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INCREASING CHILDREN AND ADULTS' POSITIVE CONNECTION TO, KNOWLEDGE
OF, AND ORIENTATION TOWARD NATURE THROUGH ENVIRONMENTAL
EDUCATION PROGRAMS

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ABSTRACT

Many efforts have been made to enhance a child’s connection to, knowledge of, and orientation toward nature through excursions such as trips to museums, nature camps, and other outdoor experiences. However, prior research has seldom been rigorous in establishing participants’ connection to, knowledge of, and orientation toward nature as a pre-test, followed by a clear specification of what range of experiences in nature are included in an intervention. Prior research also lacks rigorous assessment of a child’s connection to, knowledge of, and orientation toward nature at the post-test point after the educational intervention. This study provided such a design not only for children who attend an outdoor nature camp, but also for the adult counselors who work with the children at the camp. Using a sample of 272 participants, 177 child campers (ages 9 – 11) and 95 adult counselors (ages 18 – 35) were administered a pre- and post-test in a repeated measures design in the Penn State Outdoor School program. Findings demonstrated significant gains in areas of connection to, knowledge of, and orientation toward nature for both child campers and their adult counselors. Relative to prior developmental literature, the gains made by the children through their nature camp experience are particularly broad and significant. It appears that the present study is also the first to document gains made by adult camp counselors for a children’s nature camp experience. Overall, the data derived from this study show impressive impacts of a four-day outdoor nature program and will help inform future efforts to improve the quality and impact of outdoor nature camps and similar experiences for both children and for adults.

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INTRODUCTION

Childhood is moving indoors. With technology on the rise and spaces for outdoor play on the decline, most children are developing primarily in classrooms and homes instead of the outdoors. The previous generations had children playing in the backyard until the porch light came on. This generation's increasing technology gives more reason for children to stay in the living room, experiencing the natural world vicariously through a television screen or a computer or cell phone interface. However, the difference that separates this new generation of children from the previous generation does not rest solely on the technology introduced in the past decade. The subsequent effects of children spending more time indoors include a decrease in exposure to nature. As each generation of children spends less and less time in nature, there is a clear demand for researchers to examine if any adverse effects will follow (Louv, 2006).

Cognitive Functioning and Nature in Earlier Studies

Previous research (Tanner, 1980; Wells, 2000; Wells, 2006) introduced the concept of nature experiences to the field of psychology to examine the effects nature might have. As a new topic, one approach was to study the extent of a relationship nature can have on the human psyche. Nearing the end of the twentieth century, a study by Tanner (1980) emerged as the first of its kind concerning formative influences on the lives of 45 dedicated conservationists. Tanner (1980) concluded its qualitative, retrospective study by stating, "youthful experience of outdoors and relatively pristine environments emerges as a dominant influence on these lives" (as cited in Wells, 2006). These experiences of hours spent outdoors or having examples of parents or teachers fostering an interest in nature were stated to be the single most important influence on individuals (Tanner, 1980 as cited in Wells, 2006).

At the start of the twenty-first century, research began to surface diverging from formative experiences and instead examined nature's effect on cognitive processes such as behavior, knowledge, and motivation. Wells (2000) considered the outcome of children's cognitive functioning while living in a poor, urban environment as contrasted with a greener, more natural environment. At this time, research began to examine cognitive or attentional benefits of nature experience. Little research had been done concerning children's experiences with nature and the possible restorative effects that nature has on cognition or attentional capacities. The restorative effects that were identified in this new study were increases in positive behavior, knowledge, and motivation after being in a greener, more natural environment, almost as if they had been restored to their previous levels before being affected by the urban environment and lack of nature (Wells, 2000). This study was conducted in order to closely examine the child population that had previously been overlooked (Wells, 2000).

The subjects who participated in this study were 8 girls and 9 boys, ranging between 7 to 12 years old, from both African American and White ethnicities. These children were from low socioeconomic status families, ones participating in a self-help housing program. Using a pre- and post-test design, Wells (2000) was able to directly measure the relationship between the natural, restorative quality of a new and greener home environment and also measure the cognitive functioning of children. In the pre- and post-test design, the families were first visited while residing in the poor, urban household environments. The families were then visited a year later, after they had lived for at least four months in the greener, more natural environments. The more natural environment was rated by the views from each room in the houses, including the yard, being more than half natural and not having much of a built environment within that view

(Wells, 2000). This longitudinal test design eliminated prior extraneous variables that other studies were not able to account for, allowing for objective measures of naturalness for the environment as well as a standardized test for determining the level of cognitive functioning in attention capacity (Wells, 2000).

The results from this study were as follows. The means were compared from pre-move to post-move to determine if changes occurred in the rating of naturalness of housing and showed that there was significantly more naturalness in the post-move housing than the original housing ($M_{\text{Pre-move}} = 2.19$, $M_{\text{Post-move}} = 2.46$; $t(16) = 3.22$, $p < .01$) (Wells, 2000). Using a series of hierarchical regression analyses, the relationship was investigated between the naturalness of the home environment and the children's cognitive functioning. The study showed that the change in home environment naturalness is a statistically significant predictor of the children's attentional capacities, $F(1, 14) = 9.22$, $p < .01$ (Wells, 2000). These findings showed the restorative qualities of the housing a child lives in accounts for an additional 19% variance in attentional capacity of cognitive functioning when the environment is changed, beyond the 50% of variance the study previously determined to be explained by the pre-move attentional capacity. This additional 19% variance statistic includes controls for differences in the quality of housing and surrounding socioeconomic status variables to focus solely on the restorative qualities of the natural environment. Even in a modest sample size of 17 children, this shows the profound effect of nature on a child's cognitive functioning while living in these environments. This outcome is consistent with some prior studies using non-longitudinal methods, but also suggests that children who lived around more natural areas found benefits on their cognitive functioning and

attentional capacity (Kaplan & Kaplan, 1983; Kaplan & Kaplan, 1989; Hartig, Mang, & Evans 1991; Kaplan, 1995; Wells, 2000).

This study shows significant positive gains when living in a more natural environment. The longitudinal design allows for comparisons between the pre-move and post-move environments. However, the design of this study is still focusing on the examination of short-term effects. The post-move test was given to the children after four months of living in the new, greener environment with higher ratings of more natural views in and outside of the house with less built environment surroundings (Wells, 2000). The study did not follow up with a further test to see if the effects were lasting further into the children's lives. Because of this short-term focus, research was called for to examine the longer lasting effects. Therefore, Wells (2000) designed a second study to examine long-term influences of being in nature, a part of the literature that was lacking.

Environmental Trajectories in Adulthood

Using a long-term focus, Wells (2006) took into account the prominent research regarding short-term effects and designed a study to measure retrospective trajectories of adults. Wells (2006) focused on investigating if childhood participation with nature would motivate an individual toward a specific life pathway ending with adult environmentalism. Wells (2006) specifically wanted to compare the variables "wild" nature and "domesticated" nature. Wells (2006) defined "wild" nature as hiking or playing in the woods, camping, and hunting or fishing. "Domesticated" nature was defined as picking flowers or produce, planting trees or seeds, and caring for plants. The study was designed to compare "wild" and "domesticated" to see how these childhood experiences influenced different environmental behaviors for adulthood.

The participants included 2,004 adults aged 18-90 from the 112 most populated areas across the nation (excluding Alaska and Hawaii). The participants were selected by random-digit dialing as well as listed numbers. This resulted in 56% of the sample being female and 44% being male. The participants were interviewed over the phone using close-ended questions. The 108 interview questions inquired about participants' own childhood experiences in nature and their current attitudes toward the environment as adults.

The results showed both “wild” as well as “domesticated” nature participation in childhood had a statistically significant effect on environmental attitudes toward adulthood in a positive direction (Wells, 2006). Correlations included children’s “wild” nature participation and “domesticated” nature participation with coefficients of .21 and .16 respectively—significant at the $p < .05$ level. However, further correlations showed that participants with more “wild” nature experiences were found to have a higher rate of adult environmentalism, significant ($p < .05$) coefficient at .28, than participants with “domestic” nature experiences, with a marginally significant ($p < .10$) coefficient at .09 (Wells, 2006). This study supports the prior research that being in nature causes positive gains in environmental attitudes as well as behaviors. A person is also more likely to express pro-environment opinions as an adult if they have interacted with nature through childhood. This study validates prior research and also provides new findings that the effects are not temporary, they last into adulthood.

