RESEARCH BULLETIN

ABOUT THE RESEARCH BULLETIN

The *Environmental Education Research Bulletin* is a project of NatureBridge in partnership with Dr. Nicole Ardoin at Stanford University. It is designed to inform NatureBridge educators about recent relevant research, so the emphasis is on field science, stewardship behavior, and residential settings, among other topics. Other environmental educators might also find this bulletin useful, though, again, it does not cover all aspects of environmental education. The Research Bulletin is available online through the NatureBridge website, and you can send questions and feedback to aburnett@naturebridge.org.

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INTRODUCTION

The most talented environmental educators we know are in the field, conducting place-based programs, collaborating with communities, and using hands-on strategies to make the critical link between environmental awareness, skills building, and informed action. Rarely do these committed professionals have time to keep up on the latest research, whose beneficial findings may enhance the effectiveness of environmental education (EE) programming.

To bridge the gap between research and practice, NatureBridge is partnering with environmental education researchers at Stanford University to create a semiannual EE Research Bulletin. Our goal is to synthesize and summarize recently reported research that may help NatureBridge and environmental educators in other organizations and agencies improve their practice.

In this first volume, we've pulled together recent and relevant journal articles that relate to environmental education, with a particular emphasis on field science, stewardship behavior, and residential settings. We reviewed the most recent issues (published at the end of 2010 or the beginning of 2011, depending on each journal's publication schedule) of the following journals: *The Journal of Environmental Education*, *Environmental Education Research*, *Applied Environmental Education and Communications*, *Australian Journal of Environmental Education*, *Canadian Journal of Environmental Education*, *Journal of Experiential Education*, *International Journal of Science Education*, *Visitor Studies*, *Journal of Interpretation Research*, and the *Journal of Environmental Psychology*.

Unfortunately, we were not able to include summaries of articles from the Canadian and Australian EE journals in this issue because of access issues, but abstracts of all the recent articles from these two journals, along with all the other journals we reviewed, are in a spreadsheet that you will be able to access through the NatureBridge website.

In addition to providing a summary of the articles, we've also provided even shorter "Bottom Line" summaries to make keeping up with the work faster and easier. And we've provided citations for each article profiled so you can read it in full.

For this issue, we've grouped the articles by topic. These include articles related to teaching methods; assessment and evaluation; influencing environmental behavior; and more. We may organize future issues differently depending on research trends.

Because we are creating this document for *you*, we're eager to hear your feedback. Please let us know if there are additional topics or journals you'd like to see covered or if there's an alternative format that may be helpful. You can send all suggestions to aburnett@naturebridge.org with a header "EE Research Bulletin." We'll take these into account at the beginning of each cycle and try to adapt accordingly. And for another take on these kinds of articles, you may also want to check out the research blog available from the North American Association for Environmental Education (eelinked. naaee.net/n/eeresearch).

We wish you all the best in your important efforts to integrate high-quality research into inspiring practice!

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BEHAVIOR

CURRICULUM SENDS DIFFERENT MESSAGES IN SCIENCE AND SOCIAL STUDIES CLASSES

According to this recent research, students take away different messages from a curriculum depending on whether they receive the instruction in a social studies or science class. The researcher examined three social studies and six natural science classes (a total of 900 students in grades 9-12) as they used a curriculum unit on sustainable land use. Three science classes that did not receive the curriculum served as a comparison group.

Using pre- and post-tests and interviews with open-ended questions, the research revealed that the students were no more likely to report having taken environmental behaviors in support of sustainable land use after being exposed to the curriculum in either class.

But the researcher did find changes in the students' knowledge of things they *could* do. Students who were taught the curriculum as part of the social studies class increased listing rates of possible future actions to support sustainable land use from pre- to post-test, while science students showed no change.

For the most part, teachers did not use the action components included in the curriculum, although the science teachers did use some of the civic action portions. Nevertheless, science students did not seem to make the connection between that content and knowledge of actions they could take in the future. But social studies students—who largely did not receive the action instruction—seemed to make more gains in their action knowledge.

The researcher notes that the students were far more likely to list individual actions than group actions. She says, "Regardless of course subject, group or collective actions are simply not salient for students; they tend to think of actions in terms of individual behavior. Given the collective nature of many environmental and social problems and solutions, this is a disheartening finding, yet also an opportunity to emphasize the role of groups in civic actions."

