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Positive Emotion in Nature as a Precursor to Learning

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Abstract

This study was designed to examine the perception of learning in adults generated by the effect of a positive emotion-in this case, awe. For the study, a working definition of awe is an *impact-provoking reverence due to a powerful, positive emotional response to the natural world*. This qualitative study used primarily face-to-face interviews. A total of 71 adults were interviewed and 113 interviews were conducted. These adults described an experience in which they felt impacted by awe and as a result perceived learning. Their descriptions were coded to determine context of the experience and what was learned. Of the participants, 98.6% perceived that learning occurred due to their powerful, emotional response to the nature experience they described. These findings extend the current research on informal and formal science learning, natural resource management, experiential education, and the study of emotions as experienced in nature.

Key words: Emotions, Experience, Informal learning, Nature, Science, Interpretation, Affect.

Introduction

Informal science educators such as environmental educators, museum docents and natural area interpreters have long known that there is great value in connecting people with the outdoors. This study sought an understanding of the complex relationship between an emotional experience in nature and perceived learning and provides educators with information to design programs that truly engage students with practical, interesting and motivating learning (Beck, 1993). If it can be shown that individuals perceive they are learning when an experience yields the powerful, positive emotion known as awe, then there is sound premise for suggesting that such experiences can *improve* learning. The goal of this phenomenography is to understand the experience of awe in nature and to determine if and how learning is perceived to take place as a result of the *awe experience.*

A major theme of this research is that developing citizens who feel comfortable going out into the natural world is an important feature of education. The problem is that learners are not feeling positive emotions in nature (for this study, the emotion awe) because they are increasingly not going out into nature. Modern American culture is so removed from nature that there has been an individual and societal effect. Lack of engagement with the natural world has numerous well-documented repercussions on both health and well-being according to work done by Nabhan and Trimble (1994) and documentation by Louv (2005) and Montada and Schumacher (1999). The lack of engagement of many Americans, and perhaps individuals in other countries have with the natural environment permeates science discussions today.

For decades, starting with Rachel Carson in the early 1960s, many authors have reported that society is becoming emotionally and physically ill due to this lack of engagement with the outdoors. Among these researchers are Carson (1965), Dewey (1967), Fredrickson and Anderson (1999), Beck (1993), and Louv (2005). Furthermore, a lack of knowledge and understanding about nature (Louv, 2005; Kals et. al., 1999) as well as the negative impact of this trend on the commitment to sustaining the environment (Stapp, et al., 1969, as cited in Tal 2007, UNESCO 1978) and an educated science citizenry Carnegie Corporation (2009), National Science Teachers Association (NSTA, 2009), and the National Science Foundation (2007) are well documented. For example, the American Association for Advancement of Science (AAAS, 1993) (Project 2061), the NSTA, and the National Center for Improving Science Education (NCISE) have in recent years guided science education toward that meaningful personal and societal connection to the environment. If there is no

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relationship with nature, then the individual cannot know nature (Kals, et al., 1999). One motivation for the research presented in this article, then, was concern for this diminished relationship with nature.

A related concern is increasingly more learning about science (including nature) takes place from media as compared to direct experience (Nabhan & Trimble, 1994). The deficit of public understanding of science as noted by the Carnegie Corporation of New York (2009) and the National Science Board (2010) has been documented and this insufficiency can be extended to the dearth of nature experiences resulting in a lack of interest in and commitment to conserving our natural resources (Kals et al., 1999). One probable reason for these trends is that traditional, formal school settings do not encourage frequent (or even occasional) experiences within natural settings. If experiences in nature can be shown to positively affect learning about nature, then increased opportunities for learning in settings such as nature could be more readily justified. By demonstrating perceived learning and in many cases, action taken as a result of the perceived learning in those who experience a sense of awe, the justification of opportunities for awe can be increased, thus enhancing a connection to nature, improved health, and better learning. Hereafter, under the assumption that self-reported, perceived learning suggests cognitive change, this process will simply be called "learning".

For this study, the following research questions were used: (1) *What circumstances lead to an experience of awe in nature?* This question examines the *context* for such an experience in nature (2) *What do participants perceive they learn from the awe experience*? This question examines whether learning was perceived and what was learned due to the experience and (3) *How do participants perceive the awe experience leads to learning?* which determines how the experience fostered learning. The context for the awe experience was the focus of the initial interview and learning was the focus of the follow up interviews.

This study's working definition of an awe experience is based on the literature (Frederickson & Anderson ,1999; Schmidt & Little, 2001; Williams & Harvey, 2001) and what the pilot participants reported. Awe is *impact inspiring reverence and wonder* and *can be triggered by such things as wildlife, scenery, recreational activity and social interaction*. In turn, it can motivate the participant to respond in an emotional, behavioral, physical, or cognitive manner. However, grounding a theory about awe allows and encourages the participants to generate their own definition, which they did.

Powerful emotional experiences in nature justify the development of educational programs (both formal and informal) providing learners with experiences in nature. While much of what is learned through nature experience is science content (content about nature), outdoor educators, environmental educators, and National Outdoor Leadership School (NOLS) professionals have known for some time that there is further value in connecting people with the environment and a recently growing body of literature supports the efficacy of adult learning in informal environments (Falk & Gillespie, 2009; Falk & Needham, 2011; Falk & Storksdiek, 2010; Rennie, Falk & Dierking, 2007). Reflecting on the impact of the nature experience (or the deficiency of such experiences) in areas of science knowledge and learning in general has prompted this study on the value of being out in nature. This study is of value for those planning formal and informal learning programs in parks and other natural settings.