Wells (2006) filled the need for a study examining any long-term effects that nature experiences, such as walking, playing, hiking, or camping in natural areas, may have on individuals. Once this study showed data supporting positive gains and correlations to previous studies, future research delving further into this subject was in high demand. Future studies

would need to examine these nature experiences and determine if the connection people have toward nature could be conceptualized and measured in a standardized instrument. Other future studies could look into nature exposure programs as an intervention of sorts for children, in order to promote environmentally friendly behaviors. Gaining a clearer understanding of this topic would be the goal for the research in the coming years in order to examine effects across the lifetime. Without this natural progression of a more in-depth analysis, the research would still be focusing on short-term effects, unable to establish critical relationships. By moving forward, the research has given support to different aspects.

Recent Studies

In the past five years, more research has been conducted leading off the reviews done by Chawla (2009) and the studies by Wells (2000 & 2006). Extending beyond the prior research, these new studies set out to investigate nature exposure programs and their effectiveness in intervening at the right point to cause significant gains in a child's connection to nature—a variable that describes how much an individual perceives nature to be a part of their life. This is in hopes of motivating the child toward the trajectory for adult environmentalism in terms of care for the natural world. In a study through a dissertation for the Pennsylvania State University, Andrejewski (2011) investigated this same concept in the role of Penn State's Outdoor School—an environmental education program—to find that the weeklong program showed positive gains for fifth-grade children in ecological knowledge, connection to nature, outdoor play behavior, and environmental stewardship behavior. Most recently in 2015, a similar study done by Erdoğan (2015) considered the role of a Summer Environmental Education Program (SEEP) on students' environmental literacy, finding positive increases after the completion of the program

(Erdoğan, 2015, p. 165). These two studies aimed to assess the effects of the nature exposure program and find potential correlations between the variables of connection to nature, outdoor play behaviors, and environmental attitudes.

The recent studies (Andrejewski, 2011; Erdoğan, 2015) in the literature embody the new angles available to explore in future research. The variable of cognitive functioning has now been defined into more specific subsections such as connection to nature, environmental attitudes, or environmental behaviors (Andrejewski, 2011). This allows the exploration of particular relationships between variables and also the pinpointing of predictors for higher gains in areas such as connection to nature, environmental stewardship, and knowledge of nature.

Connection to Nature

The connection to nature variable originated in a study by Bragg, Wood, Barton, and Pretty (2013). Bragg et al. (2013) aspired to create a measure to determine a specific level of a person's connection to nature. Using a sixteen-item questionnaire called the Connection to Nature Index (CNI), this measure was able to assign a point value to a person that reflected their attitude toward the environment (Bragg et al., 2013). The CNI includes four categories of questions: enjoyment of nature, empathy for creatures, sense of oneness, and sense of responsibility. These four aspects create sixteen statements that must be answered on a Likert Strongly Agree to Strongly Disagree scale.

The development of this index allows for a standardized test to be given before and after exposure experiences. This will allow a measure to compare the change after the exposure experience has been completed. A useful tool, Andrejewski (2011) implemented parts of this

questionnaire while it was being developed into the questionnaires created for the study's test designs. The standardized score could easily be compared before and after Outdoor School.

Role of Environmental Education

Eleven years after Wells (2000) published the study, Andrejewski (2011) continued building upon the prior research concerning the effects of nature. However, the topics have become more in depth over the years. Andrejewski (2011) investigated the role of a residential environmental education program on a variety of variables including connection to nature, outdoor play behavior, and environmental stewardship attitude. Andrejewski (2011) aimed to establish if participation in Penn State Outdoor School, the residential environmental education program, had any effect on these variables.

Using a quasi-experimental research design, Andrejewski (2011) was able to test 228 fifth grade students. 156 of these students were placed in the treatment group and 72 were tested as the control. The treatment students were given a pre-test before attending Outdoor School and a post-test of a similar design following the week of attending the program. The control group received the pre-test at the same time as the other group and the post-test a week later after opportunities for learning the same basic lessons in the classroom. The results from the study were as follows. A strong positive gain (a significant 19.1% increase) was found for the experimental/outdoor nature camp group (e.g. $M_{\text{Pre-Test}} = 5.81$, $SD = 1.69$ and $M_{\text{Post-Test}} = 6.92$, $SD = 1.77$; $t(155) = 7.71$, $p < .001$, $d = .64$, large effect size) whereas the control/classroom children showed no significant differences (e.g. $M_{\text{Pre-Test}} = 5.26$, $SD = 2.05$ and $M_{\text{Post-Test}} = 5.53$, $SD = 2.10$; $t(71) = 1.50$, $p < .10$, $d = .13$) in ecological knowledge. A significant gain was demonstrated for the experimental/outdoor nature camp group (e.g. $M_{\text{Pre-Test}} = 5.76$, $SD = .89$ and

$M_{\text{Post-Test}} = 6.01$, $SD = .96$; $t(155) = 4.03$, $p < .001$, $d = .27$, medium effect size) whereas the control/classroom children showed no significant differences (e.g. $M_{\text{Pre-Test}} = 5.67$, $SD = 1.05$ and $M_{\text{Post-Test}} = 5.66$, $SD = 1.12$; $t(71) = .10$, $p < .46$, $d = .01$) in connection to nature. A significant gain was demonstrated for the experimental/outdoor nature camp group (e.g. $M_{\text{Pre-Test}} = 5.60$, $SD = 1.25$ and $M_{\text{Post-Test}} = 5.97$, $SD = 1.21$; $t(155) = 4.30$, $p < .001$, $d = .30$, medium effect size) whereas the control/classroom children showed no significant differences (e.g. $M_{\text{Pre-Test}} = 5.59$, $SD = 1.31$ and $M_{\text{Post-Test}} = 5.78$, $SD = 1.31$; $t(71) = 1.61$, $p < .06$, $d = .15$) in outdoor play behavior (Andrejewski, 2011).

The mean gains were fairly modest, with the largest mean increase being 19.1% for ecological knowledge (Andrejewski, 2011). In addition, it was noted that there were no changes in outdoor play attitudes or environmental stewardship attitudes from the pre-test to the post-test for the control/classroom group (Andrejewski, 2011). Because of the Pennsylvania Department of Education's (2002) Environment and Ecology Standards, Outdoor School may have increased understanding of school-based curricula beyond what exactly was being taught in the classroom environment, resulting in no significant gains for students in the classrooms who did not receive the extra information required by the standards set for Outdoor School (Andrejewski, 2011).

The newest developmental research on the topic comes from Erdoğan (2015), who wanted to assess the effects of a summer environmental education program (SEEP). This program consisted of six modules in science, biodiversity, sports, art, drama, and psychology. A total of 29 hours were spent during SEEP, of which 6.5 hours were dedicated to the science module, 6.75 hours to the biodiversity module, 3 hours to the sport module, 6.75 hours to the art module, 3 hours to the drama module, and 3 hours to the psychology module (Erdoğan, 2015).

Of the 29 total hours, 4.83 hours were spent in theory sessions, 19.92 hours were spent in hands on practice, outdoor activities, and laboratory activities, and 4.25 hours were spent in observation and site visits (Erdoğan, 2015).

For all modules, the students were encouraged to actively involve themselves in the first-hand experiences. The students were given a theoretical lesson in a laboratory or classroom and then participated in an outdoor component such as plant collection, bird watching, drawing pictures of nature, observation of soil, etc. (Erdoğan, 2015). This study aimed to investigate SEEP's effects on the variables of environmental knowledge, affect, skills, and behavior—the components that make up environmental literacy. The sample of this study consisted of 45 students from the 4th to the 8th grade. A total of 25 males and 20 females completed the standardized testing measures given before and after SEEP. The results of this study showed a positive gain in environmental literacy after SEEP. Mean gains on the key components were as follows.

A significant increase in students' environmental knowledge was found ($M_{\text{Pre-Test}} = 6.73$, $SD = 3.92$ and $M_{\text{Post-Test}} = 7.96$, $SD = 4.04$; $t(44) = 2.674$, $p < .05$). A significant increase was found in students' positive nature attitudes ($M_{\text{Pre-Test}} = 19.67$ and $M_{\text{Post-Test}} = 21.38$; $t(44) = 2.11$, $p < .05$, $d = .41$), sensitivity ($M_{\text{Pre-Test}} = 15.52$ and $M_{\text{Post-Test}} = 17.93$; $t(44) = 3.66$, $p < .05$, $d = .64$), and willingness to act upon environmental problems ($M_{\text{Pre-Test}} = 20.62$ and $M_{\text{Post-Test}} = 23.24$; $t(44) = 2.87$, $p < .05$, $d = .56$) which together shows a significant increase in their environmental affect. A significant increase was found in students' responsible environmental behaviors related to physical action ($M_{\text{Pre-Test}} = 21.9$; $M_{\text{Post-Test}} = 25.97$; $t(39) = 2.27$, $p < .05$, $d = .52$), warning behavior ($M_{\text{Pre-Test}} = 8.78$; $M_{\text{Post-Test}} = 10.4$; $t(41) = 2.56$, $p < .05$, $d = .59$) and political action

($M_{\text{Pre-Test}} = 6.02$; $M_{\text{Post-Test}} = 9.05$; $t(41) = 4.24$, $p < .05$, $d = .7$) which together shows a significant increase in environmental behavior (Erdoğan, 2015).