THE BOTTOM LINE: This study suggests that students learning about environmental issues in social studies classes, where they

focus on topics such as sustainable land use, may more readily incorporate civic action concepts into their mental frameworks than when they learn about environmental issues in science classes. This suggests that EE may fit well within social studies courses, whose goal is often to increase student citizenship skills. This finding runs somewhat contrary to the frequent and close association of EE with science courses.

Kumler, L. M. (2011). Students of action? A comparative investigation of secondary science and social studies students' action repertoires in a land use context. *The Journal of Environmental Education*, 42(1), 14–29.

USING A BEHAVIOR MODEL TO PREDICT WHETHER TEACHERS ADOPT ENVIRONMENTAL EDUCATION

The researchers in this study used a traditional behavior model to predict a non-traditional environmental behavior—teaching others about the environment. Typically, behavior models focus on direct actions, such as recycling. These researchers wondered whether models of direct action could also be applied to an indirect action such as teaching someone else.

The researchers focused on teachers in coastal Tanzania where the Jane Goodall Institute leads Roots & Shoots teacher training workshops. The researchers used Hungerford and Volk's 1990 model of responsible environmental behavior as their guide. According to this model, environmental behavior is a function of three levels of variables that influence each other in turn: Entry-level variables (such as environmental sensitivity and knowledge of ecology) predict ownership variables (such as in-depth knowledge of issues and personal investment in issues), which in turn predict empowerment variables (such as skills for taking action, locus of control, and intention to act). These empowerment variables, in turn, affect behavior. The model the researchers used in this study differed only in that the three levels of variables predicted

an *intention* to act, rather than the behavior itself.

The researchers surveyed nearly 400 teachers in coastal Tanzania. About half of the teachers had participated in the workshops and half had not. The trainings and follow-ups encouraged participating teachers to share what they had learned with their colleagues. The researchers assumed that this transfer of knowledge happened and surveyed both the participants and their colleagues.

The results indicate that the model did predict the teachers' intention to act. The three levels worked sequentially, although the results did differ slightly from the model in that entry level variables predicted empowerment and ownership scales equally well. (In contrast, the model suggests that entry level variables predict ownership, which in turn predicts empowerment.)

The authors note that this study was based on only one model of responsible environmental behavior. Other models might have been effective, too. The point of the study was not necessarily to test whether the model is valid, or whether one model works better than another, but to test whether the model can predict a different kind of behavior—namely, the indirect behavior of teaching someone else. They note that this may be the first attempt to test this idea, and more research is needed to better understand indirect behaviors such as teaching others.

THE BOTTOM LINE: This research indicates that Hungerford and Volk's model of responsible environmental behavior can predict a teacher's intention to teach environmental education. More research is required to confirm the results, but this research suggests an interesting new direction, as it used a behavior model to investigate the act of teaching environmental education. By contrast, behavior models are typically used to predict more direct environmental behaviors, such as recycling.

Bruyere, B., Hash, P. E., & Mbogella, F. (2011). Predicting participation in environmental education by teachers in coastal regions of Tanzania. *The Journal of Environmental Education, 42*(3), 168–180.

CHILDREN'S PARTICIPATION AS A PATH TO ACTION

Disheartened by the traditional, top-down approach to environmental education in Greek schools, the researcher investigated whether a more constructivist approach could lead children to action. The researcher explains, "I realised that the way that environmental education was being taught in my primary school prevented children from developing their critical thought, their action competence, and their willingness to participate."

Motivated by thinkers such as Paolo Friere and Roger Hart, who have advocated for a child-centered approach to education in which the educator becomes a co-learner with the students, the researcher created an EE program in which students generated the content and made decisions about what to do, if anything, about an issue that they identified. The researcher explains that the investigation aimed to uncover whether children "can have the will and ability to act, not through the transfer of scientific knowledge, but through the expression and the communication of their own ideas."

The intervention involved 60 children from 9 to 12 years old in five classes in an Athens primary school. The researcher delivered the program, which was designed to move through cycles of planning, action, monitoring, and reflection. In the first portion, the children participated in a storytelling exercise. They were asked to imagine that they were an extraterrestrial who had landed in Athens. Their stories were to include a description of the city, how they imagined it after 20 years, and changes they'd like to see.