Theoretical Framework

Positive emotion has been shown to enhance learning in all settings. A review of recent and classic literature supports the value of experience in nature and offers potential models for studying the emotional responses (Farber & Hall, 2007; Barrie, 2001; Frederickson & Anderson, 1999; Schmidt & Little, 2007) and learning in natural areas (Falk and Storksdiek, 2010; Dierking, Rennie, Anderson, & Ellenboggen, 2003). Nature generates such positive emotions and therefore can lead to learning. There exists a wealth of information in the literature about emotions and learning particularly in the fields of informal science and interpretation at places such as science centers, outdoor nature areas, and museums (Falk and Storksdiek, 2010; Dierking, Rennie, Anderson, & Ellenboggen, 2003). Therefore it is logical to assume that positive emotions, including awe and wonder lead to learning. However, while the literature shows that nature provides an arena for learning that is tied to powerful emotions, there are not studies clearly linking these emotions (particularly awe) in nature to learning, hence the need for the current study.

In this phenomenography, the perceptions of the participants are the focus of the study. The participants shared what they "know" and were asked what their knowledge prompted them to do as a result of their experience. This includes conservation, career choices and research of science in addition to further participation in nature. While this study does not include all aspects of science, learning about the natural world is a component of

learning science, and is referred to as science learning. This review includes literature in recreation, leisure studies (such as leisure in natural environments) and informal science literature since for this study, nature is the setting, or context.

Many studies indicate the importance of out-of-school (in this case, informal) learning as a connection to culture and nature, for personal leisure, and for recreation (Barrie, 2001; Falk & Gillespie, 2009; Falk & Needham, 2011; Falk & Storksdiek, 2010; Rennie et al., 2003; Rennie et al., 2007). However, as noted by Rennie and Anderson (2008), much of what we refer to as education today depends on formal education, which is education in a school with a formal curriculum. This tendency ignores the fact that most of our time is spent out of school, and that much learning takes place in less formal contexts. As a matter of fact, research shows that over a lifetime, *more* learning takes place in informal settings such as natural resource or historical interpretation sites (Miller, 2001; Falk & Needham, 2011) than in formal school environments.

In this article research addressing the inherent value of nature experience is discussed. In examining previous experiences, an understanding about what was felt and how that emotion motivated learning, specifically, *the role awe plays in learning* is sought. Figure 1 below illustrates how the literature addresses nature experience which elicits emotion resulting in learning.

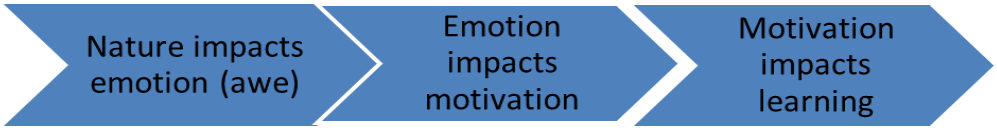

Figure 1. The literature review components and their relationship to each other.

According to the literature, nature experience triggers emotions which engage meaning-making (Frederickson & Anderson, 1999; Schmidt & Little, 2001; Farber & Hall,2007; Barrie, 2001) by an individual. This study attempts to use the literature and interviews with individuals to illustrate the entire process illustrated above.

Nature Experience Motivates Learning

The core question of this article is: *What is it about awe responses to nature that provides meaning and motivation to learn?* A review of the literature, including the research of Frederickson and Anderson (1999), Falk & Storksdiek (2010) and Barrie (2001), provides an entry point to the question, but what further research evidence links emotion with learning science?

Frederickson and Anderson (1999) researched the value of nature experiences for twelve women camping in the Boundary Waters (MN) and at the Grand Canyon. Journals written by the women showed the wilderness itself to be the basis for their emotion and spiritual inspiration. One of them described "the expansiveness of the landscape" (p. 21) as an important stimulus for her inspiration. Participants reported a motivation to learn more about the flora and fauna they encountered during their wilderness experience. In addition, Barrie's (2001) research indicated that meaning-making is a subjective depiction of an experience. While studying 80 adults in the Alaskan wilderness she categorized descriptions of the meaning made from their experience: personal, site and outcome. In addition, Farber and Hall (2007) conducted a study of 445 participants in Alaska and found descriptors in the following categories; wildlife, scenery, recreational activity, and social interaction. Falk and Storksdiek (2010) reported that cognition and emotion can be blended in a leisure experience which is determined by personal motivation and how the individual makes meaning. Their study of adult visitors to a leisure setting indicated that learning about science did indeed occur and was directly related to learner motivations. In their three year study of 191 adult visitors to a science center, they reported increases in overall learning of science due to motivation. The methodology allowed the participants to determine categories of descriptors.

Emotion due to Nature Experience

Emotions are caused by experiences and can induce motivation and meaning. An experience in nature is an event and the emotion inspiring *awe* is "the meaning of [the experience] to the participant" (Batcher, 1981).

Farber and Hall (2007) surveyed park visitors about a special experience they had in nature, the context of the experience and emotions resulting from the experience. Schmidt and Little (2007) determined that emotions can be beneficial and *caused by* nature. Further, emotions can be "peak experiences" (Panzarella, 1980; Maslow, 1964) which trigger intense happiness and well-being which can transfer to traditional learning environments. Panzarella's work reported that these peak emotions can be attributed to experiences and may be measured. Kals et. al.1999) tested emotion in nature and examined emotional affinity to nature. They determined that this affinity was enhanced by experience in nature. Schmidt and Little (2007) provided insights into experiences eliciting spirituality, specifically leisure experiences in nature. Their study indicated that "…experiences of leisure enabled the respondents to learn more about their self; to feel a sense of connection; and to experience a sense of freedom to do…" (p. 246). Their research sought to identify and understand an "indefinable" emotion (p.246). Schmidt and Little's phenomenography allowed for participants to define spirituality in their own way. Its similarity to the present study (as well as the fact that their study referred to awe specifically as an outcome of experience in nature) is very useful. In another relevant study, Farber and Hall (2007) described "influences on emotion during leisure experiences" (p. 251). These influences were scenery, recreational activity, wildlife, and social interaction. Each of these studies clearly ascribe importance to the *context* in which this emotion takes place. These researchers provide an impetus for a qualitative examination of the context of an experience of awe in nature.

The particular nature-induced emotion examined in this study is awe. Although the study of various emotions is readily found in research literature, the specific emotion *awe* and motivation or meaning-making due to awe are not found.