Throughout the modest number of studies in this literature, there are multiple findings suggesting that nature experiences may contribute to higher attentional capacities and to knowledge and attitudes concerning connection to nature and environmental stewardship.

Limitations of Prior Research

Although the studies above each examined different variables, used different measures, and studied few subjects in depth to thousands at surface level, all studies came to a common conclusion: exposure to nature shows positive gains during childhood and may be related to some positive later adult attitudes toward nature and involvement in nature. A limitation is that most research to this point has also been observational in nature or based upon interviews—it has been rare to have any experimental variation in plans or procedures related to environmental education programs. Moreover, in these studies, only three have used a multiple measure design in a rigorous assessment of pre- and post-tests and only the study conducted by Andrejewski (2011) included more than 50 children (Tanner, 1980; Wells, 2000; Wells, 2006; Erdoğan 2015).

Narrative Writing

An innovative variable that can be examined is the use of narrative writing. At the start of the “writing crisis”, Bereiter & Scardamalia (1987) helped to establish research on writing by defining writing as the mental activities that go into composing written texts, not the physical act of writing. Some recent research on writing has stated that the underlying use of strategies reveals knowledge that students bring to their writing (Smargaronsky, 1991). Bringing knowledge to writing is a subject that has not yet been investigated in regards to nature

experiences to see if individuals can communicate similar kinds and amounts of connection to, orientation toward, and knowledge of nature in the form of questionnaire data as they can in narrative writing. For this reason, a gap in the literature can be filled using not only responses from survey data similar to past research measures—including Likert scale responses to connection to nature, efficacy percentage ratings, and multiple choice knowledge questions—but also for the first time, the quality of narratives concerning nature in terms of factual knowledge, mentions of environmental stewardship, causal relationships, and length.

Present Study

The goal of this research study will be to determine the effects of a four-day environmental education program conducted in a camp in a nature-rich context (Penn State Outdoor School) for child campers and their adult counselors.

Hypothesis 1: Significant gains will be shown in the variables of connection to nature, environmental stewardship, and knowledge of nature for:

- 1a. Campers who participate in Penn State Outdoor School
- 1b. Counselors who participate in Penn State Outdoor School

Hypothesis 2: Higher gains will be shown for:

- 2a. Campers in the enhanced learning groups, where there is a bonus set of preparation activities by the Learning Group Leaders (LGLs)
- 2b. Counselors in the enhanced learning groups, where there is a bonus set of preparation activities by the Learning Group Leaders (LGLs)

Hypothesis 3: Some aspects of children's survey assessment of nature knowledge and awareness will be correlated to more sophisticated narratives (a first-time, innovative approach) in terms of connection to, knowledge of, and orientation toward nature in analyses of:

- 3a. Campers at pre-test
- 3b. Campers at post-test
- 3c. Counselors at pre-test
- 3d. Counselors at post-test

METHODS

Participants

The study participants included 272 individuals. Of these, 177 were fifth grade campers between the ages of 9 to 11 from various elementary schools in Huntingdon and Mifflin Counties who have chosen to attend Penn State's Outdoor School in the fall of their school year. There were 76 male campers and 96 female campers and 1 camper identifying as Other who participated in the pre- and post-tests. The approximate ethnic distribution of the sample was 6.2% American Indian/Alaska Native, 4.0% Asian, 1.1% Black/African American, 0.6% Native Hawaiian/Other Pacific Islander, 0.6% Hispanic, and 87.6% White/Caucasian.

The 95 counselors for the child campers were volunteers from The Pennsylvania State University signing up for course credit in either the Recreation, Parks, and Tourism Management (RPTM 140) or Science Education (SCI ED 140) course for the fall semester of 2015. The counselors were required to be 18 years of age or older and ranged up to 35 years old at the time of participation in Outdoor School. There were 42 male counselors and 50 female counselors and 1 counselor identifying as Other who participated in the pre- and post-tests. The approximate ethnic distribution of the sample was 4.3% Asian, 5.4% Black/African American, 1.1% Native Hawaiian/Other Pacific Islander, 5.4% Hispanic, and 83.9% White/Caucasian.

Consent

Before any data was collected for this study, consent was obtained from counselors using an IRB approved consent form. Consent was obtained from parents for their children to participate using an IRB approved consent form. At the beginning of the administration of the pre-tests, child verbal assent was obtained.

Data Collection Procedure

A repeated measures design was implemented in the form of a pre- and post-test. One week prior to attending the environmental education program of Outdoor School, the measure was administered by the Primary Investigator to the fifth grade campers in their typical classroom environment in order to establish a baseline. One day prior to attending the environmental education program of Outdoor School, the measure was administered by the Primary Investigator to the adult counselors in a classroom environment in order to establish a baseline. Upon the conclusion of the environmental education program of Outdoor School, the campers and counselors were administered the same set of measures and the changes in response were analyzed. The complete pre- and post-assessment package of measures included four blocks: the Connection to Nature Index; specific knowledge questions about nature; a Self Efficacy scale for actions towards nature; and two narrative writing samples regarding nature that were analyzed for connection to, knowledge of, and orientation toward nature.

Two Levels of Intervention: Learning Group Leaders with Enhanced/Bonus Training or Standard Training

The Enhanced program included a more experienced Learning Group Leader (LGL) who provided more in depth lessons due to their own increased knowledge and experience in the subject. The LGLs in the Enhanced program were undergraduate and graduate students who previously participated in Outdoor School as an LGL at least once in the past. Many of the LGLs in the Enhanced program were completing internships at Shaver's Creek Environmental Center in the Raptor Center or the Student Engagement & Experiential Discovery (SEED) program—a field experience in the forests, fields, and creeks, of Penn State's Outdoor Education Field Lab. To create the enhanced program, the specified LGLs were required to do five hours of extra

research and preparation for their lessons that included learning bonus information about the material taught in the program. Therefore, LGLs selected as the Enhanced group had a more in depth understanding of environmental interpretation and nature itself.

This variable was coded as either participation in the Basic program (“1”) or participation in the Enhanced/Bonus program (“2”) based on the experience of the Learning Group Leader that each participant was assigned to. For the campers, the Basic program included 73 (41.2%) campers and the Enhanced program included 98 (55.4%) campers. For the counselors, the Basic program included 45 (48.4%) counselors and the Enhanced program included 41 (44.1%) counselors.

Lessons for both the Basic program and the Enhanced program were taught twice a day for four days and included topics such as Living Things, Resources, Cycles, and History. The Living Things lesson included information about and moderate exposure to various birds of prey, reptiles, and amphibians. The Resources lesson included a hike to the lake at Camp Blue Diamond where a discussion took place about what animals need to survive in the wild. This lesson also incorporated games centering around carrying capacity of deer in nature. The Cycles lesson focuses on reaching the goals of section 4.2 of the Environment and Ecology Standards, Watersheds and Wetlands (Pennsylvania Department of Education, 2002). This lesson included information about watersheds nationwide and how Globe Run Stream at Camp Blue Diamond is connected to various rivers and oceans. This lesson also incorporated a stream study where individuals waded into the stream and located animals such as newts, caddisflies, mayfly larvae, and others to diagnose the pollution level of the stream. The History lesson was a period lesson where the LGLs and counselors led an immersion experience of what it was like to live in the

1850s. Children learned the materials needed to survive and how individuals interacted with the environment through topics such as the Iron Furnace and clear-cutting the forests.

Connection to Nature

An individual's connection to nature can be defined as the extent to which an individual identifies with and considers nature as a part of their daily life. The first section of the measure was taken from Bragg et al.'s (2013) Connection to Nature Index (commonly referred to as the CNI), a sixteen-item questionnaire rated on a seven-point scale of Strongly Agree to Strongly Disagree, including a Neither Agree nor Disagree option. The sixteen items are based on four dimensions: (a) enjoyment of nature, (b) empathy for creatures, (c) sense of oneness, and (d) sense of responsibility (Bragg et al., 2013). This measure was chosen because using this test provides a specific standardized score variable representing the level an individual is connected to nature. By taking an average of all the items on the CNI, a score out of 5 is provided for each participant (5 being extremely connected to nature and 1 being extremely disconnected from nature). This measure is significantly more helpful than a qualitative answer about individual connection to nature as this standardization allows for the variable to be analyzed and correlated through various statistical tests.