In the next cycle, the students were asked to photograph their neighborhood, noting favorite places, places they dislike, and places where they play. Follow-up written exercises encouraged the children to explain the photos. And in the final cycle, the children worked collaboratively on dramatizations in which the students dramatized the positive and negative aspects of the city.

The researcher analyzed data gleaned from the children's texts from the storytelling, photography, and dramatic activities; the researcher's observations; and the children's written evaluations of the program.

According to the researcher, after the first stage of the program, the students expressed dissatisfaction with many aspects of their city, but felt powerless to effect change. After the second stage, the children began to discuss the possibility of taking action. And after the third stage, the students identified and executed a plan of action that included creating a book of their ideas to send to the Municipality of Athens and developing a performance for students, teachers, parents, and government representatives.

According to the researcher, "My purpose in this educational programme was to establish an adult-children relationship that was as equal as possible." The students participated fully in each stage, defining the problem, analyzing data, and making decisions about whether and how to take action. "The action model was an attempt to demonstrate that children can develop a willingness and ability to act through the expression and communication of their ideas."

THE BOTTOM LINE: The researcher used a constructivist educational approach to move students to take action on an environmental issue in their community. The researcher, who taught the students, placed less emphasis on the acquisition of scientific knowledge and more emphasis on student-led investigation and action. Inspired by thinkers such as Paolo Friere and Roger Hart, the researcher envisioned the teacher as a coinvestigator and concluded that this type of approach was effective in inspiring action in the students.

Tsevreni, I. (2011). Towards an environmental education without scientific knowledge: An attempt to create an action model based on children's experiences, emotions and perceptions about their environment. *Environmental Education Research, 17*(1), 53–67.

PERSONALITY AND OTHER INDIVIDUAL TRAITS AFFECT ENVIRONMENTAL BEHAVIOR

Across the globe, waste management is a pressing issue. In Britain, the home country of this paper's authors, the vast majority of the nation's municipal waste is from households, and the government has emphasized the need for individuals to be part of the country's waste management strategy. But, the authors note that getting people to take on environmental behaviors such as recycling is no small feat.

Although people's attitudes often receive a lot of attention in studies of environmental behaviors, in reality, there is often a gap between how people feel and what they do. Researchers have identified a range of other factors that can influence a person's decisions to act, including feelings of personal effectiveness, the perceived threat of inaction, the subjective norms in the community, and others. This study expands on previous research with a new focus on how people's personalities and individual differences can affect their waste management behaviors.

Specifically, the researchers looked at the traits of Machiavellianism (the degree to which a person is suspicious of others and believes he must exploit others to avoid being exploited himself), political cynicism (a measure of a person's interest in public life, idealism, and political determination), and two of the Big Five personality traits of agreeableness (people who are concerned about others) and conscientiousness (associated with intellectualism and achievement). The researchers also included the socio-demographic variables of age and sex.

The team surveyed 100 adult women and 103 adult men in a large train station in London. The participants completed a four-page survey that included a scale of reported waste management behaviors (including reduction, reuse, and recycling), a personality inventory that measures the Big Five personality facets, a Machiavellianism scale, a political cynicism scale, and questions about demographic details. The researchers found that the three waste management behaviors—reduction, reuse, and recycling—were so highly correlated that they combined the three scores into one composite waste management score. And they found that lower Machiavellianism, lower political cynicism, older age, and higher conscientiousness were all associated with better waste management behaviors. The results also suggested that highly Machiavellian people also tended to be more politically cynical, compounding the effects.

The researchers suggest that these findings, though preliminary, offer insight into the puzzling picture of human behavior. Although some behavior models include broad psychological factors, these results suggest that specific factors such as personality can affect environmental behaviors.

THE BOTTOM LINE: There is a gap between what people know, how they feel, and how they act. Research, and the behavior models it has generated, has uncovered a variety of situational and psychological factors that can also affect whether a person takes a specific action. This research suggests that a person's personality and individual differences also can play a role. Specifically, people who are less Machiavellian, less politically cynical, older, and more conscientious are more likely to report undertaking behaviors such as reducing, reusing, and recycling.