Learning Triggered by Emotion

Falk and Gillespie (2009) show that engaging the emotions of a learner can allow for construction of meaning from the nature experience. In addition, Loomis's (1996) non-empirical work examined research using theories applied to visitor learning at an interpretive site. It assessed learning programs and measured what visitors gained from an experience. The work by these authors encouraged research on experience in nature that would address problems such as those posed by this study. Improving learning and academic performance through nature may correlate with "increases in self-esteem, problem solving and motivation to learn", all attributes (1996, p. 41) of a person engaged with science content.

As it pertains to this study, Dierking and her colleagues (2003) proposed that learning is motivated by a desire to learn and derives from experiences out of the formal classroom, such as experiences of nature. In a recent study of adults, Falk & Storksdiek (2010) provide empirical support for learning science in informal settings and indicated that cognitive and affective growth factors persisted. Furthermore, motivation is often the impetus for cognitive growth and such growth is often measured in terms of resulting actions or behaviors. Deci, Vallerand, Pelletier and Ryan (1991) support this correlation in terms of "self determination". Evidence of the cognitive change for this study result in actions such as conserving, researching or spending more time in nature. In other words, participants who self-determined their learning supported the learning by what they did as a result of the learning. While the existing literature suggests elements or characteristics of nature experiences in which positive emotions are felt and addresses the effects of learning in informal environments, it does not address learning resulting from a positive emotional experience in nature, such as the awe moment.

Method

This study seeks information about the phenomenon of awe and to generate a theory about nature experience by examining the perception of awe experience (Stark & Brown, 2007; Mertens, 1998; Glaser, 2004). It uses the constant comparative method with many sources of data; a phenomenography attempting to a ground a theory about participants' own definitions of awe. Both phenomenography and grounded theory seek to explore real-life situations, and involve much interaction (such as those gleaned through multiple interviews) between the researcher and the participant (Stark and Brown, 2007; Creswell, 2004); in the form of interviews and/or observations meant to elicit a wide range of stories (Gubrium and Holstein, 1998). To ensure the findings are not influenced by preconceived ideas, participants were involved in data analysis which increased the trustworthiness of the findings (Creswell, 2004). It is important to note the rationale and means for measurement of learning was borrowed from Arseneault's (1998) study in which self-reflection of knowledge was used to elicit learning in nature by adults (Gubrium & Holstein, 2002).

The research instrument was designed and the participants and locations chosen so as to allow for the story of the awe-inspired nature experience to unfold (Glaser, 2004; Creswell, 2004). Data collection and analysis occurred simultaneously. After the pilot interview, the process of data collection consisted of an initial (main) interview and follow-up interviews (which took place within ten days and again six months later). The follow-up interviews targeted the component of learning and were conducted to clarify responses, inquire further about the participants' responses and allow for further refection by the interviewee if necessary (Mertens, 1998). Data were analyzed and further validated by member-checking and inspection by an independent reviewer (Dr. Elizabeth Barrie) upon conclusion of both initial and follow-up interviews (Glaser, 2004; Creswell, 2004).

The Research Instrument

The research questions (Gubrium & Holstein, 2002), and models from Barrie (2001) and Farber and Hall (2007) were used to develop the interview protocol. The protocol was an improvised, conversational method and was also guided by the pilot interview. Advantages of such a protocol allowed the participant to give their own description of the awe experience, or rather, tell their story in a conversational way, encouraging them to expand on their answers. Conversely, this protocol encouraged a vast amount of information and required much clarification via the follow up interviews. Given such a conversational method, several of the follow up questions may have been answered by the participants in their initial interview.

A test of the interview questions with 11 participants in a public setting (a restaurant) strengthened the process. Interestingly, it became apparent that a definition for awe was not necessary since all pilot study participants self-defined and explained their experience without a guiding definition. Elimination of several questions allowed the participants to describe their awe-inspiring experience without constraint. As a result of the field testing, the final questions, asked over (a maximum of three) interviews were:

1) (initial interview) *Please tell me about your most awe-inspiring experience in nature*.
2) (follow-up interviews) *Did learning take place due to your awe experience in nature? Please describe it for me.*
3) What, if anything was learned?
4.) What, if anything, did you do as a result of your learning?

These questions were augmented by prompts to add detail and examples (Barrie, 2001). The interviewees were encouraged to talk at length and in doing so, many participants shared information about learning in the initial interview. There were no time limits.

Selection of Setting and Participants

The pilot study provided insight that the target population might be better served in natural settings such as county parks rather than the public setting of the pilot interview. Targeting adult participants who were at a park when we first met is important for several reasons. First, those attending a nature park at various times of the day and week are likely to have had prior experiences in nature since I encountered them in the target setting (Lincoln and Guba, 1995). As Gubrium & Holstein (2002) suggest and Farber & Hall (2007) and Barrie (2001) model, while participants were purposefully sought out that fit the requirements for participation in this study, these individuals were self-selecting to be in this space at this time and do not represent the entire population. In addition, those at parks were more likely to elaborate due to the tone of leisure involved in their activity.

The study population consisted of adults because adults are a rich source of *memories* related to learning (Falk and Needham 2011; Miller, 2001). The sample population consisted of adults (at least 21 years old) able to report having had an awe-inspired nature experience that they were willing to share. The sample included sixteen to twenty-three individuals in each park (Table 1). I approached 72 individuals and interviewed a total of 71 adults; 35 males and 36 females with a mean age of 44. One declined to participate as there was no financial reward. Another initially declined to participate as she "did not have an awe experience", yet changed her mind after thinking about it. The demographics of the sample reflected the demographics of the neighboring townships in age and ethnicity. The study population consisted of 98% White, .050% Hispanic or Latino, .025 % Asian, .025% Pacific Islander, .012 % African American, .012% Native American, .012%, Indian (Scholtz, personal report, 2008) and while the population of this study was targeted, the population studied did represent the surrounding counties.

