Factors That Influence Sense of Place as a Learning Outcome and Assessment Measure of Place-Based Geoscience Teaching

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Abstract

Sense of place encompasses the meanings that a given place holds for people and the attachments that people develop for that place. Place-based science teaching integrates the natural and cultural meanings of a place as context for scientific study, and hence leverages the senses of place of students and instructor. It has been proposed that this method enhances relevance and interest for introductory students, particularly those with cultural ties to the places under study. Authentic evidence of place-based learning comprises not only gains in locally situated knowledge and skills, but also enrichment of the sense of place. Valid and reliable surveys for measuring sense of place exist and have been tested successfully as assessment instruments. However, a student's proximity of residence and history of visitation with a place used as the setting for a lesson may also influence his or her sense of that place. To investigate the possible effects of these factors and further explore the sense of place in assessment, introductory geology students were surveyed on their proximity of residence to, history of visitation to, and sense of Grand Canyon: an iconic place and the subject of a class laboratory exercise. Frequency and recency of visits to Grand Canyon, but not proximity of residence to it, were correlated with student's sense of place. These findings suggest that place-based geoscience teaching is applicable to nonresident and local students alike, but that prior experiences with the place may influence a student's receptivity to the method.

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Sense of Place in Science Teaching

Place is defined as any locality or space that has become imbued with meaning by human experience in it (Tuan, 1977). A spectrum of humanistic and scientific meanings may accrue to any given place, reflecting all of the ways that diverse individuals and groups know and experience it. People also tend to build strongly emotional attachments to meaningful places. The *sense of place* has been defined as the combined set of the *place meanings* and *place attachments* that a person or a group develop for a place

(Brandenburg & Carroll, 1995; Williams & Stewart, 1998). Sense of place therefore encompasses the cognitive and affective domains, and possibly also the psychomotor domain if particular kinesthetic activities are associated with or localized in a particular place (Semken & Butler Freeman, 2008). The nature of sense of place and its relevance to science education are discussed in detail in a paper by Semken and Butler Freeman (2008).

Place-based (sometimes called *place-conscious*) teaching (Woodhouse & Knapp, 2000; Smith, 2002; Gruenewald, 2003a, 2003b; Sobel, 2004; Gruenewald & Smith, 2008) is a situated approach that consciously leverages (Lim & Calabrese Barton, 2006) and enriches the senses of place of students and instructor through localized experiential learning, cross-cultural and trans-disciplinary content and pedagogy, and outreach to the community. In contrast, a great deal of conventional teaching is decontextualized and focused on a canonical list of abstract principles or isolated facts (Barab & Roth, 2006), of which only a few may have any local significance.

The Earth, ecological, and environmental sciences are taught in and by means of places. Place-based teaching in the natural sciences, offering meaningful context and practical relevance (Aikenhead, 1997, 2001; Semken & Morgan, 1997; Butler, Hall-Wallace, & Burgess, 2000; Semken, 2005; Glasson, Frykholm, Mhango, & Phiri, 2006; Chinn, 2006; Semken & Butler Freeman, 2008), is thought to improve engagement and retention of students, particularly for members of indigenous or historically rooted communities who already have rich senses of the places under study (Cajete, 2000; Emekauwa, 2004; Riggs, 2005; Aikenhead, Calabrese Barton, & Chinn, 2006; Levine, González, Cole, Fuhrman, & Le Floch, 2007). Conversely, teaching that contradicts or minimizes such students' senses of place may dissuade them from studying science (Kawagley, D. Norris-Tull, & R. A. Norris-Tull, 1998; Aikenhead & Jegede, 1999; Semken, 2005; Chinn, 2006). This may be particularly true for the geosciences, which by their nature penetrate and probe the physical substrates of places that are deeply meaningful or even sacred to some cultural groups. Geoscience educators should be aware and respectful of possible pre-existing place attachments among their students, particularly when teaching in the field or about certain topics, such as mining, recreation, and other forms of resource extraction or use (Semken, 2005).

To this point, research on the effectiveness of place-based teaching has been focused on elementary and secondary school programs and has yielded affirmative but indirect results, which include:

- significantly enhanced student performance on standardized multi-disciplinary achievement tests (Lieberman & Hoody, 1998);
- significantly improved student achievement motivation (Athman & Monroe, 2004) and critical-thinking skills (Ernst & Monroe, 2004); and
- more collaborative and interdisciplinary practice, and more frequent use of service-learning projects, by teachers (Powers, 2004).