Environmental Stewardship

An individual's environmental stewardship or orientation toward nature refers to the actions or behaviors an individual takes in order to preserve the environment. Environmental stewardship was measured using Bandura's (2006) self-efficacy scale with adapted components to examine an individual's level of nature efficacy. In the measure, following the CNI, was the Self Efficacy scale adapted from Bandura's (2006) study. Instead of using questions about an individual's own efficacy (confidence in one's own actions), questions were created using

information from Chawla's (2009) synthesis of research. These questions covered the efficacy of doing actions of environmental stewardship such as being able to eat all meals for one day with zero food waste or being able to tell a friend to recycle instead of throwing away a water bottle. Participants rated their confidence in their ability to do these actions on a scale of 1-100 (100 being very confident, 1 being not confident at all). This measure examines an individual's actions and willingness to act rather than their thoughts and feelings on issues of stewardship in the environment.

Knowledge of Nature

Specific knowledge of nature can be defined as the level of information an individual understands surrounding topics about plant life, animal life, and species interactions. Knowledge of nature was measured using seven multiple choice questions. The third block of the measure included specific knowledge questions about animals and the environment. These seven questions were multiple choice and included knowledge such as the label for animals that only come out at night. The specific knowledge score was calculated as the number of correct answers out of the seven.

Narrative Writing Samples

The final block of the measure included two samples of writing, covering two questions, "Tell me about one kind of wild animal living in nature that you find extremely interesting" and "How have some people have helped the health and survival of one kind of wild animal living in nature?". The individual was given five minutes to write openly and the measure was coded for factors of word count, causal linkages in sentences, mentions of environmental stewardship, and inclusion of factual knowledge. These coded measures thus provided another way of measuring, beyond the survey measures, multiple aspects of nature attitudes and knowledge.

RESULTS

Test of Hypothesis 1

1a. Measures of connection to nature, environmental stewardship, and knowledge of nature, including scored narratives that were administered to campers and counselors were submitted to Paired Samples *t*-Tests. All means, standard deviations, and *t* values for the Paired Samples *t*-test analysis for campers can be found in Table 1.

For the child campers, significant gains were shown in the variables of connection to nature ($M = .186$, $SD = .35$, $t = 6.912$, $p < .001$), environmental stewardship ($M = 10.836$, $SD = 20.42$, $t = 6.918$, $p < .001$), and knowledge of nature ($M = 27.764$, $SD = 23.28$, $t = 15.866$, $p < .001$). Within the narratives, gains in factual knowledge in the Health and Survival narrative showed a significant increase ($M_{H\&S} = .145$, $SD = .90$, $t = 2.078$, $p < .05$) while word count in both narratives showed a significant decrease ($M_W = -6.604$, $SD = 17.36$, $t = 4.945$, $p < .001$; $M_{H\&S} = 7.090$, $SD = 16.94$, $t = 5.391$, $p < .001$). A marginally significant trend was found as an increase in factual knowledge for the Wild Animal narrative ($M_W = .214$, $SD = 2.09$, $t = 1.330$, $p < .10$).

1b. All means, standard deviations, and *t* values for the Paired Samples *t*-test analysis for counselors can be found in Table 2.

For the counselors, significant gains were shown in the variables of connection to nature ($M = .252$, $SD = .30$, $t = 8.174$, $p < .001$) and environmental stewardship ($M = 11.380$, $SD = 11.94$, $t = 9.195$, $p < .001$). Knowledge of nature showed an increase but was not statistically significant ($M = .614$, $SD = 18.71$, $t = 7.227$, $p < .376$). Within the narratives, gains were shown

in mentions of environmental stewardship for the Wild Animal narrative ($M_W = .035$, $SD = .19$, $t = 1.753$, $p < .042$), causal relationships for both narratives ($M_W = .256$, $SD = .96$, $t = 2.539$, $p < .01$; $M_{H\&S} = -.281$, $SD = 1.13$, $t = 2.349$, $p < .01$), and factual knowledge for both narratives ($M_W = .456$, $SD = 2.07$, $t = 2.085$, $p < .05$). A significant decrease was shown in word count for both narratives ($M_W = -13.433$, $SD = 24.00$, $t = 5.311$, $p < .001$; $M_{H\&S} = -19.267$, $SD = 29.51$, $t = 6.194$, $p < .001$) and factual knowledge for the Health and Survival narrative ($M_{H\&S} = -.382$, $SD = 1.68$, $t = 2.142$, $p < .05$).

Test of Hypothesis 2

2a. Measures of connection to nature, environmental stewardship, and knowledge of nature, including scored narratives that were administered to campers and counselors at pre- and post-test were submitted to an Independent Samples *t*-Test. These same measures administered to campers at post-test were submitted to a second Independent Samples *t*-Test. All means, standard deviations, and *t* values for the Independent Samples *t*-test analysis for the campers' pre- and post-test measures can be found in Tables 3 and 4 respectively.

Significant differences were shown between the campers' Basic and Enhanced groups at pre-test for connection to nature ($M_{Basic} = 4.12$, $M_{Enhanced} = 4.27$, $t = 1.901$, $p < .05$) and word count for the Wild Animal narrative ($M_{WBasic} = 57.06$, $M_{WEnhanced} = 48.58$, $t = 2.444$, $p < .01$). Trends of marginally statistical significant differences were shown in knowledge of nature ($M_{Basic} = 43.44$, $M_{Enhanced} = 40.09$, $t = 1.206$, $p < .11$), word count for the Health and Survival narrative ($M_{H\&SBasic} = 52.80$, $M_{H\&SEnhanced} = 48.20$, $t = 1.392$, $p < .10$), and factual knowledge for the Health and Survival narrative ($M_{H\&SBasic} = .13$, $M_{H\&SEnhanced} = .28$, $t = 1.585$, $p < .06$).

Significant differences were shown between the campers' Basic and Enhanced groups at post-test for word count in both narratives ($M_{WBasic} = 49.00$, $M_{WEnhanced} = 43.01$, $t = 2.066$, $p <$

.05; $M_{H\&SBasic} = 46.87$, $M_{H\&SEnhanced} = 40.33$, $t = 2.290$, $p < .01$). Trends of marginally statistical significant differences were shown in connection to nature ($M_{Basic} = 4.30$, $M_{Enhanced} = 4.43$, $t = 1.583$, $p < .06$), knowledge of nature ($M_{Basic} = 72.41$, $M_{Enhanced} = 68.80$, $t = 1.230$, $p < .11$), and mentions of environmental stewardship in the Health and Survival narrative ($M_{H\&SBasic} = 2.77$, $M_{H\&SEnhanced} = 2.47$, $t = 1.228$, $p < .11$).

2b. All means, standard deviations, and t values for the Independent Samples t -test analysis for the counselors' pre-test and post-test measures can be found in Tables 5 and 6 respectively.

No significant differences were shown between the counselors' Basic and Enhanced groups at pre-test. A trend of a marginally statistical significant difference was shown in the Health and Survival narrative for causal relationships ($M_{H\&SBasic} = 1.52$, $M_{H\&SEnhanced} = 1.25$, $t = 1.245$, $p < .11$).

A significant difference was shown between the counselors' Basic and Enhanced groups at post-test for knowledge of nature ($M_{Basic} = 70.48$, $M_{Enhanced} = 79.09$, $t = 2.656$, $p < .01$). Trends of marginally statistical significant differences were shown in connection to nature ($M_{Basic} = 4.54$, $M_{Enhanced} = 4.63$, $t = 1.297$, $p < .10$), mentions of environmental stewardship in the Wild Animal narrative ($M_{WBASIC} = .05$, $M_{WEnhanced} = .00$, $t = 1.329$, $p < .10$), and factual knowledge in the Health and Survival narrative ($M_{H\&SBasic} = 1.38$, $M_{H\&SEnhanced} = 1.00$, $t = 1.228$, $p < .11$).

Test of Hypothesis 3

3a. Measures of connection to nature, environmental stewardship, and knowledge of nature, including scored narratives that were administered to campers and counselors at pre- and post-test were submitted to a Pearson correlation. All correlational values and corresponding

levels of significance for the Pearson correlations for the campers' pre-test measures can be found in Table 7.