Visitors to the parks were selected between 0800 and 2100 in the month of June, with no interviews conducted after dusk. Research was conducted using cluster sampling at random areas of the park in order to achieve the greatest degree of representation possible (Mertens, 1998; Lincoln & Guba, 1995)). An important parameter of phenomenography and grounding a theory is the establishment of trust (Gubrium & Holstein, 2002, Lincoln & Guba, 1995). Thus my approach to

Table 1. Participant demographics at each of four study sites

	Fallasburg Park	Seidman Park	Kirk Park	Rosy Mound Park
Number of females age 21-44	4	4	2	2
Number of females age 45-82	6	5	6	6
Number of males age 21-44	6	3	3	2
Number of males age 45-82	7	4	5	6
	23	16	16	16
			Total	71

Data Collection

71 individuals were interviewed about their awe experience. Forty-three of these individuals were also interviewed about learning related to their awe experience. All of the initial interviews were audio recorded. The most popular areas of the parks were targeted rather than approaching visitors as they entered or exited the park. An individual or groups were asked if one member of the group would be willing to discuss a recollected awe experience in nature. Of those approached, all but one were willing to participate in the interview. These participants were asked to fill out a consent form (including contact information) prior to the interview. By consenting, they agreed to follow-up interviews and stated which method of contact (phone or email) they preferred. For 34 of them, email was the preferred method of contact for subsequent interviews. The others listed phone numbers for follow-up contact which took place within ten days and then again six months later. Interviews took an average of 11 minutes and ranged from four to 47 minutes in duration.

The data was transcribed using only the first name, age, and gender of the person interviewed, per the consent form. Each tape was analyzed a minimum of two times and extensive notes were taken to assure a thorough record of what was said. The process allowed necessary prompts and explanations as well as additional questions for the follow-up interview. After the transcription, the audio tapes were destroyed. Within ten days and then again six months after the initial interview, follow-up interviews were conducted with 43 individuals in order to determine information about learning, and then to validate my interpretation of their initial stories and further probe their experience.

The follow-up interviews included the questions: “In the previous interview you said….did I understand your story correctly?”, and “What, if anything, was learned due to your awe experience?” Due to the conversational nature of the process, some participants had already answered the follow-up questions during the previous interview. For those where this information was lacking, they were asked, “What evidence do you have that learning took place?” and “What did you do as a result of your learning?” All but six of the follow-up interviews were documented via email while these six were conducted via phone and transcribed. A total of 113 interviews took place with the 71 participants, which provided for saturation of data and a greater sense of validity. Farber and Hall (2007) and Barrie (2001) conducted interviews with 445 and 80 visitors, respectfully.

Data Analysis

Data was analyzed using the constant comparative method of Strauss and Corbin (1990). This method consisted of journaling ideas about codes, sorting, and writing up the codes so as to continually search for themes and to maintain integrity of the participant stories and resulting data rather than bias the interpretation with my own perspectives. Journaling while gathering data allowed for clarity and comparison. In order to make the necessary conceptual leaps from raw data to explain the research in the context in which it was examined, this was an essential step of analysis. This process led to relevant coding and sorting of the data. Analysis of five sources of data took place. These sources were recordings of initial interviews, transcriptions of those interviews, follow-up interviews, researcher journals, and thoughts written and sent via email by participants after the follow up interview. The data segments pertinent to the current study are phrases, quotes, or portions of transcribed text

that provide meaning within the scope of one thought or idea. Constant comparison of the data ensured reliability of the analysis and guided follow-up with participants to clarify interpretation of participant's words.

After the in-vivo segmentation there were patterns that emerged through continual reduction and interpretation to formulate the matrices (Creswell, 1994; Glaser, 2004). The matrices are provided in the findings section. When all of the transcripts were coded, the data were re-evaluated and groupings made based on the research questions. Steps taken were as follows: open coding, in which data segments were coded line by line according to the interview questions and to the research questions. Then axial coding was conducted in which data were placed into multiple categories when suitable. For example, coding of an interview with a 41 year old man as he talked about an awe experience in Yellowstone National Park and Grand Canyon provided an experience of the *processes of nature* (research question 1). Furthermore, *authenticity* (research question 2) emerged from the last two lines of text. Statements and phrases in italics indicate raw data from the participants. " *I could see nature in process. I became an Earth Science Major and the learning I did connected to my curriculum, which allowed me to learn. I was able to fit it all in with my curriculum. If I had not had those experiences I would not have chosen that as my career path."*

All of the data (grouped by descriptor of the awe experience, and also learning) were delivered to an independent reviewer, Dr. Elizabeth Barrie. Dr. Barrie judged the validity of the summaries and categories. Selective coding (theoretical sampling) delimited the study (Glaser, 1998; Strauss & Corbin, 1998). The exact coding was later verified by referring continually to researcher journals. In addition, follow-up interviews validated the interpretation and understanding of the data.

Trustworthiness

In order to ensure credibility and to establish a link to the literature, persistent and repetitive observation and interaction with the data were used. In order to develop dependability and authenticity the data were read and re-read for consistency, and the data was distilled to ensure conformability. In addition to further develop the phenomenon of awe, corroboration with the independent researcher and journaling to maintain awareness of researcher bias, allowed the participants' experiences to speak for themselves (see Table 3). Possible limitations in the study were continually examined and addressed in order to enhance transferability of the results (Glaser, 1992; Lincoln & Guba, 1995)

Possible Limitations of the Study

Researchers have personal views on the subjects of nature experience and learning and the topic determining their research direction. There are steps to minimize bias and to increase the rigor of this study. For example, when interpreting the participants' responses, the researcher's understanding of the responses was provided to the participants to clarify any misrepresentation and the perception of the independent researcher was called upon in all stages of data analysis. These steps helped to clarify any inappropriate coding or bias. Due to its scope, this study is delimited to adults visiting natural areas where they were asked about a recollected experience and learning. This study involves participants' recall of the experience and content and may be impacted by the passing of time. Dierking et al. (2007) and Rennie (2010) posit that self-determined learning in adults is an *appropriate measure of learning* and a phenomenography is an appropriate method of study. In addition, the researcher's own learning in nature has been shaped by personal experience. It is anecdotally clear that the current culture has a diminished relationship with nature that impacts the opportunity to learn from the awe experience. As a veteran teacher and past Director of Outdoor Education, the researcher is uniquely positioned for such as study. While these experiences provide knowledge, awareness and sensitivity for the challenges associated with this study, they do impact researcher bias. In addition, the interviews conducted over a period of six months, while they may give perspective on long term memories, were conducted in a variety of formats; face to face for the initial interview and either email survey or phone interviews (per the participant) for the follow up interviews might limit the study.