Although each of these studies endorses place-based teaching, none directly addresses the defining attribute and aim of the approach, which is intimate, meaningful, and sustainable engagement with the surrounding natural and cultural environments (Lim & Calabrese Barton, 2006; Ault, 2008). Authentic evidence of place-based learning should thus encompass not only significant improvement in locally situated content knowledge and skills, but also significant enrichment or enhancement of the sense of place, which encapsulates the student's personal connection to the study place or places (Semken & Butler Freeman, 2008). Hence, authentic assessment of place-based teaching would be facilitated by any valid and reliable means of measuring sense of place in students.

Deconstructing and Measuring the Components of Sense of Place

Personal senses of a given place can vary greatly, and Relph (1976) has described how these can be ranked by their depth or intensity, from utter alienation ("existential outsideness," p. 51) to complete belonging ("existential insideness," p. 55). Hence it is possible to quantitatively measure an individual's sense of a particular place. Such measurement finds application in land-use planning and resource management, in which it is now often necessary to account for the senses of place of different stakeholders (Williams & Stewart, 1998; Clark & Stein, 2003). Quantitative analysis of the sense of place is also important to the recreational and tourism industries (Bricker & Kerstetter, 2002). As a consequence, the construct has been extensively characterized in environmental psychology, and there now exist published psychometric instruments designed to measure each of the two principal components of sense of place: place attachment and place meaning.

Place Attachment

Place attachment is an emotional bond to a place that develops from direct experience (e.g., living, working, or vacationing in the place), vicarious engagement (e.g., through books or visual media), or some combination thereof (Relph, 1976; Williams & Stewart, 1998). Love of one's hometown or a favorite campsite; a desire to protect a wilderness area or a historic urban structure from demolition; delight in collecting and viewing paintings made of a landscape or region one may or may not have ever visited: each is an example of place attachment.

Shamai (1991) proposed a seven-point empirical intensity scale for place attachment, based on Relph's (1976) ranking system, ranging from no sense of place at one extreme, to a willingness to make personal sacrifices on behalf of a place at the other. Shamai's test of this scale on students in a Jewish school in Toronto, and a separate use of the scale by Kaltenborn (1998) to characterize place attachment among inhabitants of the Svalbard archipelago, showed that an empirical instrument could resolve and measure intensities of place attachment in two geographically and culturally distinct groups.

A valid and more generalizable place-attachment survey was developed by Williams and colleagues (Williams, Patterson, Roggenbuck, & Watson, 1992; Williams & Vaske, 2003). In accord with a theoretical model from environmental psychology

(Brown, 1987; Williams et al., 1992), their instrument measures two dimensions of place attachment: *place dependence*, the capacity or potential of a place to support an individual's needs, goals, or activities (Stokols & Shumaker, 1981; Williams & Vaske, 2003); and *place identity*, an individual's various affective relationships to a place (Proshansky, 1978; Proshansky, Fabian, & Kaminoff, 1983; Korpela, 1989; Williams & Vaske, 2003), such as memories, preferences, and feelings. Williams and Vaske validated this instrument using data from 2819 respondents polled at six recreational sites and parklands in Colorado and Virginia, and on a university campus in Illinois. Their study, detailed in their 2003 paper, confirmed construct validity with a factor analysis that sustained the two-dimensional model of place attachment; and convergent validity as significant positive correlations between the two dimensions and theoretically linked variables, such as familiarity and frequency of visitation.

Williams and Vaske also showed that a concise survey with no more than six place-dependence items and six place-identity items (Table I) had good internal-consistency reliability (Cronbach's alphas ranging from 0.81 to 0.94) across all seven study places, and could be considered highly generalizable (coefficients 0.924 for place dependence and 0.869 for place identity) to different places. Additional items yielded little improvement in generalizability (Williams & Vaske, 2003). The survey uses a five-point Likert scale. In this paper it will be identified as the *Place Attachment Inventory* (*PAI*).

Table I
Place Attachment Instrument of Williams & Vaske (2003)

I feel (place name) is a part of me.
(Place name) is the best place for what I like to do.
(Place name) is very special to me.
No other place can compare to (place name).
I identify strongly with (place name).
I get more satisfaction out of visiting (place name) than any other.
I am very attached to (place name).
Doing what I do at (place name) is more important to me than doing it in any other place.
Visiting (place name) says a lot about who I am.
I wouldn't substitute any other area for doing the types of things I do at (place name).
(Place name) means a lot to me.

The things I do at (place name) I would enjoy doing just as much at a similar site.

Note. The odd-numbered items measure place identity, the even-numbered items measure place dependence, and the final item is reverse scored. This instrument is used with a Likert scale in which 1 corresponds to "strongly agree," 2 to "agree," 3 to "neutral," 4 to "disagree," and 5 to "strongly disagree."

