not appear to negatively influence students' *enjoyment of nature* was seeing and interacting with animals. In addition to a shorter visit overall, colder weather with more precipitation also limited the number of animals students were able to see. Several students from School 1 journaled about their desire to see animals and, relatedly, conveyed sadness when they did not see certain expected animals, which may have affected their connection with nature. School 2 and 3 students had additional opportunities to interact with nature and see animals when visiting a pond as the guided activities included examining creatures from the pond or creek, in addition to more time outdoors, overall. Students wrote about interacting with and identifying invertebrates, as well as exploring their habitats. The students expressed their *enjoyment of nature* through their

descriptions of how they caught and studied the creatures. As supported by results of the CNI survey, scores for students in Schools 2 and 3 increased for *enjoyment of nature*, whereas scores for students in School 1 decreased.

Nature connectedness can also be encouraged and supported by providing children the opportunity to interact directly with nature through gardening-related activities. Congruent with the research of Laaksoharju, Rappe, and Kaivola (2012), Williams and Dixon (2013), and others, gardening affords the opportunity to experience and interact with plants and nature, as well as build inter- and intrapersonal skills. Student journals demonstrated positive responses to the gardening activities in which they participated during this field study.

Food is very important to fifth-grade students, and satisfaction with food affected their satisfaction with the whole experience. Students from all three schools who wrote about food gave positive feedback about harvesting and eating the vegetables from the garden. Whereas all students from Schools 2 and 3 enjoyed the snacks they had during their hikes, some students from School 1 expressed dislike when those snacks became soggy due to the rain.

Notwithstanding the weather, all students conducted some form of solo hike. Students from all three schools journaled that they enjoyed solo hiking the best of all the activities; they were able to complete simple tasks and overcome their anxiety at being alone in nature.

Empathy for creatures

The research of Palmberg and Kuru (2000) showed that children who had the greatest level of experience with nature also had the greatest level of empathy for nature. Some students in School 1 expressed a desire to see animals before they went on the field study. Because their pond and creek visits were curtailed, they journaled that they saw only farm animals as well as newts, slugs, and a few birds, even though they wanted to see more birds and wild mammals. School 2 students attended during the transitional season from rainy to dry days and visited the pond, where they reported seeing tadpoles, birds, and cows. School 3 students visited both the creek and the pond and saw animals such as nymphs of a dragonfly and water striders, as well as birds, bats, and foxes. These experiences may have influenced School 1's low scores for *empathy for creatures*. The effect size that resulted from the paired-sample *t* tests for *empathy for creatures* was moderately positive for School 3 based on Cohen's (1992) criteria.

Sense of oneness

Schultz (2002), referring to Kals, Schumacher, and Montada (1999), stated that those authors introduced the construct of emotional affinity, which he defined as being reflective of a person's 'emotional bond with nature' (68). Just as a relationship between people becomes more powerful and complex as they spend time together, so does a person's relationship with nature. From that, Schultz (2002) inferred that people can have a feeling of intimacy or caring for animals or places. Students' journal entries about the role of humans in nature and being humble shows that they were developing an understanding of the concept of oneness with nature.

Through activities including solo hiking or sitting and noticing nature around them, students were immersed in nature, giving them an opportunity to think about and develop an understanding of their place in nature or a *sense of oneness* with nature. Their selection of *nature names* for themselves demonstrated their sense of kinship with the natural world. These names also demonstrated the effects of the weather, as School 1 students selected names such as Rain, Mud, Dirty Plant, and Lightning Bolt, whereas students from School 2's and School 3's selection included more plant and animal names such as Woodpecker, Owl, Fox, Oak, and Wild Berry.

In order to develop a *sense of oneness* with nature, an individual must first notice nature. As the Lindemann-Matthies' (2005) study demonstrated, the more wild plants a child noticed, the greater was his or her appreciation of those species. Although students from all three schools

journaled about what they noticed in nature and how they felt a *sense of oneness* with it, School 3 students displayed the strongest demonstration of a *sense of oneness* with nature, whereas School 1 students displayed the weakest demonstration of a *sense of oneness* with nature.

Clayton's (2003) construct of self-concept contains a component of environmental identity, which begins with 'a sense of connection to some part of the nonhuman natural environment' (45-46). This conclusion was reinforced by Schultz and Tabanico (2007) who stated, 'environmental identity is the belief that the natural environment is an important part of who we are' (1220). For example, the weather was cold when School 1 students attended. Because children were cold, they gave their night creatures attributes such as warm fur. A student drew what she called an 'Owl penguin,' a creature able to tolerate 'freezing cold temperatures.' Other students transferred tools they used to their night creatures, demonstrating a *sense of oneness* with them, while another student drew a flashlight as a tool for that night creature.