Results

These findings are summarized and reflect the order of the research questions, namely the descriptions of the circumstances that led to an awe experience in nature and whether and how the participants believed that awe in nature led to learning.

Research question 1: circumstances leading to an awe experience in nature

As Barrie, (2001), Schmidt and Little (2007), Kals et al.(1999) and Farber and Hall (2007) indicate, there is value in descriptions of participant experiences as they provide a context for understanding what elicited the experience. While Barrie (2001) and Farber and Hall (2007) found the following categories of descriptors; personal, site and outcome and wildlife, scenery, recreational activity, and social interaction, respectively, the grounded theory approach encouraged the participants to determine their own categories of descriptions.
In order to determine the context of the awe experience, the interviews sought a description of the awe experience and the characteristics or context of such an experience.

Although awe is intangible, the 71 participants in this study fully understood what this experience meant without a definition provided for them. They were able to describe the moments that led to awe and these descriptions are represented here. Multiple descriptors were used by each participant and variations provided a picture of the triggers, the context of awe and the context of their nature experience (see Table 2). The most frequent elements or descriptors used were seeing the "grandeur" or feeling the "vastness" of the environment (N=38%), experiencing "peacefulness/solitude" (N=29%), feeling a sense of "authenticity" and "understanding" (N=24%), "sensing" the divine/spiritual (N=24%).

Characteristics were allowed to emerge from the transcripts of research question one as data was gathered and without bias from previous studies. Participant descriptions of their awe experience (research question one) such as *grandeur, processes of nature* and *wildlife* and evidence of these descriptions were extracted using the constant comparative method (Glaser, 2004). One suggestion the independent reviewer made was to enhance the concepts of "authenticity" and the importance of "place". The following descriptions were validated by the participants in subsequent interviews, and are listed by frequency. Examples are also provided in Table 2.

Table 2. Frequencies of awe descriptors and examples

seeing grandeur or feeling the vastness of the environment (N=38%)	A 54 year old man shared: "...seeing the stars from that vantage point-the milky way in such *splendor*. I am in *awe* of the long term processes. The glacier has been there tens of thousands of years... *"*
experiencing peacefulness/solitude (N=29%)	A 50 year old man stated: "It is impressive and unexpectedly serene…nature at its best; grandeur and simple serenity. It felt like a holy place to me. We felt violated when someone else showed up. I researched geology and the spring itself. I was curious to find out what led to this spring"
feeling a sense of authenticity and understanding (N=24%)	A 35 year old woman responded by saying: "I had just read the story behind this area and wanted to see what it was all about. I was amazed at the beauty and how it was so much more meaningful because I knew about its history. I was able to learn about it because I had seen it in a different light and was able to apply what I knew about it from reading."
sensing the divine/spiritual (N=24%)	A 35 year old man shared: "I experienced depression. The following spring I trained for an adventure race. I was alone by myself and experienced spring in the woods. It was a rebirth *I learned the value of the healing power of nature*. "
discovering a place that was novel/different/surreal (N=23%)	A 53 year old man shared: "It gave me a different perspective than I got here (Greenville, MI). It makes the brain percolate differently than it does in a day to day world.
seeing or experiencing wildlife (N=18%)	A 77 year old man reported: "Seeing a baby fox at its den…there were four babies sitting around the den. This was 15 years ago and I still remember it."
witnessing pristine beauty (N=13%)	It was so pristine and beautiful. I was inspired by the area and wanted to spend time in the mountains and protecting the area (Spoken by a 45 year old woman)
experiencing physical challenges (N=8%)	A 61 year old man shared: "The weather was amazing and changing…powerful. I did not feel the danger of the weather or of the mountain because it was so seductively beautiful. It was a huge physical challenge and the most satisfying experience of my life."
experiencing heightened senses (N=6%)	A 68 year old woman told me: "We were on a high ridge and there was a profuseness of wildflowers. Everyone was quiet. It was overloading our senses- a scenic and hearing overload. I sensed that all were feeling the same sense of awe at the same time."

2007) surveyed park visitors about emotions resulting from their experience. Schmidt and Little (2007) determined that emotions can be *caused by* nature while Kals et. Al. (1999) examined emotional affinity to nature. Falk and Storksdiek (2010) reported that cognition and emotion can be blended in a leisure experience which is prompted by personal motivation and how the individual makes meaning. The present study went on to determine that nature affinity was enhanced by experience in nature and to further develop the theory that emotions are caused by experiences and can induce motivation and meaning. The motivation and meaning examined in this study further support the additional aspect of learning due to the experience in nature.

Research question 2: perceived learning

In the initial interview, participant responses pertaining to research question number two or *what was learned* yielded the following summarized data. Highlights of Table 3 are as follows; of the responses, 98.6% (70/71) perceived that there was learning related to their awe experience. Some respondents indicated that they "could not help but learn" and some indicated learning student-like behavior or learning about one-self (N=26%). Participants reported making sense of and understanding *specific content*, such as dune formation, astronomy, habitats, calderas, red buds, dogwoods, the "let-burn" policy, and insect life cycles. Most frequently reported content includes geology (N=35.2%), processes of nature (different from patterns of nature) (N=23.9%) and conservation (N=21.1%). Items such as appreciation, awe, respect, connection and admiration totaled 27%. This information is graphically represented in Table 3.

Of note, twenty-six % of the follow-up participants noted that they learned, "how to be (a) learner"(s), learned what "kind of learner" they are, or learned but "did not feel like (they were) learning." Learning can be "sneaky," fun and some of the best learning can take place when the learner does not feel like he or she is "being taught." As a matter of fact, 14 % of the individuals described going into a science teaching career due to their awe experience. For example, a 53 year old male told his story about a hiking trip and recalled the processes of nature *" I am curious about how all of this stuff works. To study it gives you an idea of how it all works together. It helps seeing school stuff in real life. If you love something you want to make it better."* This participant then went on to share that he became a science teacher as a result of this experience.