Place Meaning

Although the meanings that imbue places run the gamut from spiritual (e.g., sacredness) to scientific (e.g., interpretation of bedrock geology), place meaning is always contextually bound to the place itself. Therefore, to be authentic, any psychometric measure of place meaning should be developed empirically and locally, with items emergent from the set of meanings held by those who variously inhabit, promote, visit, or consider the place. The work of Young (1999), who created an empirical place-meaning survey for a World Heritage parkland in northeast Queensland, Australia, exemplifies the construction and valid use of this kind of instrument. A tourism geographer, Young described place meanings as socially constructed and negotiated between those who "produce" and disseminate them, such as tour guides and interpretative specialists; and those who "consume" (hold or construct) them, such as tourists and other visitors. This model is relevant to place-based formal education, in that teachers can be described as "producers" and students "consumers" (although one would expect more of a two-way exchange of place meanings in this more open and collaborative learning environment). Young's model for construction of place meanings is also analogous to those of other theorists of sense of place (Ryden, 1993; Casey, 1996).

Young extracted a set of produced meanings from a textual analysis of brochures published to promote the region, and surveyed tour operators to determine which of these were most important. A set of consumed meanings emerged from brief semi-structured interviews of visitors in the parks. Young then incorporated these parallel sets of place meanings into a 30-item questionnaire (Table 2) with a five-point scale, which polls respondents on whether each of the items is a poor, fair, good, very good, or excellent description of the place. Young used this instrument in a study of different influences on the place meanings held by tourists. One finding particularly relevant to place-based teaching was that respondent place meanings were influenced by the level of prior knowledge of the place, preferences for particular types of surroundings, and sociocultural background.

Table II
Place Meaning Instrument of Young (1999)

Ancient	Privilege to visit	Fun
Pristine	Relaxing	Threatened

Scenic	Important for Aboriginal culture	Crowded
Beautiful	Overdeveloped	Dangerous
Remote	Tropical	Interesting
Unique	Unusual	Educational
Important to preserve	Scientifically valuable	Tranquil
Authentic	Ecologically important	Spiritually valuable
Fragile	Wilderness	Historical
Exotic	Adventurous	Comfortable

Young (1999) did not report on the validity or reliability of this instrument. In the absence of statistical data, this survey can be considered valid for the measurement of local place meaning in individual respondents on the basis of Young's theoretically sound model for the construction of place meanings and the naturalistic, empirical method by which the survey was created, following lines of reasoning put forth by Mishler (1990), Aikenhead and Ryan (1992), and Semken and Butler Freeman (2008). Because the survey was developed for use in Australia, Young also did not address its generalizability to other countries. However, nearly all of the items are generic enough to be applicable to other parklands or wild places elsewhere. This instrument will be referred to in this paper as *Young's Place Meaning Survey* or *YPMS*.

Applications to Assessment of Place-Based Science Teaching

In a recent preliminary study, Semken and Butler Freeman (2008) used the PAI and YPMS as pre- and post-tests of sense of place in a group of 27 students who completed an experimental Arizona-based, culturally inclusive, meaning-rich, introductory geology course at a large state university in metropolitan Phoenix. They ran dependent-samples *t* tests on the pre-test and post-test means for the PAI and YPMS, and observed significant ($p < 0.01$) increases in mean student place attachment and place meaning for Arizona between the start and completion of the place-based course. Semken and Butler Freeman's results suggest that the PAI and YPMS are generalizable and sensitive enough for use as assessment tools. However, since a control group was not available for this study, the effectiveness of the place-based course in enhancing sense of place was not conclusively shown. Neither could this study address any subjective factors (e.g., familiarity with or prior experiences in the study place) that might be predictors of individual differences in sense of place. Such factors would likely influence the effectiveness of this teaching approach in any large academically, ethnically, culturally, socioeconomically, and geographically diverse student population, such as the typical large-enrollment ($n > 100$) introductory geoscience classes that universities regularly offer.

The study described in this paper is an exploration of several factors that are likely to be present to some degree in all introductory geoscience students, and which may be correlated with place attachment or place meaning. These factors may influence the use of sense of place (more specifically, sense of the specific place or places examined in the curriculum) as a learning outcome or a metric of the effectiveness of a place-based approach to geoscience teaching.