Swami, V., Chamorro-Premuzic, T., Snelgar, R., & Furnham, A. (2011). Personality, individual differences, and demographic antecedents of self-reported household waste management behaviours. J*ournal of Environmental Psychology, 31*(1), 21–26.

RESEARCHERS LINK BEHAVIOR THEORIES TO THE PHILOSOPHIES OF MUIR AND LEOPOLD

In thinking about what motivates environmental behavior, the Michigan State University researchers who authored this paper acknowledge that the knowledge-attitudes-behavior link that so commonly guides environmental education programs often doesn't work or is an overly simplistic representation. (What is commonly referred

to as the knowledge-attitudes-behavior model rests on the assumption that knowledge about the environment spurs more positive attitudes, which in turn lead to more responsible environmental behavior.)

The authors of this paper argue that, before people can learn and care about a topic or issue, they must first be ethically engaged. They state that "the ethical framework we employ . . . assumes that students will neither care about nor retain the knowledge they gain unless they are first emotionally and ethically engaged by place, community, and content." And, they argue, by focusing on developing an environmental ethic, educators can set students up for a lifetime of better choices, even as environmental issues and appropriate actions change.

But what kind of ethic is most appropriate? The authors compare the philosophies of John Muir and Aldo Leopold and argue that one is better than the other at spurring action.

John Muir, "the iconic leader of the preservation movement," argued that the key to environmental preservation is in getting more people to see and experience wild places. Muir supported open immigration policies and road building as ways that more people could experience the places he wanted to protect. And he said, "If every citizen could take one walk through this reserve, there would be no more trouble about its care." The authors believe this reflects the classic knowledge-attitudes-behavior model. If people experience the natural world, they'll become emotionally attached and, as a result, work to preserve it.

But, the authors question "whether it is true that such exposure is a sufficient condition for environmental action. We question the assumption that all people, in spending time and learning about a place, will develop similar feelings of respect for that place." The authors cite anecdotal evidence that each individual in a group who together experience a wild place do not each develop the same feelings of respect for the place, nor does each person agree on the actions that might best honor it. And the authors also cite empirical evidence that knowledge doesn't lead to action. They point to a recent study that indicated that the more that people know about climate change, the less they seem to care about the issue.

Leopold, on the other hand, emphasizes people's *relationships* to the land in his land ethic. The authors explain that "in Muir . . . the human is often looking in upon nature, not an integral participant within the larger community. Leopold's philosophy of action, on the contrary, . . . includes humans as equal participants in a wider web of connection."

Leopold argues that, over time, people's social consciousness has widened. He gives as an example Odysseus, who hanged a dozen young slaves who he suspected had misbehaved. During Odysseus's time, moral and ethical obligations simply didn't extend to slaves. Today, obviously, the boundaries have changed. And Leopold argues that what's needed now is another boundary shift that will also include the natural world within our sphere of moral obligations. The authors explain, "In effect, ecology serves to expand the previously perceived limits of our community, just as centuries of evolution expanded our human community to include all humans beyond Odysseus's limited definition."

The authors believe that the role of environmental educators, then, is "to educate for a changed perception of community" that includes the natural world. In conducting discussions, for example, they believe "we should talk about protecting ourselves, or our home, rather than brainstorming the ways we can work to protect or maintain our special places when we get 'back to the real world.'" While the ultimate goal might be changing actions, the authors argue that the best path, and one that will lead to better choices over the long term, is in expanding moral boundaries.

THE BOTTOM LINE: John Muir and Aldo Leopold have inspired generations of people with concern about the environment. But the authors of this paper argue that Muir's philosophy sets humans up as outside observers of nature. And Muir's philosophy also rests on assumptions that nature experiences alone can be sufficiently powerful to move people to action. The researchers argue that this way of thinking is outdated in light of research that indicates that knowledge does not lead to action. The authors instead

believe that environmental educators should embrace Aldo Leopold's land ethic, helping extend students' moral boundaries from human communities to include the natural world. This feeling of moral obligation to the wider natural communities to which we belong will guide a lifetime of environmental action.

Goralnik, L., & Nelson, M. P. (2011). Framing a philosophy of environmental action: Aldo Leopold, John Muir, and the importance of community. *The Journal of Environmental Education, 42*(3), 181–192.