Positive correlations were reported between connection to nature and word count in both narratives ($r_W = .199, p < .01$; $r_{H\&S} = .171, p < .05$), between connection to nature and causal relationships in the Health and Survival narrative ($r_{H\&S} = .164, p < .05$), between knowledge of nature and word count in the Wild Animal narrative ($r_W = .169, p < .05$), and between knowledge of nature and mentions of environmental stewardship in the Health and Survival narrative ($r_{H\&S} = .163, p < .05$).

3b. All correlational values and corresponding levels of significance for the Pearson correlations for the campers' post-test measures can be found in Table 8.

Positive correlations were reported between knowledge of nature and word count in the Wild Animal narrative ($r_W = .135, p < .05$), and between knowledge of nature and factual knowledge in both narrative ($r_W = .175, p < .05$; $r_{H\&S} = .238, p < .01$).

3c. All correlational values and corresponding levels of significance for the Pearson correlations for the counselors' pre-test measures can be found in Table 9.

Positive correlations were reported between connection to nature and word count in both narratives ($r_W = .241, p < .05$; $r_{H\&S} = .178, p < .05$), between connection to nature and causal relationships in the Wild Animal narrative ($r_W = .179, p < .05$), between connection to nature and factual knowledge in the Wild Animal narrative ($r_W = .197, p < .05$), and between environmental stewardship and word count in both narratives ($r_W = .222, p < .05$; $r_{H\&S} = .208, p < .05$).

3d. All correlational values and corresponding levels of significance for the Pearson correlations for the counselors' post-test measures can be found in Table 10.

Positive correlations were reported between connection to nature and word count in the Health and Survival narrative ($r_{H\&S} = .222, p < .05$), between connection to nature and mentions of environmental stewardship in the Health and Survival narrative ($r_{H\&S} = .215, p < .05$), between environmental stewardship and word count in the Wild Animal narrative ($r_W = .106, p < .05$), between knowledge of nature and word count in the Wild Animal narrative ($r_W = .211, p < .05$), and between knowledge of nature and factual knowledge in the Wild Animal narrative ($r_W = .184, p < .05$).

DISCUSSION

Summary

The purpose of this study was to examine the effects of Penn State's Outdoor School, a residential environmental education program conducted in a camp in a nature-rich context, for both child campers and their adult counselors. This study intended to determine if a higher level of leader or counselor preparation could influence the gains shown in connection to nature, orientation toward nature, and knowledge of nature. Using an innovative approach with narrative writing, this study also expected to investigate if the results from the first-time use of this measure would also demonstrate pretest-to-posttests gains concerning nature and whether the narrative measures would be correlated to previously used measures including the Connection to Nature Index (Bragg et al., 2013) and the Self-Efficacy Scale (Bandura, 2006).

For the child campers, there were positive gains in all areas of connection to nature, environmental stewardship, and knowledge of nature. Likewise, there were significant positive gains in areas of connection to nature, environmental stewardship, and knowledge for the adult counselors after the completion of Penn State's Outdoor School.

Hypothesis 1

The study expected to find gains from pre-test to post-test in connection to, orientation toward, and knowledge of nature through increases in scores on the Connection to Nature Index, environmental stewardship, specific knowledge questions about nature, and narrative measures of knowledge about nature (Bragg et al., 2013; Bandura, 2006).

As predicted, there were significant gains for children in all areas: connection to, orientation toward, and knowledge of nature. After participation in the Outdoor School program,

these results denoted that children felt nature to be more a part of their lives, were more conscious of how their actions impacted the environment, were more likely to take action to protect the environment, and were more knowledgeable about nature. In the narratives, factual knowledge was found to increase significantly from pre-test to post-test on one measure and marginally so on another. Considering together all the narrative measures, it appears that children's knowledge is better integrated and expressed through their writing. In essence, increases in knowledge but conveyed in shorter word counts for narratives illustrates that children are better able to concisely convey information through their writing about nature after the completion of the Outdoor School program.

As predicted there were also significant gains for the children's adult counselors in all areas: connection to, orientation toward, and knowledge of nature. After participation in the Outdoor School program, these results denoted that the engaged adult counselors felt nature to be more a part of their lives, were more conscious of how their actions impacted the environment, were more likely to take action to protect the environment, and were more knowledgeable about nature. However, in one contrast to the results for the children, for the counselors it was the narrative measures that were most sensitive to knowledge change—on four out of six measures, the counselors increased their mentions of environmental stewardship, inclusion of causal relationships, and reporting of specific facts about animals or the environment.

As in the case of the child campers, for their adult camp counselors there were increases in knowledge but conveyed in shorter word counts for narratives, suggesting that the counselors are better able to concisely convey information through their writing about nature after the completion of the Outdoor School program. Most strongly, despite the shorter narratives, more

knowledge was exhibited with causal relationships, showing the complex understanding of the interrelationships between the environment and animals.

Hypothesis 2

It was predicted that participants in the enhanced groups instructed by Learning Group Leaders who engaged in bonus material and preparation prior to teaching lessons at Outdoor School would have higher gains. More specifically, it was predicted that both child participants and the adult counselors who had the enhanced program would show higher differences in equalities of means from pre- to post-test in scores on the Connection to Nature Index, environmental stewardship, specific knowledge questions, and narrative scores (Bragg et al., 2013; Bandura, 2006).

At pre-test, the test for equality of campers' means reported just two significant results: a higher connection to nature score and a lower word count for the health and survival narrative for enhanced child campers. These two results signified the basic and enhanced groups differed before the Outdoor School program began, despite choosing the groups at random. At pre-test, the ideal result would be no significant differences in the equality of means for the basic and enhanced groups. Conceptually, however, the differences were almost negligible: CNI scores were 4.27 and 4.12 out of 5 respectively for Enhanced and Basic child camper participants; word counts were 48.58 and 57 respective words written in five minutes for Enhanced and Basic child camper participants.

At post-test, two significant results were reported in the *lower* word count for both narrative categories in the enhanced groups. Child campers who participated in the enhanced program were shown to have written significantly less in their narratives than child campers in the basic program. Again, the difference conceptually was negligible: word counts were 43.01

and 49.00 respective words written in five minutes for Enhanced and Basic child camper participants in the Wild Animal narrative and 40.33 and 46.87 respective words written in five minutes for Enhanced and Basic child camper participants in the Health and Survival narrative. Interestingly, both of these small differences are in the direction opposite to the prediction that higher post-test scores would be shown for campers in the Enhanced Learning Group Leader condition.

At pre-test, the test for equality of counselors' means reported no significant results, illustrating the participant sample for the adult counselors had no differences between the Basic and Enhanced group participation at the beginning of the Outdoor School program. At post-test, one significant result was reported in the knowledge category: adult counselors in the enhanced program showed higher knowledge scores than their counterparts in the basic program. This result expresses that adult counselors having an enhanced Learning Group Leader who prepared more and researched more for their lessons resulted in very significantly higher levels of counselor knowledge at the end of the Outdoor School program.

Hypothesis 3

This study predicted that questionnaire measures used to assess participants' knowledge and awareness of nature would be positively correlated to more sophisticated narratives. More specifically, the Connection to Nature Index, Environmental Stewardship modified Self-Efficacy Scale, and specific survey knowledge questions about nature would be positively correlated with narrative measures of higher word counts, mentions of environmental stewardship, inclusion of causal relationships, and reporting of factual knowledge (Bragg et al., 2013; Bandura, 2006).

For child campers at pre-test, significant correlations were found between the Connection to Nature Index and word count in both narratives as well as inclusion of causal relationships in

one narrative. The relationship between the score received on the CNI and word count of narratives indicates a child more connected to nature will write a longer narrative on wild animals or the health and survival of animals in nature. The correlated scores from the CNI and inclusion of causal relationships shows that the score a child receives about how much nature affects their life is predictive of the interrelationships they will write about in their narratives about nature. Significant correlations were also found between scores on specific knowledge questions and word count on one narrative and mentions of environmental stewardship on one narrative. The correlated scores between knowledge and word count indicate that a child with a higher knowledge of nature will write more in narrative. The relationship between knowledge and mentions of environmental stewardship also denotes that a child with a higher knowledge of nature will mention protecting the environment more often in narrative.