Factors Thought to Influence a Student's Sense of Place

Proximity to a Place

In any large university geoscience course, some of the students will be local and others will hail from outside of the region. How will these different groups respond to teaching that is explicitly situated locally? One can certainly develop a rich sense of a place without ever coming near to it (Relph, 1976; Proshansky, Fabian, & Kaminoff, 1983). Consider the Western novels of the author Karl May (1842—1912), who never ventured west of New York state (Wohlgschaft, 1994), but who proffered meanings and instilled strong attachments to the western USA and its indigenous cultures in several generations of his fellow Germans. However, in general, it would be expected that place attachment and place meaning would be associated with familiarity derived from the proximity of a student's residence to the place. Familiarity could arise from residing in or near the place, from regularly traveling through or nearby to it, or from hearing or seeing the place referenced frequently in local media, schools, museums, or even casual conversation. A sense of place thus constructed could either be affirmative (e.g., feelings of community) or negative (e.g., boredom with the place) (Pretty, Chipuer, & Bramston, 2003). Young (1999) found that a respondent's place of origin was the factor most strongly correlated with place meaning in his Australian study: domestic visitors to the study region scored higher on the YPMS than did visitors from overseas. His interpretation was that the former were more familiar with the area owing to well-publicized environmental disputes about a decade earlier (Young, 1999).

Visits to a Place

Individuals who reside far from a place may still make frequent visits to it for avocational or vocational reasons. Frequent visitation, motivated by place dependence, may in turn bolster the visitor's place identity (Moore & Graefe, 1994), and thus enhance place attachment. In a study conducted in four wilderness areas, Williams, Patterson, Roggenbuck, & Watson (1992) found attachment to these places to be strongly associated ($p < 0.001$) with the number of a respondent's previous visits, and also with the number of years since the first visit (i.e. the length of the history of visitation). The effect of prior visitation on place meaning is less clear. Young (1999) found that frequency of visits to natural environments in general is associated ($p < 0.01$) with richness of place meaning for the tourist respondents in his study region, but not with repeat visits to the place itself. This unexpected result could have been a consequence of the temporal and spatial constraints on free exploration imposed by guided tours, which were used by the majority of the respondents (Young, 1999).

The Study

Research Question Addressed

If pre-post or formative changes in a student's sense of place are to be used as an assessment measure in place-based science education (Semken & Butler Freeman, 2008), any pre-intervention meanings or attachments the student has for the place(s) under study must be understood and accounted for. Hence, the research question addressed in this study: Is a student's level of prior experience (measured as the proximity of residence and history of visitation) with a place that serves as the subject of a place-based geoscience intervention correlated with the student's prior sense of that place (measured as intensity of place attachment and richness of place meaning)?

Setting

The study was carried out in an introductory physical geology laboratory course during the spring 2005 semester. Most students in this course are not science majors, and they commonly enroll to fulfill a general studies requirement for graduation. The typical spring enrollment for this course is approximately 1100 students, who register in lab sections of no more than 30 students each to fit their class schedules. Each lab section meets for a two-hour session each week for 14 weeks (12 laboratory-room sessions, one on-campus field trip, and one research session held in the university map library). The course is inquiry–driven, systematic, and well-organized; each week's activities are outlined in detail in a custom-published laboratory manual (Reynolds, Johnson, & Stump, 2005) that each student purchases in advance. The content of the course emphasizes the physical landscapes of Arizona and the geology that underlies them.

The study centered on the ninth-week laboratory class in this course, which is focused on the geology of Grand Canyon in northern Arizona. Other places in Arizona are addressed in other weeks and other chapters of the manual, but Grand Canyon was selected because of its exceptionally rich place meanings, its importance to many diverse groups throughout history (Hirst, 2006; Powell, 1895/1987; Pyne, 1998; Morehouse, 1996; Beus & Morales, 2003) and its general recognizability, even to those who have never been there. The objective was to maximize any potential prior effects on student senses of place by selecting the most iconic place used in the Arizona-based curriculum.

Population

Race, ethnicity, and sex were not tabulated within the study population, but it appeared to be reasonably representative of the undergraduate student population at the university during spring 2005: 53% female, 47% male; 69.2% White, 5.1% Asian-American, 3.7% African-American, 2.2% Native American; 12.9% Hispanic; 2.7% international; and 4.2% undeclared or unknown. Approximately 400 students participated in the survey.

Survey

The first part of the survey used in this study consisted of four multiple-choice items used to determine a student's proximity of residence to and history of visitation of Grand Canyon (Table III). Proximity of residence was expressed as approximate driving time from the respondent's home to Grand Canyon. It was thought that respondents, if aware of their proximity to Grand Canyon, would more accurately know the driving time than the actual distance in miles or kilometers.