TEACHING METHODS

RESIDENTIAL EE PROGRAM YIELDS POSITIVE RESULTS, ESPECIALLY FOR URBAN PARTICIPANTS

At the NorthBay Adventure Center on the shores of the Chesapeake Bay, urban and rural middle school students attend a five-day residential program that promotes three main outcomes: environmental responsibility; character development and leadership; and positive attitudes toward school. Although character development may be associated with many EE programs, it is not often evaluated in EE settings. Instead, researchers have tended to focus on this outcome in after-school programs, and such outcomes are often referred to as positive youth development (PYD). The researchers in this study note that "NorthBay programming exists at the intersection of environmental education and PYD."

Located in northern Maryland, NorthBay's 97-acre site includes forested areas, wetlands, and developed areas. Facilities include a high ropes course, two climbing walls, a 40-foot boat, two indoor recreational facilities, a theater, hiking trails, one-half mile of waterfront, and a zipline that transports users from a tower into the Chesapeake Bay. Programs at NorthBay use a constructivist approach. Hungerford, Volk, Ramsey, Litherland, and Peyton's Investigating and Evaluating Environmental Issues and Actions (IEEIA) model serves as a curriculum guide. The students identify, investigate, and address environmental issues with a multidisciplinary, student-focused approach. Programs also aim to link experiential lessons at the site with similar personal challenges the students might face at home. For example, the researchers explain, "The program links the idea of wetlands as ecological filters for pollutants in nature with role models as filters for negative influences in students' lives." Evening programs use multimedia presentations to reinforce character development themes.

The researchers evaluated NorthBay's programs over two years, monitoring the students before, immediately after, and three months after their visit. Students completed pre-experience surveys upon arrival; post-experience surveys before departure; and follow-up surveys in their classrooms three months later.

The researchers selected a sample that reflected a cross-section of participants from urban, suburban, and rural schools. Of the students from urban schools, 88% were African American and 79% were eligible for free or reduced-price lunch programs. Students in the non-urban schools were 73% white with 24% eligible for free or reduced-price lunches.

The researchers found that participation in the weeklong NorthBay program generated significant positive short-term effects on environmental responsibility; character development and leadership; and attitudes toward school. Those gains persisted at three months, with the exception of positive attitudes toward school, which faded. The authors note that the long-term gains on environmental responsibility and character development and leadership are "particularly noteworthy" because follow-up surveys typically reveal that gains have faded to near pre-experience levels. Urban students had more positive scores on all measures at all points in time.

Although the authors didn't specifically investigate which parts of the program contributed to its success, or why urban students seemed to glean greater benefits, they offer thoughts based on observations, interactions with staff and students, and the literature: "The successes of the approach at NorthBay suggest that making explicit linkages between students' on-site and home lives can have meaningful lasting impacts on students. The racial diversity of the NorthBay staff may further contribute to this effect by providing legitimate role models for students." They also note that NorthBay's focus on local environments may align with the ways that research shows urban audiences conceptualize notions of "environment."

The researchers believe that "NorthBay's constructivist approach to student empowerment, its culturally relevant definition of environmental responsibility, and its intermingling of environmental outcomes with positive youth development have been keys to its success thus far."

THE BOTTOM LINE: The NorthBay Adventure Center is a residential environmental education program whose goals go beyond typical environmental education goals to also include personal development outcomes. The program's culturally sensitive and constructivist approaches, which evaluation results suggest are effective, promote environmental and personal development goals. As a result of program participation, students show significant gains in environmental responsibility, character development and leadership, and attitudes toward school, with urban students showing the most positive scores. Gains in environmental responsibility and character development and leadership persist at three months.

Stern, M. J., Powell, R. B., & Ardoin, N. M. (2011). Evaluating a constructivist and culturally responsive approach to environmental education for diverse audiences. *The Journal of Environmental Education, 42*(2), 109–122.

FOCUSING ON STRENGTHS FOSTERS PERSONAL GROWTH

Although many traditional educational approaches aim to help learners shore up knowledge and skills where they may have weaknesses, a strengths-based approach accentuates the learner's strengths. The authors of this study used an outdoor adventure course to illustrate how a strengths-based approach can result in positive outcomes in personal growth.