Participants indicated that their experiences enhanced their learning or motivation to learn, and they used words associated with learning (research question two) such as "motivated" or "curiosity" or "making sense of my sixth-grade science book". A cross analysis of what was learned was completed after repeated examination of the data and the research questions. Main categories of typology of learning were; 1) student-like behavior 2) an appreciation of nature, not necessarily with a behavior change 3) science content such as that described previously and 4) a conservation behavior change. Much overlap occurred across each category. The analysis illustrated in Table 3 determined patterns of what was learned in terms of the elements of the awe experience or rather the frequency in which participants described their awe experience using each element, and what they had learned. This information is summarized below.

A summary of Table 3 depicts the following main points:

A. Elements of student-like behavior such as a desire to learn and learning about self were largely fostered by awe experiences in which novelty and peacefulness were present. Awe experiences in which "senses" were the main descriptor did not foster student-like behavior.
B. An appreciation of nature was largely presented: grandeur, peacefulness and solitude and the challenge of nature brought about learning about self, appreciation, respect for nature, a connection to nature, a desire to learn, an understanding of the healing power of nature, awe and respect and recognition of natural beauty, according to the participant explanations. However, and interestingly, the element of "senses" was not linked to an appreciation of nature.
C. It is important to note when participants referred to natural science content, links between all of the descriptors or elements of their awe experiences provided some sort of learning in this category. Wildlife, geology, history, habitat, life cycles, geography, processes of nature, in addition to astronomy with the exception of challenge which promoted a desire to learn. While overlap did occur, the percentage of participants using these descriptors was very high. For example, 82% of participants describing their awe experience using peacefulness, solitude gave natural science content as "what was learned" and shared seven different science content topics.
D. With the exception of the element divine/spiritual as a descriptor, the awe experience elicited conservation behavior changes and about one's self and one's role in nature. One female participant shared "*I hear the frogs, crickets, birds and noises of the evening. These are my favorite sounds and I*

am grateful for them. I have a sadness if I cannot hear them. I have a personal commitment to enjoy the outdoors more-a conservationist thinking green. I have become a steward of the environment."

Table 3. Cross analysis of patterns of the typology of learning, elements promoting learning, what was learned

Typology of Learning *Overlap occurred, therefore % were not calculated here	**Element that promoted the learning** and % frequency when crossed with specific descriptor of experience	**What was learned**
A. Elements of student-like behavior	• Novel/different/surreal (N=25%) • Peacefulness (N=25%) • Beauty/pristine (N=13%) • Authenticity/understanding (N=13%) • Challenge (N=6%) • Divine/spiritual (N=6%) • Grandeur (N=6%) • Wildlife (N=6%)	Desire to read about natural science Desire to learn Learning about self Desire to learn Skills and activities Learning about self Desire to learn Seeing nature as a child Desire to learn Desire to learn Desire to learn
Category not fostered by elements of student-like behavior is: senses		
B. Elements of an appreciation of nature, not necessarily with a behavior change	• Grandeur (N=57%) • Peacefulness/solitude (N=57%) • Challenge (N=31%) • Authenticity/intangible becomes tangible (N=19%) • Novel/different/surreal (N=19%) • Beauty/pristine (N=19%) • Wildlife (N=19%) • Divine/Spiritual (N=13%)	Learning about self Appreciation Respect Connection to nature Desire to learn Learning about self Appreciation Healing power Learning about self Awe and respect Appreciation Natural beauty Learning about self Learning about self Learning about self Desire to learn Learning about self
Categories not represented here are: "senses".		
C. Natural Science Content	• Peacefulness/solitude (N=82%) • Grandeur (N=67%) • Wildlife (N=63%) • Authenticity (N=50%) • Novel/Different/ • Surreal (N=50%) • Divine/spiritual (N=44%) • Senses (N=38%) • Beauty/pristine (N=25%) • Challenge (N=13%)	Wildlife Geology History Habitat Life cycles Geography Processes of nature Processes of nature Geology Habitat Learning about wildlife History Geology Habitat Processes of nature Geology History Geology Learning about wildlife Habitat History

		Processes of nature Geology Wildlife behavior Wildlife identification History Geology Processes of nature Astronomy Habitat Geology Habitat Processes of nature Desire to learn
All categories provided some sort of learning about *content*, with the exception of "challenge" which promoted a desire to learn.		
D. Conservation skills or desires	• Grandeur (N=44%) • Beauty/pristine (N=31%) • Wildlife (N=25%) • Novel/Different/Surreal (N=19%) • Senses (N=19%) • Peacefulness, solitude (N=19%) • Authenticity (N=13%) • Challenge (N=6%)	Conservation Learning about self Environmental issues Environmental policy Conservation Earth as cradle of civilization Desire to learn Desire to learn Desire to learn Learning about self Desire to learn Learning about self
Element not related to conservation skills or desires is "divine/spiritual"		

Research question 3: how the awe experience leads to learning

What the literature lacks is data about how the awe experience leads to learning re this study is important in order to examine such a connection between experience in nature, emotion and resulting learning. In addition to being asked about whether learning took place in the follow-up interview 43 participants were asked to describe *evidence* of learning. This question garnered information about *how* the awe experience led to learning and of note, the participants equated this with *action or behaviors as a result* of the learning. All but two participants were able to give evidence of their learning (those two, however, gave evidence for a change in conservation behavior rather than increased learning---which could be considered learning.). The evidence consisted of motivation to learn and to research topics online as well as to "spend more time out-of-doors learning," in addition to a desire to "teach others" what they had learned. Themes pertaining to research question three were extracted from the interviews are as follows; 37% researched media, 33% studied and/or monitored nature, 21% chose to teach others, 14% pursued a career in the field and 12% worked for or volunteered in a nature group. Results are summarized in Tables 4 and 5. Some overlap occurred.