Table III
Survey Items Relating to Proximity to and Visitation of Grand Canyon

Of all the places you have lived for at least one year, what was the shortest amount of driving time between your home and the Grand Canyon? (Possible responses: less than 3 hours; 3—6 hours; or more than 6 hours)
How many times have you visited the Grand Canyon in total? (Possible responses: zero; 1—3 times; or more than 3 times)
How many times have you visited the Grand Canyon in the last year (12 months)? (Possible responses: zero; 1—3 times; or more than 3 times)
How long ago was your last visit to the Grand Canyon? (Possible responses: never; within the last year; or more than 1 year ago)

The responses to the questions shown in Table III were selected after considerable debate by the authors. These ranges were defined in order to reflect geographic and personal factors, and to allow for enough categories to elicit a variety of responses from the students. The range for driving time, with intervals ending and starting at three and six hours, reflects the roughly three-hour driving time from the university to Grand Canyon and the roughly six-hour driving time from the farthest places in our state to Grand Canyon. The range for number of total visits and visits within the last year was intended to differentiate among students who had never visited Grand Canyon, who had visited only a few times, and who were frequent visitors. Similarly, the range for length of time since the last visit to Grand Canyon was intended to distinguish those who had never visited the place, those who visited it some time ago, and those who visited it recently.

The second part of the survey consisted of the twelve PAI items as they are presented in Table I, verbatim from the published instrument of Williams and Vaske (2003), with "Grand Canyon" inserted as the place name. Students were asked to rate each statement on a five-point Likert scale, with 1 corresponding to "strongly agree," 2 to "agree," 3 to "neutral," 4 to "disagree," and 5 to "strongly disagree." For the first eleven items, a lower rating indicates a stronger place attachment; for the final item the opposite

is true, so this item was reverse scored. A PAI score is calculated as the total of all twelve responses. Therefore the lowest PAI score, representing strongest place attachment, is 12; a neutral score is 36; and the highest score, representing weakest place attachment or place aversion, is 60.

The third part of the survey consisted of 27 YPMS items from the survey of Young (1999; Table II). Three place meanings from the original instrument ("tropical," "fun," and "comfortable") were omitted, and the term "Aboriginal" was changed to "Native American," to render the survey more locally relevant. Students were asked to rate the degree to which each of the 27 place-meaning terms represented Grand Canyon for them, on a five-point Likert scale identical to that used with the PAI. Strong agreement (expressed by a numerically low rating) with any of the terms except four (overdeveloped, threatened, crowded, and dangerous) indicates that Grand Canyon strongly holds that particular affirmative place meaning for the student. In the case of the other four terms, the opposite was held to be true, as these are meanings indicative of degradation of Grand Canyon. The YPMS score is calculated by summing the numerical responses to all items, with the four negative items reverse scored. The lowest YPMS score of 27 indicates that Grand Canyon holds the richest meanings for a student, whereas a score approaching the maximum of 135 indicates that Grand Canyon has little meaning to the student.

The survey was administered to the students in class one week before the scheduled Grand Canyon laboratory exercise. Participation in the surveys was voluntary, and the surveys were coded to maintain the anonymity of the participants. The students needed about ten to fifteen minutes to complete the surveys.

Data Analysis

Proximity and visitation versus place meaning and place attachment

In the analyses discussed below, proximity and visitation factors, indicated by responses to the four multiple-choice items at the head of the survey (Table III), were the independent variables; and PAI (Table I) and YPMS (Table II) scores were the dependent variables.

Place attachment (PAI score) versus proximity of residence to Grand Canyon

A one-way analysis of variance (ANOVA) was conducted to evaluate the hypothesis that student's place attachment to Grand Canyon would be more strongly affirmative, on average, the closer that student lives to Grand Canyon. The independent variable, the proximity factor, comprised the three levels described above: less than 3 hours driving time, 3—6 hours driving time, and more than 6 hours driving time. The dependent variable was the individual's PAI score. The ANOVA was non-significant, $F(2, 375) = 1.66$, $p = 0.19$. Table IV shows the means and standard deviations for PAI score for each level of the factor.

Table IV
Means and Standard Deviations of Place Attachment (PAI) Score for the Proximity Factor

Proximity Group	*N*	*M*	*SD*
Less than 3 hours	92	46.82	9.46
3—6 hours	224	45.02	8.82
More than 6 hours	62	46.63	9.30

Place attachment (PAI score) versus total number of visits to Grand Canyon

A one-way ANOVA was conducted to evaluate the hypothesis that student's place attachment to Grand Canyon would be more strongly affirmative, on average, the more times that student has visited Grand Canyon. The independent variable, the total visit frequency factor, included the three levels discussed above: never visited, visited 1—3 times, and visited more than 3 times. The dependent variable was the student's PAI score. The ANOVA was significant, $F(2, 383) = 23.70$, $p < 0.05$. The strength of the relationship between the total number of times visiting Grand Canyon and PAI score, as assessed by η^2, was small, with the total visit frequency factor accounting for 11% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pairwise differences among the means. Because the variances among the three groups ranged from 8.42 to 9.99 it was assumed that the variances were homogeneous, and post-hoc comparisons were made using the Least Significant Difference (LSD) test, which is appropriate for three levels of a factor. There were significant differences in the means between all of the groups (all $p < 0.05$). The group that had never visited Grand Canyon showed a weaker PAI score in comparison to the group that visited one to three times in total, and in comparison to the group that visited more than three times in total. The group that visited a total of one to three times in total also showed a weaker PAI score in comparison to the group that visited more than three times in total. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for each level of the factor, are shown in Table V.