At post-test, significant correlations were found between survey knowledge and word count on one narrative, and survey knowledge and reporting of factual knowledge on both narratives. These correlated values exhibit that the score received on a multiple choice knowledge measure is associated with their ability to report facts in their writing about nature. This result is specifically interesting as it shows a direct relationship between the level of knowledge a child has in multiple choice measures (which in analyses above clearly increased from pre-test to post-test) and including facts in their written post-test narratives. This significant correlation shows the innovative approach of using narratives as a measure can be used to accurately gauge knowledge levels. Future research might address as well whether directly training narrative complexity for nature topics could profit from prior research on training narrative skills overall in children (Khan, Nelson, & Whyte, 2013; Nelson & Arkenberg, 2008).

For adult counselors as well as their coached child campers, the only significant correlations between narrative measures and survey/questionnaire measures were in the expected positive direction. For the counselors, at pre-test, significant correlations were found between scores on the CNI and word count in both narratives, inclusion of causal relationships in one narrative and reporting of factual knowledge in one narrative. The relationship between the score received on the CNI and word count of narratives indicates an adult more connected to nature will write a longer narrative on wild animals or the health and survival of animals in nature. The correlated scores from the CNI and inclusion of causal relationships shows that the score an adult receives about how much nature affects their life is predictive of the interrelationships they will write about in their narratives about nature. The significant correlation between score on the CNI and reporting of factual knowledge indicates that an adult more connected with nature will include more facts about animals in their narrative.

At post-test, significant relationships for the counselors were found between scores on the CNI and word count in one narrative and mentions of environmental stewardship on one narrative. The relationship between the score received on the CNI and word count of narratives indicates an adult more connected to nature will write a longer narrative the health and survival of animals in nature. The correlation between the score received on the CNI and mentions of environmental stewardship shows that an individual who is more connected to nature will include more phrases about protecting the environment in their narrative. A significant relationship was also found between environmental stewardship and word count on one narrative. This correlation indicates that an individual who acts to protect the environment will write longer narratives about wild animals. Finally, significant relationships were found between scores on the multiple choice knowledge measure and word count on one narrative and reporting

of factual knowledge on one narrative. The correlated values of specific knowledge and word count as well as reporting of factual knowledge exhibit that the score received on a multiple choice knowledge measure is associated with their ability to write more and include more facts in their writing about wild animals. This result is specifically interesting as it shows a direct relationship between the level of knowledge an adult has in multiple choice measures and including facts in their written narrative on wild animals. This set of correlations shows the innovative approach of using narratives as a measure can be used to accurately gauge knowledge levels in adults.

Lack of a significant result for either children or adults between the modified Self-Efficacy Scale, which examined confidence of completing actions of environmental stewardship, and mentions of environmental stewardship on the children's and adults' narratives is noteworthy as it would be expected that these measures would have been related to each other.

Comparisons to Prior Research with Children at Nature Camps

Previous research has demonstrated some modest gains due to exposure to nature in areas of cognitive functioning such as attentional capacity, adult environmentalism, ecological knowledge, connection to nature, outdoor play behavior, environmental stewardship behavior, and environmental literacy (Wells, 2000; Wells, 2006; Andrejewski, 2013; Erdoğan, 2015).

It is important to make clear that the present study is broader in scope of measures and with a larger sample size of children than any prior study. It shows similar directions of findings to those in prior literature exemplified through similar questionnaire measures, but the present study gains on these measures generally are stronger than those in prior intervention studies with children. Moreover, there are multiple significant gains shown by the children using innovative narrative measures.

Innovative Findings on How Adults Are Affected by Serving as Counselors at Nature Camps

Previous studies have only examined the effects of nature exposure on children (Wells, 2000; Wells, 2006; Andrejewski, 2013; Erdoğan, 2015). There is a lack of prior pre-test/post-test designs for adult possible changes in knowledge and attitudes concerning nature. Therefore, this study is the first of its kind to examine the effects on adult counselors participating in a residential, environmental education program. The gains demonstrated through this study are extremely pertinent as it indicates that adult connection to nature as well as behaviors and attitudes towards the environment can change based upon preparation for and service as adult counselor/coaches for children in a four-day nature camp. This could encourage adults to be more active in nature in order to foster a connection to the environment, as many adults believe it is too late to change their beliefs about nature. More programs for adults might also be designed following up on the results of the present study.

Adult counselors who were assigned to an Enhanced training condition based upon enhanced, bonus preparation by their Learning Group Leaders showed at post-intervention testing an expected higher level of nature knowledge compared with counselors with more basic training. This is encouraging toward future better preparation of adults who work with children in outdoor nature experiences. However, since environmental stewardship and other attitudes were not affected by the Enhanced training, it would be important to devise engaging and challenging procedures for affecting counselors' attitudes and orientation and not just their knowledge levels.

Implications for Teaching Children

The results of this study indicate that a four-day program for fifth graders at an outdoor nature camp led to substantial changes in multiple aspects of their knowledge of and attitudes

and beliefs concerning nature. These advances were evident on both questionnaire and narrative measures. Specific advances included all of the following: on questionnaire instruments, gains in connection to, orientation toward, and knowledge of nature for children; in narratives higher inclusion of factual knowledge in a more concise narrative. New work on helping children integrate both knowledge and action possibilities into nature narratives would benefit from prior work on narrative interventions. In that work there are promising beginnings on how to structure adult-child interactions to scaffold children's increasing complex narratives.

In education, these intervention programs could be worked into curriculums that include direct experiences in natural settings or encourage a reform of the current classroom teaching techniques. A future study comparing the effects of a standard school to a school teaching nature education with more exposure within the school day would be beneficial. The results of this potential study could show if nature exposure on a daily level would help children in a significant way that justifies the curriculum changes. This type of study could also speak to the difficulty it would present if the school boards were to change the curriculums and train the teachers on the new way of teaching. Future research studies in psychology could capitalize on the implications and test the efficacy of the potential changes in curriculum to see if they are improving the same variables in the normal classroom area.

Other studies of intervention programs that could take place without changing curriculums could be creating initiatives for schools to have their students play and explore outside more in nature. A beneficial study could examine the effectiveness of extra-curricular clubs created to study nature, after school programs that include outdoor play, or even a school-wide challenge for tracking new knowledge learned about nature or how much time was spent outside discovering nature. The study's results would show if these initiatives would increase the

desire for children to go outdoors and become more connected to nature—based on the prior literature’s tentative support for nature exposure increasing connection to nature (Wells, 2000; Wells, 2006; Andrejewski, 2011; Erdoğan, 2015).

In the area of development, this could encourage parents to interact with their children in nature to try and foster a connection to the environment. Due to the increasing usage of technology in the modern era, parents might be more inclined to let their children stay indoors and occupy themselves with many different types of screens. However, research like this study could motivate parents to change the direction of their children’s hobbies and promote outdoor activities in their children’s daily lives.

Implications for Adults

The results of this study indicate that participating in supervision/coaching of campers in a four-day program for fifth graders at an outdoor nature camp led to substantial changes in multiple aspects of adults’ knowledge of and attitudes and beliefs concerning nature. These advances were evident on both questionnaire and narrative measures. Specific advances included all of the following: on questionnaire measures, gains in connection to and orientation toward nature; lower word count on narratives but higher inclusion of factual knowledge, indicating a more efficient narrative, together with narrative gains in causal linkages and mentions of environmental stewardship. Future research studies in psychology could further the examination of adult effects due to the exposure to nature to see if the same variables improve in other specifically designed nature programs for adults only, for adults counseling or coaching child participants, or through other outdoor experiences in nature for adults.

Limitations

Participants in this study were predominately Caucasian individuals from the Huntingdon, Mifflin, and Centre county areas in Pennsylvania where the percentage of inhabitants that identify themselves as Caucasian is 92.6%, 97.5%, and 88.7% respectively (US Census Bureau, 2014). The sample of participants in this study was predominately Caucasian at approximately 87.6% for campers and 83.9% for counselors. Lack of a diverse sample could limit the generalizability of the results found in this study. Nevertheless, for the samples studied this study demonstrated that substantial gains were found in connection to and orientation toward nature and nature stewardship as well as in knowledge of nature for both children and adults.

Future Research

Future studies should strive to obtain a more heterogeneous sample in order to collect new narratives from a more diverse population of children and adults. The survey and questionnaire instruments employed in this study also call for information using more diverse populations of children and adults in future studies.

Using written narratives as an innovative measure would require further research into the collection and interpretation of the narratives to confirm the reliability of the coding measure within a larger, more diverse sample. The potential for narratives is higher for assessing the integrated knowledge and attitudes and action commitments shown by individuals participating in the environmental education program. Written narratives as a measure should be further examined to confirm the level of correlation between the narrative writing and survey instruments assessing knowledge and awareness of nature. Further research could also investigate possible uses of narratives as a psychological measure and correlations with other

types of instruments outside of evaluating behaviors and attitudes towards the environment and nature.