Table 4. How the awe experience leads to learning and examples

motivation/curiosity (N=30%)	"It made me want to read more about it and maybe ask someone who knew what they were. Now I remember those mushrooms and can tell others." (a 36 year old woman)
student-like behavior (N=26%)	"I learned about myself as a learner. I now had a desire to read and to learn, It gave me an interest in science," (a 22 year old woman)
application of knowledge; a need to know in order to "teach" another, to use a particular skill, or to share with others in some way (N=22%)	A 54 year old woman shared "I wanted to remember how it all worked so I could teach my husband about what I experienced."
a desire to preserve/conserve/improve personal behaviors pertaining to preserving/conserving; (N=22%)	A 36 year old woman stated "I think the power of the beauty inspired me to personally do a better job taking care of the planet and made me realize that I have the opportunity to help others see their responsibility to the

	environment. For a possibly jaded world traveler, the experiences gave me new insight and a clear mission."
it was learning in and of itself (N=13%)	When prompted about "real learning rather than motivation to learn" (follow- up interview), a 54 year old male shared "it did not motivate me to learn—it was learning in and of itself.
authenticity of text (N=8%)	A 34 year old woman explained her reading "came to life" and "made more sense". She described "The experience allowed a textual depiction of history and science of the place in which I had my experience. I felt awe because of the authenticity and understanding of the reading about this location".
connection to nature (N=8%)	A 32 year old man described a backpacking trip during which he determined we are "dependent on nature" A 56 year old woman said "Nature was our entertainment. Kids don't understand that today." A 58 year old man shared "Being on the top of snow dome made me realize that we are all connected to nature."

Table 5. Participant's responses of "evidence of learning"; Action as a result of learning due to an awe experience in nature

Frequency of response	**Action**
N=37%	Researched media
N=33%	Studied, monitored nature
N=21%	Chose to teach others
N=14%	Pursued career in field
N=12%	Learning or working/volunteering group

There was a sensory element to the awe experience related to participants' perception of learning. (Four of the 71 initial interview participants reported elements of their awe experience in the *senses* category). Certainly, they said the memory of the experience was enhanced; in general they still remember the sights, sounds, and smells of the experience many years after it occurred. Three participants reported that they had not learned from this particular experience and therefore were not referenced in Table 5. However, interestingly, each went on to explain something they did or learned as a result of the experience. For example, one of them said, "It did not motivate me to learn, but, partnered with other experiences, I have since learned." Others described actions they took as a result of their awe experience and reported that they found themselves to be "motivated to go outside" or "watch wildlife" more.

These findings provide a useful context for an awe experience and are recurring for all the participants in this study.

Discussion and Recommendations

This study furthers research demonstrating connections between emotional affinity with nature by demonstrating that awe-inspiring nature experiences trigger perceptions of learning. Such learning includes enhanced curiosity, motivation to seek out information and increased participation in nature.

There is value in this connection between awe experiences and nature/science learning. Learning was reported by participants after awe experiences in nature, motivating them to change behaviors, such as conservation of water and wildlife. My study responds to the need for greater theoretical and descriptive clarity in discussion of the value of positive emotional qualities in natural places and provides data to support the theory that emotional experiences in nature enhance learning.

Regarding a definition for awe, none of the participants sought or received a definition for awe and did not ask for clarification of awe. They were asked "Have you had an awe experience in nature and would you mind sharing it with me?" As a result, the phenomenon of an awe experience in nature and how participants' lived experience affected learning formed patterns such as those found in Table 2 "Frequencies of awe descriptors and

examples" and Table 3 "Cross analysis of patterns of the typology of learning, elements promoting learning, what was learned"

This study about experience in nature, learning and how awe experiences lead to learning cannot be generalized to the population as a whole, but rather to individual who self-select nature experiences. It can provide information beneficial to educators, both formal and informal, natural resource managers and park interpreters.

Experience in nature

Aligning with research by Barrie, (2001), Schmidt and Little (2007), Kals et al.(1999) and Farber and Hall (2007) this study showed great value in descriptions of participant experiences. These descriptions provide a context for understanding what elicited the awe experience. For example if one can design an educational program with such characteristics, positive emotional experiences (such as awe) could help improve learning about nature by incorporating elements such as "novel, different, and surreal". A 54 year old man shared "*When I was all done, I finally caught my breath. It took my breath away! I felt alive! It was fun! There was a risk factor, a power of nature. It gave me a different perspective than I got here (Greenville, MI). It makes the brain percolate differently than it does in a day to day world"*

Addressing the first research question, adults described the circumstances leading to an experience of awe in nature by telling stories rich with detail. By describing their experience using the following characteristics; 1) authenticity/intangible becomes tangible 2) beauty/pristine 3) challenge 4) divine/spiritual 5) grandeur, 6) novel/different/surreal 7) senses 8) solitude/peacefulness, and 9) experiencing wildlife participants provide a context for their awe experience in nature. While these experiences took place in a variety of environments including one's back yard, a wilderness area, and urban environments and in national parks, the participants share the experience of being in nature and multiple ranges of nature experiences provided awe. This does not limit the type of nature experience, but indicates that nature experiences can vary, yet instill awe. As evidenced by the number of individuals who expressed their awe experience in nature and the elements they chose to describe their experiences (see Table 2), awe can be generated when individuals have opportunities for wildlife observation, experience of the grandeur of nature, novelty that is different from everyday life, peacefulness, and connecting to nature (among others).

Additionally, according to links between patterns derived from interview answers, every category of the context of the awe experience provided a perception of learning about natural science content such as geology, patterns of nature and habitats (see Tables 3 and 4). Conservation skills or intentions were shown to be developed through the experience in nature where characteristics such as grandeur and wildlife exist and awe is felt. Grandeur and peacefulness were found to greatly enhance an appreciation or respect for nature.