Table V
Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences for Place Attachment (PAI) Score for the Total Visit Frequency Factor

Total visit frequency group	*N*	*M*	*SD*	Zero times	1—3 times
Never visited	148	48.66	8.43		
1—3 times	197	45.11	8.42	1.70 to 5.39*	
More than 3 times	41	38.46	9.99	7.21 to 13.18*	3.74 to 9.55*

Note. An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the 0.05 level using the LSD procedure.

Place attachment (PAI score) versus number of visits to Grand Canyon within the last year

A one-way ANOVA was conducted to evaluate the hypothesis that student's place attachment to Grand Canyon would be more strongly affirmative, on average, the more times that student visited Grand Canyon within the last year. The independent variable, the one-year frequency factor, included the three levels discussed above: never visited within the last year, visited 1—3 times within the last year, and visited more than 3 times within the last year. The dependent variable was the student's PAI score. The ANOVA was significant, $F(2, 378) = 11.57$, $p < 0.05$. The strength of the relationship between the number of times visiting Grand Canyon within the last year and PAI score, as assessed by η^2, was small, with the visit frequency factor accounting for only 5.8% of the variance of the dependent variable.

As above, follow-up tests were conducted to evaluate pairwise differences among the means. Because the variances among the three groups ranged from 8.83 to 11.31 it was assumed that the variances were homogeneous, and post-hoc comparisons were made using the LSD test. There was a significant difference in the means between not visiting Grand Canyon in the last year and visiting one to three times in the last year ($p < 0.05$). There was also a significant difference between not visiting in the last year and visiting more than three times in the last year ($p < 0.01$). No significant differences were seen between visiting one to three times in the last year and visiting more than three times in the last year ($p = 0.07$). The group that had not visited in the last year showed weaker place attachment in comparison to the group that visited one to three times and in comparison to the group that visited more than three times. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for each level of the factor, are shown in Table VI.

Table VI
Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences for Place Attachment (PAI) Score for the One-Year Frequency Factor

One-year frequency group	*N*	*M*	*SD*	Zero times	1—3 times
Zero times	339	46.45	8.83		
1—3 times	40	40.53	9.09	3.01 to 8.84*	
More than 3 times	2	29.00	11.31	5.09 to 29.81*	-1.11 to 24.16

Note. An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the 0.05 level using the LSD procedure.

Place attachment (PAI score) versus length of time since last visit to Grand Canyon

A one-way ANOVA was conducted to evaluate the hypothesis that student's place attachment to Grand Canyon would be more strongly affirmative, on average, the more recently that student has visited Grand Canyon. The independent variable, the recency factor, included the three levels discussed above: never visited, visited within the last year, and visited more than one year ago. The dependent variable was the student's PAI score. The ANOVA was significant, $F(2, 379) = 17.50$, $p < 0.05$. The strength of the relationship between how recently someone has visited Grand Canyon and PAI score, as assessed by η^2, was small, with the recency factor accounting for only 8.5% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pairwise differences among the means. Because the variances among the three groups ranged from 8.46 to 9.41 it was assumed that the variances were homogeneous, and post-hoc comparisons were made using the LSD test. There were significant differences in the means between all groups of length of time since visiting Grand Canyon (all $p < 0.05$). The group that has never visited showed a weaker place attachment in comparison to the group that visited within the last year and in comparison to the group that visited more than one year ago. The group that visited within the last year showed a stronger place attachment in comparison to the group that had visited more than one year ago. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for each level of the factor, are shown in Table VII.

Table VII
Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences for Place Attachment (PAI) Score for the Recency Factor

Recency group	*N*	*M*	*SD*	Never visited	Visited within last year
Never visited	145	48.63	8.46		
Visited within the last year	44	40.39	9.01	5.29 to 11.21*	
Visited more than one year ago	193	44.73	8.88	2.02 to 5.79*	-7.21 to –1.47*

Note. An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the 0.05 level using the LSD procedure.