According to the authors, a strengths-based approach leverages a learner's natural talents. By contrast, they note, "The traditional developmental approach includes measurement, identification of strengths and weaknesses, and weakness fixing." When leaders accentuate a learner's strengths, previous research suggests that the learner can become more engaged, directed, and hopeful, among other benefits.

In this study, the authors used a strengths-based approach in leading an international adventure education course on ecotourism. Fifty-eight college students (aged 19 to 22) participated in the study-abroad course, which involved a variety of adventure activities including hiking,

rappelling, canyoning, and surfing. During the pre-course meetings, the authors administered the Gallup Organization's Clifton StrengthsFinder (CSF), an online survey instrument that generates a list of the respondent's top five strengths based on their responses to 180 questions that measure their patterns of thought, feeling, and behavior. The authors planned seven opportunities for the participants to identify, use, or reflect upon their strengths during the course, and informal discussions of strengths and the strengths-based approach also occurred throughout the course.

To evaluate the results, the authors administered one survey to measure personal growth and a second to assess the extent to which the participants understood and applied their strengths. The authors also analyzed the students' final papers. The surveys revealed that personal growth was correlated with the students' awareness and application of their strengths. According to the authors, "These data suggest that a focus on developing strengths was associated with greater personal growth."

In addition, the analysis of the students' final papers suggests that the strengths-based approach encouraged "mindful learning, enhanced relationships, and overcoming physical challenges." They cite as an example of mindful learning a student who, because he was made aware of his communication strength, worked on honing his storytelling skills during the course. Another remarked, "It was unbelievable how much more I thought about personal growth and improvement once I knew where to start from."

The students also appeared to use their strengths to help build relationships and work better as a team. For example, one student employed her harmony skills in helping resolve conflicts in the group, while another used her strength of command to take the lead in certain circumstances.

Finally, some students reported using their strengths to overcome challenges during the course. For example, one student used his skill of competition to motivate himself to overcome his fears.

The authors note that this study does have limitations, including a small sample size and the lack of a control group. The authors also note that the students' final papers, which the researchers analyzed, were submitted for a grade, thus introducing the potential for bias.

The authors also recognize that not everyone agrees that this kind of positive psychology is beneficial. They cite one critic in particular (Ehrenreich) who has published a book that suggests that positive psychology represents a "departure from realism" and that the "American ideology of relentless positivity" has created myriad problems. The authors caution that "this relates to a practical pitfall of the strengths-based education—feeling limited or confined by a particular set of strengths. Care must be taken by educators to ensure CSF results do not become barriers to success."

THE BOTTOM LINE: This study suggests that identifying and focusing on students' strengths during an outdoor adventure program can help foster personal growth, mindful learning, and enhanced relationships. Focusing on strengths can also help overcome physical challenges. Yet more rigorous research should be conducted to confirm these results, and educators should be aware that, although focusing on a student's strengths can help him or her overcome obstacles, strengths can become obstacles if the student begins to feel confined by those strengths.

Passarelli, A., Hall, E., & Anderson, M. (2010). A strengths-based approach to outdoor and adventure education: Possibilities for personal growth. J*ournal of Experiential Education, 33*(2), 120–135.

CHARACTER AND ABILITY KEY ELEMENTS FOR BUILDING TRUST IN AN OUTDOOR LEADER

Previous research indicates that the relationships that form between participants and leaders in outdoor programs are a key factor in the success of those programs. According to one study of the National Outdoor Leadership School (NOLS), participants' rapport with instructors is correlated with leadership development, skills development, and environmental awareness. Recognizing the importance of strong relationships between leaders and participants, the authors of this study examined the role of trust in the relationships between leaders and participants in outdoor programs.

The authors first examined the literature to determine the importance of trust in outdoor leaders. They conclude that multidisciplinary literature indicates that trust is important in learning, cooperation, and performance within groups. But in examining the outdoor education literature, the authors found that although the concept of trust is well represented, a common understanding of what it is and how it develops is missing. They conclude that "seemingly, outdoor leaders have relied on the assumption that building trust among participants is a worthy goal and that trust is an integral part of experiential education, but they have failed to offer a clear understanding of what trust is and how it might be established."