Perception of learning

Ninety-eight % of the participants stated learning took place due to their awe experience in nature. As Table 3 depicts, a perception of learning was expressed relative to several areas; self, nature and content, in particular learning about oneself and science content such as geology and processes of nature. Further, individuals reported conserving more or spending more time in nature, indicate their social responsibility (Deci, et. Al, 1991) and often take action. In the interview process, when asked for *evidence of learning*, participants responded with *actions and behaviors*. For this reason, Table 5 consists entirely of action taken. In an analysis of patterns of the characteristics of the awe experience (research question one-see also Table 3) and a perception of learning (research question two-see Tables 4 and 5), natural science content emerged and "what was learned" was enhanced by nature's role in *how* it was learned. Of those who learned, some said they simply became a better learner or "more aware." Others indicated that what they perceived was something about themselves. In some cases, the participant did not report any specific learning from the experience, yet went on to describe what they perceived about themselves. The participants' perceptions included learning how to be learner, learning what kind of learner they are, or learned even though they did not "feel like they were learning." For example, a 21 year old female shared *"This helped me to decide where I wanted to go next…literally and figuratively. I learned a lot about myself. I learned that this is the way I learn."*

This study indicates that individuals who reported awe experiences in nature also reported learning. The engagement of the learners was observed in the interviews. For example, a 53 year old man who *experienced* "nature in process" became an Earth Science Major" and his awe experience connected to his curriculum. This is on the awe component of learning at its best.

How the awe experience leads to learning

Using Arseneault's (1998) study in which self-reflection of knowledge was used to elicit learning by adults as a model, the grounded theory approach enabled the researcher to determine how did the participants perceived that awe in nature lead to their learning. While 7% of the participants *stated* they had not learned, *all* participants gave evidence of learning in that they described what they had done or changes they had made due to their learning. In turn, the awe experience fosters motivation, and learning is enhanced by motivation. By further probing about learning, the follow-up interviews provided information about evidence of learning and, importantly, action taken as a result of the learning. Table 4 illustrates *How the awe experience leads to learning and examples*. Participants most frequently explained; 30% felt motivation and/or curiosity, 26% experienced student-like behavior, 22% described an application of knowledge such as a need to know in order to "teach" another, the ability to use a particular skill, or to share with others in some way and 22% explained a desire to preserve, conserve or improve personal behaviors pertaining to preserving/conserving.

As a result, 38% of the participants researched media, 33% studied and monitored nature, 21% chose to teach others and 21% took a course related to nature study in addition to pursuing a career in the field (14%) and volunteering for care of the environment (12%). This study also determined an appreciation for nature and learning resulting from motivation, curiosity, application and authenticity of text, and behavior change. The role awe plays in learning is an important one. If learners could experience awe in nature, that emotional experience would help improve their motivation to be in and protect nature to learn science content.

Summary

This study on awe provides evidence that positive emotional experiences in nature can lead to important long-term results. This study not only furthers the theoretical support linking emotional affinity toward nature with awe, but it also delineates characteristics of the context in which a perception of learning can take place. The elements described by participants were shown to provide memories, motivation and curiosity (cognitive growth) as well as taking action and behavior changes.

Implications for learning

Concepts described in and supported by this study promote the inspiring connection that provides synaptic changes in learners, touching them both cognitively and affectively. Participants in this study perceived that they had learned. Indeed, for 14% of the individuals, a greater appreciation for nature led to a career in the area of science or natural resources. As aforementioned, Deci et al., (1991) show a relationship between motivation and cognition to engagement and "social responsibility"(p. 343). This research depends on the Deci et. al. study by relating the motivation and cognitive growth illustrated in the current study to actions such as spending more time in nature and conserving or learning more about nature. Further, the evidence provided by this study clearly supports the relevance and importance of nature experiences (including those provided by informal and environmental education). While learning how to be a better learner, becoming more attentive, engaging with nature, developing motivation and curiosity all lend themselves to cognitive growth, the main indicator of learning in this study is the memory of the experience and specific science content reported by the participants. If learning about nature is perceived and instituted as valid science education, certainly some of the weaknesses currently recognized in science learning (such as low science scores and learning science from media rather than the environment) could be overcome. It would further benefit the science education community to consider these data and examine them for learning in contexts where learning may not be expected to occur. It is particularly compelling to note that four of the five participants who said they had not learned anything from their awe experience went on to describe something they had learned. Therefore, we should encourage more nature experiences to improve science learning.

Implications for interpretation and natural resource management

Interpretation research is intended to determine what elements of nature programs provide for the most meaningful experiences for visitors. This research is important in order to determine allocations of constrained budgets and to determine justification of the programs they support. The evidence provided by this study supports nature education as a component of science education and can enhance the aforementioned weaknesses currently defined in learning about science. Participants reported that they developed a greater appreciation of nature due to experience in nature and of import, described actions taken for the environment (volunteering,

conserving, and other efforts to protect nature and the outdoors in some way). This information indicates a life-long effect of experiences in nature. For these reasons, nature experiences, particularly those providing elements or characteristics of those eliciting awe experiences could promote an increase in attendance in interpretive programs and thus in funding of such programs. Interpreters and natural resource managers should increase opportunities for such programs. On-going interpretation research will help determine specifically which nature programs provide the most meaningful experiences for learners---research that can help determine allocations in constrained budgets and justification of the programs.

Implications for a scientific citizenry

In addition to life-long effects of nature conservation and appreciation, experiences in nature can enhance psychological well-being, self-image and self-satisfaction (Falk & Storksdiek, 2010; Louv, 2005). However, important to the development of more stakeholders who promote the future of natural areas is long-term knowledge about science and the environment. Scientifically literate citizens and policymakers tend to recognize the importance of knowing about the natural world from first-hand experience where positive emotions in nature occur (Nabhan & Trimble, 1994). Funding for nature programs should be supported and more experiences should be provided for nature learning situations such as park interpretation programs, and out-of-door experiences so that a more educated and caring science citizenry can develop. The results gathered here further suggest that an educated science citizenry learns best (Nabhan & Trimble, 1994) and learns more (Falk & Storksdiek, 2010; Falk & Needham, 2011; Rennie, 2012; Rennie et. al, 2003) from these types of experiences.

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