Place meaning (YPMS score) versus proximity of residence to Grand Canyon

A one-way analysis of variance was conducted to evaluate the hypothesis that the place meanings Grand Canyon holds for a student would be richer, on average, the closer that student lives to Grand Canyon. The independent variable, the proximity factor, comprised the three levels described above: less than 3 hours driving time, 3—6 hours driving time, and more than 6 hours driving time. The dependent variable was the student's YPMS score. The ANOVA was non-significant, $F(2, 362) = 0.10$, $p = 0.90$. Table VIII shows the means and standard deviations for each level of the factor for the total YPMS score.

Table VIII
Means and Standard Deviations for Place Meaning (YPMS) Score for the Proximity Factor

Proximity Group	*N*	*M*	*SD*
Less than 3 hours	90	58.16	14.72
3—6 hours	216	57.56	16.56
More than 6 hours	59	58.48	13.52

Place meaning (YPMS score) versus total number of visits to Grand Canyon

A one-way ANOVA was conducted to test the hypothesis that the place meanings Grand Canyon holds for a student would be richer, on average, the more times that student visits Grand Canyon in total. The independent variable, the total visit frequency factor, included the three levels explained above: never visited, visited one to three times, and visited more than three times. The dependent variable was the student's YPMS

score. The ANOVA was significant, $F(2, 370) = 7.08$, $p = 0.001$. The strength of the relationship between the total number of times visiting Grand Canyon and YPMS score, as assessed by η^2, was medium, with the total visit frequency factor accounting for 37% of the variance of the dependent variable.

To evaluate pairwise differences among the means, follow-up tests were again conducted. Because the variances among the three groups ranged from 13.25 to 13.31 it was assumed that the variances were homogeneous, and post-hoc comparisons were made using the LSD test. There were significant differences in the means between all of the groups (all $p < 0.05$). The group that had never visited Grand Canyon showed a lower YPMS score (i.e., Grand Canyon place meanings were less rich or weaker for this group) in comparison to the group that visited one to three times in total, and in comparison to the group that visited more than three times in total. The group that visited a total of one to three times also showed a lower YPMS score in comparison to the group that visited more than three times in total. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for each level of the factor, are shown in Table IX.

Table IX
Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences for Place Meaning (YPMS) Score for the Total Visit Frequency Factor

Total visit frequency group	*N*	*M*	*SD*	Zero times	1-3 times
Never visited	141	60.93	16.31		
1—3 times	193	57.02	15.03	0.57 to 7.26*	
More than 3 times	39	50.92	13.25	4.54 to 15.47*	0.79 to 11.40*

Note. An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the 0.05 level using the LSD procedure.

Place meaning (YPMS score) versus number of visits to Grand Canyon within the last year

A one-way ANOVA was conducted to test the hypothesis that the place meanings Grand Canyon holds for a student would be richer, on average, the more times that student visited Grand Canyon within the last year. The independent variable, the one-year visit frequency factor, included the three levels discussed above: never visited in the past year, visited one to three times in the past year, and visited more than three times in the past year. The dependent variable was the student's YPMS score. The ANOVA was significant, $F(2, 365) = 6.02$, $p < 0.01$. The strength of the relationship between the number of times visiting Grand Canyon within the last year and YPMS score, as assessed by η^2, was very small, with the one-year visit frequency factor accounting for only 3.2% of the variance of the dependent variable.

Follow-up tests were again conducted to evaluate pairwise differences among the means. Because the variances among the three groups ranged from 12.07 to 15.76 it was assumed that the variances were homogeneous. Post-hoc comparisons were again made using the LSD test. There were significant differences in the means between never visiting Grand Canyon in the last year and visiting one to three times in the last year. There were no significant differences between never visiting in the last year and visiting more than three times in the last year. Neither were there significant differences between visiting one to three times in the last year and visiting more than three times in the last year. The group that had never visited showed a lower YPMS score in comparison to the group that visited one to three times, and in comparison to the group that visited more than three times. The 95% confidence intervals for the pairwise differences as well as the means and standard deviations for each level of the factor are shown in Table X.

Table X
Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences for Place Meaning (YPMS) Score for the One-Year Visit Frequency Factor

One-year visit frequency group	*N*	*M*	*SD*	Zero times	1-3 times
Never visited	325	58.85	15.76		
1-3 times	42	50.95	12.07	2.94 to 12.86*	
More than 3 times	1	81.00		-52.46 to 8.17	-60.67 to 0.58

Note. An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the 0.05 level using the LSD procedure.

Place meaning (YPMS score) versus length of time since last visit to Grand Canyon

A one-way ANOVA was conducted to test the hypothesis that the place meanings Grand Canyon holds for a student would be richer, on average, the more recently that student has visited Grand Canyon. The independent variable, the recency factor, included the three levels discussed above: never visited, visited within the last year, and visited more than one year ago. The dependent variable was the student's YPMS score. The ANOVA was significant, $F(2, 366) = 6.52$, $p < 0.01$. The strength of the relationship between how recently someone has visited Grand Canyon and YPMS score, as assessed by η^2, was very small, with the visit frequency factor accounting for only 3.4% of the variance of the dependent variable.