Sense of responsibility

Ajzen's (1991) Theory of Planned Behavior argues how an individual's journey from intention to behavior is influenced by attitudes, norms, and intentions (Ajzen 2002; Heimlich and Ardoin 2008). According to this theory, the individual will only be able to act a certain way if he or she first possesses an attitude about the value of that action. Schultz's (2002) dimension of inclusion is behavioral. If a person has a sense of connection to nature and cares about it, he or she will be motivated to take care of and protect it.

For this theme, School 1 students completed more journal entries about their commitment to environmentally responsible behaviors than did students in Schools 2 and 3. School 3 students provided the largest percentage of responses for Communicating or Encouraging Environmental Awareness. A likely explanation for these results is that due to the weather, School 1 students spent a greater amount of time working on indoor activities, such as journal writing about environmental responsibilities. In contrast, School 3's students spent most of their time in outdoor activities, and therefore potentially had more positive experiences that they wanted to share with others.

Implications and recommendations

Connection to nature is a complex phenomenon, with some believing it is an essential part of the human experience and others concerned about the way that it has been portrayed as resulting from exclusive experiences (cf, Ardoin 2006; Cheng and Monroe 2012; Nisbet, Zelenski, and Murphy 2009; Tam 2013). With the single experience reported on here, the results of this study indicate that developing a connection with nature requires more than just one programed outdoor experience. Integration of outdoor experiences should be included in all public schools and repeated over time during the students' education. When planning such outdoor experiences, educators and program directors should intentionally design programs that account for and may be adapted to all sorts of weather and seasonal conditions.

Weather conditions can have a positive or negative effect on a learner's connection with nature. While some students enjoy being out in the pouring rain, others do not, resulting in staying inside and missing out on the outdoor experience. To address this, the program developers must consider the expectations of students, as well as the program's desired learning outcomes. They have to design the program to manage those expectations and achieve those outcomes.

If the activities are designed to be conducted in a certain kind of weather (e.g., dry, sunny versus cloudy, wet), then the desired outcomes may be most likely to be achieved in those conditions. Yet because that weather is not guaranteed, program developers are more likely to be successful at achieving the desired outcomes if they design curricula and expectations appropriate for a range of

conditions. Communicating this information to learners can help manage their expectations and satisfaction.

Conclusions

The importance of providing opportunities for children from an early age to experience nature-rich settings and make positive connections cannot be overstated (Chawla 1988, 1999, 2007; Wells and Lekies 2006). Because a first impression can never be changed, it is important that naturalists and educators lay the groundwork for creating positive, early nature experiences, particularly when those experiences are intensive, multi-day, and have the potential for lifelong learning influence.

Our findings suggest the importance of providing opportunities – especially programs – for students to establish a positive connection with nature through direct interaction with the environment, regardless of the weather. For some students who have prior experiences and knowledge on which to build, forming those positive connections may be easier than for others, for whom such settings and activities are novel. Understanding with more breadth and depth the range of variables at play, including weather, allows educators to craft experiences that meet learners where they are, making it more likely that such programs will be meaningful and influential, in the short and long term.

Notes

Nature is 'everything in the universe *except* what humans have manufactured. It encompasses every substance, event, force, and energy – sunlight, flowers, animals, bacteria, rocks, thunder, waves, and so on. It excludes everything artificial' (Starr, Evers, and Starr 2008, 4).

CNI acronym refers to the "Connection to Nature Index" (Cheng and Monroe 2012). An index is a composite measure. In this study, using the CNI assessment pre- and post-experience allows us to measure change over time. When referring to the instrument that participants complete, we use the term, CNI; when referring to individual measurement items, we describe the specific wording or terms.

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References

Ajzen, I. 1991. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes* 50 (2): 179–211. doi:10.1016/0749-5978(91)90020-T.

Ajzen, I. 2002. "Attitudes." In *Encyclopedia of Psychological Assessment*, Vol. 1, edited by R. Fernandez Ballesteros, 110–115. London, UK: SAGE Publications.

Ardoin, N. M. 2006. "Toward an Interdisciplinary Understanding of Place: Lessons for Environmental Education." *Canadian Journal of Environmental Education* 11 (1): 112–126.