Conclusion

Overall, this study expands upon a fairly small set of previous studies and findings regarding exposure to nature through direct experience for children in nature camps or similar settings. The present study employed a broader set of measures and a larger sample size within a pre-test/intervention/post-test design than any prior study. Strong gains were demonstrated by the children and adults on several measures in this investigation: orientation toward nature, knowledge of nature, and inclusion of factual knowledge in narrative. In addition, the present results converge with the few prior pre-test/intervention/post-test studies in showing gains on the measure of connection to nature used most commonly across the studies.

Relative to the most germane prior studies, the level of gains made by the children in this study are similar in kind but stronger on questionnaire measures of connection to nature, environmental stewardship, and knowledge of nature. The level of gains made by children in this study also reflect these gains in a broader scope from just the questionnaire measures through the results of the innovative use of the narrative measures. These new narrative measures include word count, mentions of environmental stewardship, inclusion of causal relationships, and reporting of factual knowledge.

The present study is highly innovative in its multiple-measure examination of what kinds of gains in knowledge, attitudes, and beliefs concerning nature are made by trained adult counselors who are the coaches and tutors for children attending an outdoor nature camp. Remarkably, these adult counselors overall made gains that are as substantial and broad as those made by their younger students. Specifically, increases on questionnaires in connection to nature

and orientation toward nature, and in narratives the increased inclusion of causal relationships in narrative, mentions of environmental stewardship, and factual knowledge of nature. It will be fascinating to extend research on this topic of adult positive changes achieved through their teaching and counseling roles with children.

Appendix A

Survey Instruments

Instrument 1. Pre-Survey

ID: _____

First Name: _____

(Primary Investigator use only)

Last Name: _____

(Identifying information will be removed when ID is assigned)

Pre-Survey

What is your age?

- Under 10
- 10 - 17
- 18 - 29
- 30 - 49
- 50 - 64
- 65 and older

What is your gender?

- Male
- Female
- Other

What is your race/ethnicity? (you may select more than one)

- American Indian/Alaska Native
- Asian
- Black/African American
- Native Hawaiian/Other Pacific Islander
- White/Caucasian
- Other (Please specify) _____

Please tell us how much you agree or disagree with each of the following statements, by checking the relevant box.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I like to hear different sounds in Nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to see wild flowers in Nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I feel sad, I like to go outside and enjoy Nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being in the natural environment makes me peaceful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to garden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collecting rocks and shells is fun	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel sad when wild animals are hurt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to see wild animals living in a clean environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy touching animals and plants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking care of animals is important to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Humans are part of the natural world	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People cannot live without plants and animals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being outdoors makes me happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My actions will make the natural world different	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Picking up trash on the ground can help the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People do not have the right to change the natural environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer these questions to the best of your ability. There will only be one answer per question.

1. How many years does it take to make one inch of top-soil, on average?

- Three days
- One hundred years
- Ten years
- Four months

2. What is an animal called when it only comes out at night?

- Diurnal
- Nocturnal
- Crepuscular
- Arrhythmic

3. How often does a hibernating turtle's heart beat?

- Once a second
- Once a minute
- Once every 5 minutes
- Once every 10 minutes

4. How do honeybees communicate?

- A symbolic dance
- Honey bees do not communicate
- Echolocation
- Using their wings to hum

5. If a monarch butterfly is born in Pennsylvania in October, how long is it likely going to live?

- 2 months
- 7 months
- 11 months
- 2 weeks

6. What is one very good effect of having enough predators (like coyotes, foxes, and hawks) as part of a local environment in Pennsylvania?

- They keep groups of rabbits, mice, and chipmunks healthy by eating the least healthy/weakest animals.
- They protect the smaller animals so the smaller animals can survive better.
- They help the smaller animals (who are their prey) find food.

7. What is something similar between hummingbirds and dragonflies?

- They both eat snails
- They are very quick and flexible in their flying patterns
- They both migrate in the fall to Mexico
- They are both insects

Instrument 2. Post-Survey

ID: _____

First Name: _____

(Primary Investigator use only)

Last Name: _____

(Identifying information will be removed when ID is assigned)

Post-Survey**What is your age?**

- Under 10
- 10 - 17
- 18 - 29
- 30 - 49
- 50 - 64
- 65 and older

What is your gender?

- Male
- Female
- Other

What is your race/ethnicity? (you may select more than one)

- American Indian/Alaska Native
- Asian
- Black/African American
- Native Hawaiian/Other Pacific Islander
- White/Caucasian
- Other (Please specify) _____

Who was your Learning Group Leader?

Please tell us how much you agree or disagree with each of the following statements, by checking the relevant box.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I like to hear different sounds in Nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to see wild flowers in Nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I feel sad, I like to go outside and enjoy Nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being in the natural environment makes me peaceful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to garden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collecting rocks and shells is fun	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel sad when wild animals are hurt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to see wild animals living in a clean environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy touching animals and plants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking care of animals is important to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Humans are part of the natural world	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People cannot live without plants and animals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being outdoors makes me happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My actions will make the natural world different	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Picking up trash on the ground can help the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People do not have the right to change the natural environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer these questions to the best of your ability. There will only be one answer per question.

1. How many years does it take to make one inch of top-soil, on average?

- Three days
- One hundred years
- Ten years
- Four months

2. What is an animal called when it only comes out at night?

- Diurnal
- Nocturnal
- Crepuscular
- Arrhythmic

3. How often does a hibernating turtle's heart beat?

- Once a second
- Once a minute
- Once every 5 minutes
- Once every 10 minutes

4. How do honeybees communicate?

- A symbolic dance
- Honey bees do not communicate
- Echolocation
- Using their wings to hum

5. If a monarch butterfly is born in Pennsylvania in October, how long is it likely going to live?

- 2 months
- 7 months
- 11 months
- 2 weeks

6. What is one very good effect of having enough predators (like coyotes, foxes, and hawks) as part of a local environment in Pennsylvania?

- They keep groups of rabbits, mice, and chipmunks healthy by eating the least healthy/weakest animals.
- They protect the smaller animals so the smaller animals can survive better.
- They help the smaller animals (who are their prey) find food.

7. What is something similar between hummingbirds and dragonflies?

- They both eat snails
- They are very quick and flexible in their flying patterns
- They both migrate in the fall to Mexico
- They are both insects

Appendix B

Tables

Table 1. Paired Samples t Test of Campers' Changes: Post-Mean minus Pre-Mean

<i>Measure</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>Sig. (1-tailed)</i>
CNI	.186	.35	6.912	.000
ES	10.836	20.42	6.918	.000
Knowledge	27.764	23.28	15.866	.000
Word Count W	-6.604	17.36	4.945	.000
Word Count H&S	-7.090	16.94	5.391	.000
Mentions W	.006	.21	.377	.354
Mentions H&S	-.134	1.73	.994	.161
Causal W	-.047	1.12	.548	.292
Causal H&S	.012	1.57	.099	.461
Factual W	.214	2.09	1.330	.093
Factual H&S	.145	.90	2.078	.020

Note: CNI = Connection to Nature Index; ES = Environmental Stewardship; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

Table 2. Paired Samples t Test of Counselors' Changes: Post-Mean minus Pre-Mean

<i>Measure</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>Sig. (1-tailed)</i>
CNI	.252	.30	8.174	.000
ES	11.380	11.94	9.195	.000
Knowledge	.614	18.71	.317	.376
Word Count W	-13.433	24.00	5.311	.000
Word Count H&S	-19.267	29.51	6.194	.000
Mentions W	.035	.19	1.753	.042
Mentions H&S	-.081	1.72	.438	.331
Causal W	.256	.96	2.539	.007
Causal H&S	.281	1.13	2.349	.011
Factual W	.456	2.07	2.085	.020
Factual H&S	-.382	1.68	2.142	.018

Note: CNI = Connection to Nature Index; ES = Environmental Stewardship; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

Table 3. Independent Samples t-Test for Equality of Camper's Means at Pre-test

<i>Measure</i>	<i>LGL* M</i>	<i>LGL** M</i>	<i>Difference</i>	<i>t</i>	<i>Sig. (1-tailed)</i>
CNI	4.27	4.12	-.157	1.901	.029
ES	73.95	71.86	-2.089	.580	.281
Knowledge	40.09	43.44	3.357	1.206	.114
WC W	48.58	57.06	8.474	2.444	.008
WC H&S	48.20	52.80	4.599	1.392	.083
Mentions W	.02	.00	-.021	.862	.195
Mentions H&S	2.72	2.81	.093	.341	.367
Causal W	.92	1.03	.112	.790	.215
Causal H&S	1.47	1.41	-.063	.278	.390
Factual W	1.99	1.84	-.149	.782	.326
Factual H&S	.28	.13	-.151	1.585	.057