Follow-up tests were then conducted to evaluate pairwise differences among the means. Because the variances among the three groups ranged from 13.21 to 16.35 it was again assumed that the variances were homogeneous; post-hoc comparisons were made using the LSD test. There were significant differences in the means between all groups of length of time since visiting Grand Canyon ($p < 0.05$). The group that has never visited showed a lower YPMS score in comparison to the group that visited within the last year, and in comparison to the group that visited more than one year ago. The group that

visited within the last year showed a higher YPMS score in comparison to the group that had visited more than one year ago. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for each level of the factor, are shown in Table XI.

Table XI
Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences for Place Meaning (YPMS) Score for the Recency Factor

Recency group	*N*	*M*	*SD*	Never visited	Visited within last year
Never visited	139	61.07	16.35		
Visited within the last year	46	52.07	13.21	3.86 to 14.15*	
Visited more than one year ago	184	57.08	15.13	0.60 to 7.40*	-10.00 to -.0024*

Note. An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the 0.05 level using the LSD procedure.

All results are summarized in Table XII.

Table XII
Summary of Relationships between Proximity and Visitation Factors and Student's Sense of the Study Place (Grand Canyon)

Factor	Does this factor significantly affect	
	Place attachment?	Place meaning?
Proximity of Residence	No	No
Total Number of Visits	Yes (More visits = Stronger attachment)	Yes (More visits = Richer meaning)
Number of Visits in the Last Year	Yes (More frequent visits = Stronger attachment)	Yes (More frequent visits = Richer meaning)
Length of Time Since Last Visit	Yes (More recent visits = Stronger attachment)	Yes (More recent visits = Richer meaning)

Discussion

In this study, proximity and visitation factors that reflect the level of prior experience with Grand Canyon, suggested by previous research to be related to sense of place, were compared to measurements of place attachment and place meaning in order to determine whether these factors have any influence on student's sense of the study place prior to the place-based intervention.

Proximity of Grand Canyon to the places where the geology students live or have lived does not appear to have any influence on their prior senses of the place. This result may simply reflect unfamiliarity with regional geography, as there was no way to confirm the accuracy of student responses to the question of distance from their homes to Grand Canyon. However, it may also confirm the point discussed above, that living close to a place could just as readily provoke indifference ("one doesn't go camping in one's backyard"), boredom, or negativity (Pretty, Chipuer, & Bramston, 2003) as affirmative place attachment.

However, both emotional attachment to and richness of meaning represented by Grand Canyon were positively correlated with the frequency and recency of visits there. This result is concordant with the tourism-related findings discussed above (Williams, Patterson, Roggenbuck, & Watson, 1992), and further confirms that individuals are more likely to make repeat visits to places they value and enjoy; that experiences at the actual Grand Canyon are richer and more meaningful than those imparted remotely by videos, images, or writings; and that the affective and cognitive effects of experiences at Grand Canyon will be strongest in those who have visited it the most recently.

As discussed above, Grand Canyon was selected as the subject of this study because of its recognizability and broad familiarity. It was assumed that these would enhance effect. It is certainly possible that not all of the student respondents who were familiar with Grand Canyon had a positive association with the place. However, the positive correlation between visitation and place attachment suggests that any negative contribution from place aversion was minimal.

It should also be noted that perception of the content encoded in the items of the PAI and especially the YPMS is highly subjective, and the numerical scales of these instruments may be understood somewhat differently by respondents and the researcher (Vázquez, Manassero, & Acevedo, 2006). Future sense-of-place instruments could be made more valid by enabling respondents to express a level of agreement with different statements pertaining to meanings of a place (rather than words or short phrases as in the YPMS), each reviewed and scaled beforehand by a panel of recognized experts on that place (Vázquez, Manassero, & Acevedo, 2006; Semken & Butler Freeman, 2008).

A practical implication of these findings for place-based geoscience teaching, which is consciously intended to leverage and enhance the sense of place (Semken, 2005; Lim & Calabrese Barton, 2006), is that an instructor need not be concerned that the method will be effective only for locally resident students, particularly when the study place or places are widely known and richly imbued with humanistic as well as scientific meaning. Ideally, however, all students should be afforded opportunities to visit and explore these places if it is at all practical. In designing and implementing a place-based

geoscience course or curriculum, the instructor should be broadly aware of students' interests, preferences, and prior experiences related to regional travel and outdoor activities.

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