Ardoin, N. M., M. DiGiano, J. Bundy, S. Chang, N. Holthuis, and K. O'Connor. 2014. "Using Digital Photography and Journaling in Evaluation of Field-Based Environmental Education Programs." *Studies in Educational Evaluation* 41: 68–76. doi:10.1016/j.stueduc.2013.09.009.

Ardoin, N. M., M. DiGiano, K. O'Connor, and N. Holthuis. 2016. "Using Online Narratives to Explore Participants Experiences in a Residential Environmental Education Program." *Children's Geographies* 14 (3): 263–281. doi:10.1080/14733285.2015.1033615.

Bragg, R., C. Wood, J. Barton, and J. Pretty. 2013. "Measuring Connection to Nature in Children Aged 8–12: A Robust Methodology for the RSPB." https://www.rspb.org.uk/Images/methodology-report_tcm9-354606.pdf.

Chawla, L. 1988. "Children's Concern for the Natural Environment." *Children's Environments Quarterly* 5 (3): 13–20.

Chawla, L. 1999. "Life Paths into Effective Environmental Action." *The Journal of Environmental Education* 31 (1): 15–26. doi:10.1080/00958969909598628.

Chawla, L. 2007. "Childhood Experiences Associated with Care for the Natural World: A Theoretical Framework for Empirical Results." *Children, Youth and Environments* 17 (4): 144–170.

Chawla, L. 2009. "Growing up Green: Becoming an Agent of Care for the Natural World." *The Journal of Developmental Processes* 4 (1): 6–23.

Cheng, J. C. 2008. "Children, Teachers and Nature: An Analysis of an Environmental Education Program." PhD diss., University of Florida, Gainesville, FL.

Cheng, J. C., and M. C. Monroe. 2012. "Connection to Nature: Children's Affective Attitude toward Nature." *Environment and Behavior* 44 (1): 31–49. doi:10.1177/0013916510385082.

Clayton, S. 2003. "Environmental Identity: A Conceptual and an Operational Definition." In *Identity and the Natural Environment*, edited by S. Clayton and S. Opotow, 45–65. Cambridge, MA: MIT Press.

Cohen, J. 1992. "A Power Primer." *Psychological Bulletin* 112 (1): 155–159. doi:10.1037/0033-2909.112.1.155.

Collado, S., H. Staats, and J. A. Corraliza. 2013. "Experiencing Nature in Children's Summer Camps: Affective, Cognitive, and Behavioural Consequences." *Journal of Environmental Psychology* 33: 37–44. doi:10.1016/j.jenvp.2012.08.002.

Creswell, J. W. 2015. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th ed. Thousand Oaks, CA: Sage.

Cronbach, L. J. 1951. "Coefficient Alpha and The Internal Structure of Tests." *Psychometrika* 16: 292–334.

Duerden, M. D., and P. A. Witt. 2010. "The Impact of Direct and Indirect Experiences on the Development of Environmental Knowledge, Attitudes, and Behaviour." *Journal of Environmental Psychology* 30 (4): 379–392. doi:10.1016/j.jenvp.2010.03.00.

Ernst, J., and S. Theimer. 2011. "Evaluating the Effects of Environmental Education Programming on Connectedness to Nature." *Environmental Education Research* 17 (5): 577–598. doi:10.1080/13504622.2011.565119.

Frantz, C. M., and F. S. Mayer. 2014. "The Importance of Connection to Nature in Assessing Environmental Education Program." *Studies in Educational Evaluation* 41: 85–89. doi:10.1016/j.stueduc.2013.10.001.

Heimlich, J. E., and N. M. Ardoin. 2008. "Understanding Behavior to Understand Behavior Change: A Literature Review." *Environmental Education Research* 14 (3): 215–237. doi:10.1080/13504620802148881.

Hinds, J., and P. Sparks. 2008. "Engaging with the Natural Environment: The Role of Affective Connection and Identity." *Journal of Environmental Psychology* 28 (2): 109–120. doi:10.1016/j.jenvp.2007.11.001.

Kals, E., D. Schumacher, and L. Montada. 1999. "Emotional Affinity toward Nature as a Motivational Basis to Protect Nature." *Environment and Behavior* 31 (2): 178–202. doi:10.1177/00139169921972056.

Kerr, K. 2015. *Report for the Royal Society for the Protection of Birds (RSPB): Connection to Nature Questionnaire on the Northern Ireland Kids Life and Times Survey*. Belfast, Ireland: Queen's University Belfast.