Note: CNI = Connection to Nature Index; ES = Environmental Stewardship; WC = Word Count; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

* Bonus – LGLs who had enhanced training in addition to the basic program

** No Bonus – LGLs who had the basic program training

Table 4. Independent Samples t-Test for Equality of Camper's Means at Post-test

<i>Measure</i>	<i>LGL* M</i>	<i>LGL** M</i>	<i>Difference</i>	<i>t</i>	<i>Sig. (1-tailed)</i>
CNI	4.43	4.30	-.130	1.583	.057
ES	84.79	82.15	-2.634	.763	.223
Knowledge	68.80	72.41	3.602	1.230	.110
WC W	43.01	49.00	5.990	2.066	.020
WC H&S	40.33	46.87	6.543	2.290	.011
Mentions W	.02	.01	-.007	.346	.365
Mentions H&S	2.47	2.77	.294	1.228	.110
Causal W	.87	1.00	.134	.979	.164
Causal H&S	1.46	1.61	.142	.772	.220
Factual W	2.21	2.05	-.151	.571	.284
Factual H&S	.33	.42	.093	.726	.234

Note: CNI = Connection to Nature Index; ES = Environmental Stewardship; WC = Word Count; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

* Bonus – LGLs who had enhanced training in addition to the basic program

** No Bonus – LGLs who had the basic program training

Table 5. Independent Samples t-Test for Equality of Counselor's Means at Pre-test

<i>Measure</i>	<i>LGL* M</i>	<i>LGL** M</i>	<i>Difference</i>	<i>t</i>	<i>Sig. (1-tailed)</i>
CNI	4.38	4.30	-.088	1.046	.149
ES	83.17	80.94	-2.230	.721	.236
Knowledge	73.52	70.79	-2.726	.719	.237
WC W	65.28	60.29	-4.986	.932	.177
WC H&S	60.08	65.24	5.169	.869	.193
Mentions W	.00 ^c	.00 ^c	-- ^c	-- ^c	-- ^c
Mentions H&S	2.50	2.86	.360	1.122	.132
Causal W	.63	.49	-.136	.918	.180
Causal H&S	1.25	1.52	.273	1.245	.108
Factual W	1.83	2.07	.242	.535	.298
Factual H&S	1.73	1.50	-.225	.821	.207

Note: CNI = Connection to Nature Index; ES = Environmental Stewardship; WC = Word Count; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

* Bonus – LGLs who had enhanced training in addition to the basic program

** No Bonus – LGLs who had the basic program training ^c Mentions W was not included in the Output Table because the standard deviations of both the Basic and Enhanced groups are both 0.

Table 6. Independent Samples t-Test for Equality of Counselor's Means at Post-test

<i>Measure</i>	<i>LGL* M</i>	<i>LGL** M</i>	<i>Difference</i>	<i>t</i>	<i>Sig. (1-tailed)</i>
CNI	4.63	4.54	-.089	1.297	.099
ES	93.42	93.38	-.044	.028	.489
Knowledge	79.09	70.48	-8.618	2.656	.005
WC W	51.20	46.87	-4.328	.863	.195
WC H&S	41.63	46.69	5.055	1.115	.134
Mentions W	.00	.05	.045	1.329	.094
Mentions H&S	2.51	2.77	.260	.859	.196
Causal W	.80	.82	.017	.083	.467
Causal H&S	1.56	1.71	.150	.725	.235
Factual W	2.54	2.20	-.337	.952	.172
Factual H&S	1.00	1.38	.378	1.228	.111

Note: CNI = Connection to Nature Index; ES = Environmental Stewardship; WC = Word Count; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

* Bonus – LGLs who had enhanced training in addition to the basic program

** No Bonus – LGLs who had the basic program training

Table 7. Pearson Correlation for Measures of Campers at Pre-test

	CNI	Environmental Stewardship	Knowledge
Word Count W	.199**	.126	.169*
Word Count H&S	.171*	.084	.113
Mentions W	.034	.047	-.067
Mentions H&S	.068	.094	.163*
Causal W	.122	.046	.012
Causal H&S	.164*	.065	.026
Factual W	.023	-.053	.111
Factual H&S	.089	.019	.102

* $p < .05$, ** $p < .01$ at the 1-tailed level

Note: CNI = Connection to Nature Index; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

Table 8. Pearson Correlation for Measures of Campers at Post-test

	CNI	Environmental Stewardship	Knowledge
Word Count W	.079	.108	.135*
Word Count H&S	.019	.015	.105
Mentions W	.094	.046	-.086
Mentions H&S	.014	-.006	.092
Causal W	-.015	.004	-.041
Causal H&S	.018	.061	.097
Factual W	.012	.036	.175*
Factual H&S	.027	.032	.238**

* $p < .05$, ** $p < .01$ at the 1-tailed level

Note: CNI = Connection to Nature Index; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

Table 9. Pearson Correlation for Measures of Counselors at Pre-test

	CNI	Environmental Stewardship	Knowledge
Word Count W	.241*	.222*	.096
Word Count H&S	.178*	.208*	-.138
Mentions W	-- ^c	-- ^c	-- ^c
Mentions H&S	.049	.089	-.066
Causal W	.179*	.080	-.025
Causal H&S	.027	.105	.027
Factual W	.197*	.114	.069
Factual H&S	-.094	.088	.051

* $p < .05$, ** $p < .01$ at the 1-tailed level

Note: CNI = Connection to Nature Index; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

^c Mentions W was not included in the Output Table because the variable is constant

Table 10. Pearson Correlation for Measures of Counselors at Post-test

	CNI	Environmental Stewardship	Knowledge
Word Count W	.131	.106*	.211*
Word Count H&S	.222*	.078	.042
Mentions W	.025	.093	.086
Mentions H&S	.215*	.164	.022
Causal W	.082	-.141	-.014
Causal H&S	-.049	-.115	.014
Factual W	.084	.093	.184*
Factual H&S	-.046	.091	-.005

* $p < .05$, ** $p < .01$ at the 1-tailed level

Note: CNI = Connection to Nature Index; W = Question about Wild Animal, H&S = Question about Health and Survival in reference to the Narrative measure

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Academic Vita

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EDUCATION

The Pennsylvania State University University Park, Pennsylvania
Schreyer Honors College May 2016
Bachelor of Science, Psychology

RESEARCH EXPERIENCE

Communication, Arts, and Sciences Department, Pennsylvania State University June 2015 – Present
Research Assistant

- 100 hours of video transcription and review; 200 hours of transcript preparation for LIWC program
- Train new research assistants on preparation of Linguistic Inquiry and Word Count (LIWC) program transcripts

Child Attention and Learning Lab, Pennsylvania State University January 2014 – December 2015
Research Assistant

- Trained to administer WISC, WIAT, WRAML, WAIS
- Collect data through phone screens to determine family eligibility

Internship, Dr. Brian Kehoe, Ph.D. LLC July 2014 – August 2014
Intern

- Process intake paperwork for new patients
- Observe sessions with patients using CBT and token economies

EMPLOYMENT HISTORY

Residence Life, Pennsylvania State University June 2015 – Present
Resident Assistant

- Establish & maintain a positive living environment based around community through floor and building programs
- Mentor and support around sixty students on personal and academic questions and concerns
- Enforce University policies and report any violations to coordinator and police
- Interview potential candidates for the Resident Assistant class and jobs

Shaver's Creek Outdoor School, Pennsylvania State University April 2015 – April 2016
Counselor

- Facilitate activities to help elementary and middle school students learn about resources and our environment
- Lead cabin groups of eight campers and monitor safety while at Camp Blue Diamond

INVOLVEMENT

Psi Chi (National Honor Organization in Psychology), Pennsylvania State University October 2014 – Present
Treasurer

National Residence Hall Honorary, Pennsylvania State University November 2014 – Present
Member

Fossil Free Penn State, Pennsylvania State University May 2014 – May 2015
Media Specialist

HONORS & AWARDS

Schreyer Honors Scholar, 2013 – 2016

Gerald L. Bayles Scholarship, 2013 – 2016

Haskell Honors Scholarship, 2014 – 2016

Military Officers Association of America Scholarship, 2014 – 2016

Paterno Student Enhancement Scholarship, 2014

Frazier Honors Scholarship, 2014