Laaksoharju, T., E. Rappe, and T. Kaivola. 2012. "Garden Affordances for Social Learning, Play, and for Building Nature-Child Relationship." *Urban Forestry & Urban Greening* 11 (2): 195–203. doi:10.1016/j.ufug.2012.01.003.

Liefländer, A. K., G. Fröhlich, F. X. Bogner, and P. W. Schultz. 2013. "Promoting Connectedness with Nature through Environmental Education." *Environmental Education Research* 19 (3): 370–384. doi:10.1080/13504622.2012.697545.

Lindemann-Matthies, P. 2005. "Loveable' Mammals and 'Lifeless' Plants: How Children's Interest in Common Local Organisms Can Be Enhanced through Observation of Nature." *International Journal of Science Education* 27 (6): 655–677.

Mayer, F. S., and C. M. Frantz. 2004. "The Connectedness to Nature Scale: A Measure of Individuals' Feeling in Community with Nature." *Journal of Environmental Psychology* 24 (4): 503–515. doi:10.1016/j.jenvp.2004.10.001.

Mayer, F. S., C. M. Frantz, E. Bruehlman-Senecal, and K. Dolliver. 2009. "Why is Nature Beneficial?: The Role of Connectedness to Nature." *Environment and Behavior* 41 (5): 607–643. doi:10.1177/0013916508319745.

Nisbet, E. K., J. M. Zelenski, and S. A. Murphy. 2009. "The Nature Relatedness Scale: Linking Individuals' Connection with Nature to Environmental Concern and Behavior." *Environment and Behavior* 41 (5): 715–740. doi:10.1177/0013916508318748.

Palmberg, I. E., and J. Kuru. 2000. "Outdoor Activities as a Basis for Environmental Responsibility." *The Journal of Environmental Education* 31 (4): 32–36. doi:10.1080/00958960009598649.

Patton, M. Q. 2002. *Qualitative Research and Evaluation Methods*. 3rd ed. Thousand Oaks, CA: SAGE Publications.

Royal Society for the Protection of Birds (RSPB). 2013. "Connecting with Nature: Finding Out How Connected to Nature the UK's Children Are." http://www.rspb.org.uk/Images/connecting-with-nature_tcm9-354603.pdf.

Schultz, P. W. 2000. "Empathizing with Nature: The Effects of Perspective Taking on Concern for Environmental Issues." *Journal of Social Issues* 56 (3): 391–406. doi:10.1111/0022-4537.00174.

Schultz, P. W. 2002. "Inclusion with Nature: The Psychology of Human-Nature Relations." In *The Psychology of Sustainable Development*, edited by P. Schmuck and P. W. Schultz, 61–78. New York, NY: Kluwer Academic Publishers.

Schultz, P. W., and J. J. Tabanico. 2007. "Self, Identity, and the Natural Environment: Exploring Implicit Connections with Nature." *Journal of Applied Social Psychology* 37 (6): 1219–1247. doi:10.1111/j.1559-1816.2007.00210.x.

Starr, C., C. Evers, and L. Starr. 2008. *Biology Concepts and Applications*. 7th ed. Pacific Grove, CA: Brooks Cole.

Stern, M. J., R. B. Powell, and N. M. Ardoin. 2008. "What Difference Does It Make? Assessing Student Outcomes of Participation in a Residential Environmental Education Program." *The Journal of Environmental Education* 39 (4): 31–43. doi:10.3200/JOEE.39.4.31-43.

Tam, K. P. 2013. "Concepts and Measures Related to Connection to Nature: Similarities and Differences." *Journal of Environmental Psychology* 34 (C): 64–78. doi:10.1016/j.jenvp.2013.01.004.

UNESCO-UNEP. 1989. "The International Environmental Education Programme 1990-1991." *Connect: UNESCO-UNEP Environmental Education Newsletter* XIV (4): 1–2.

Walker Creek Ranch. 2016. "Marin County Outdoor School." http://www.walkercreekranch.org/

Wells, N. M., and K. S. Lekies. 2006. "Nature and the Life Course: Pathways from Childhood Nature Experiences to Adult Environmentalism." *Children, Youth and Environments* 16 (1): 1–24.

Williams, D. R., and P. S. Dixon. 2013. "Impact of Garden-Based Learning on Academic Outcomes in Schools Synthesis of Research between 1990 and 2010." *Review of Educational Research* 83 (2): 211–235. doi:10.3102/0034654313475824.

Yin, R. K. 2017. *Case Study Research and Applications: Design and Methods*. 6th ed. Thousand Oaks, CA: SAGE Publications, Inc.