To help fill this void, the authors conducted two studies to examine how participants build trust in their leaders. The first exploratory study gathered a team of leaders from some of the largest and most well respected outdoor programs (including Outward Bound, NOLS, and others) and brainstormed factors they believed contributed to participants' trust of leaders. They presented these factors in the form of a questionnaire to 181 participants in two university outdoor programs, and asked them to indicate the degree to which each of the factors influenced their trust in their leader.

The results indicate that the five most important factors in building trust in leaders were: honesty, calm during a crisis, knowing the itinerary, showing respect, and communicating effectively. Appearance was the least important factor. The researchers also worded the factors negatively in order to examine factors that erode trust. In this case, the factors that effected trust most negatively were: not knowing about safety, not remaining calm in a crisis, not possessing adequate experience, not being an effective communicator, and not practicing what she or he preaches. Again, appearance was least important. The authors conclude that the results point to the importance of technical skills in building trust, and also the important role of interpersonal skills. They also note that other researchers have found that appearance may play an important role in participants' initial perceptions of a leader's competence. They suggest that further research might explore how appearance affects trust.

The researchers also conducted a second study to test a model of trust development posited by Mayer et al. According to the Mayer model, three factors influence trust in a leader: ability, benevolence, and integrity. (A fourth predictor, propensity to trust, is an attribute of the person doing the trusting.) The researchers in this study presented 66 university students enrolled in outdoor skills courses with written vignettes that described hypothetical situations in which leaders displayed varying levels of ability, benevolence, and integrity. The results indicate that Mayer's factors were predictors of the participants' likelihood to trust the leader. Ability was the most important factor, followed by benevolence and integrity.

The researchers conclude that "taken together, these two studies suggest that both a leader's ability and a leader's character can influence participants' trust." And the researchers suggest that "along with giving the necessary time and attention to technical and interpersonal skills trainings, program managers might consider the importance of adding a character development component to their staff trainings."

THE BOTTOM LINE: Positive relationships among participants and between participants and leaders are key to achieving outdoor education goals. Trust plays an important role in healthy relationships and contributes to better results within groups. This paper indicates that a leader's technical ability is a key factor that helps participants build trust in their leader. And the research also suggests that character-based traits such as honesty, consistency, benevolence, and integrity are important predictors of trust. Program managers should consider this balance of technical and interpersonal skills when hiring and training outdoor leaders.

Shooter, W., Paisley, K., & Sibthorp, J. (2010). Trust development in outdoor leadership. *Journal of Experiential Education, 33*(3), 189–207.

STUDENTS' MENTAL MODELS REVEAL MIXED IDEAS ABOUT THE GREENHOUSE EFFECT

Given the severity of the climate change problem, and the resources now being devoted to educating students about it, the authors set out to understand how students think about the greenhouse effect. Previous studies, most of which have been conducted outside the United States, suggest that students lack a clear understanding of how the greenhouse effect works. This study focused on 225 seventh-grade students in three small, rural communities in the U.S. Midwest. The students varied in their academic ability, were primarily Caucasian, and were roughly evenly divided between males and females. About 30% were eligible for free or reduced lunch programs.

The students participated in an instructional development project coordinated by the authors. The authors asked students to complete an activity in which they would draw the greenhouse effect and then explain their drawing. The researchers analyzed the student responses and grouped the responses into the following five categories representing the students' mental models of the greenhouse effect:

Model 1: "Greenhouse" for growing plants (29%)

Model 2: Greenhouse gases cause ozone depletion or formation, which either allows more of the sun's rays to reach the Earth or causes the sun's rays to be "trapped" or "bounced" back toward Earth (6%)

Model 3: Greenhouse gases, but no heating mechanism; simply gases in the atmosphere (17%)

Model 4: Greenhouse gases "trap" the sun's rays, heating the Earth (may or may not identify specific greenhouse gases) (35%)

Model 5: Sun's rays are "bounced" or reflected back and forth between the Earth's surface and greenhouse gases, heating the Earth (may or may not identify specific greenhouse gases) (13%)

Based on their analysis, the authors conclude that most of the students "lacked a clear understanding of the greenhouse effect." Nearly a third of the students described the greenhouse effect in terms of Model 1 (greenhouse for growing plants), which the authors believe indicates that the students did not understand the greenhouse effect.

But all is not lost. The authors also note that "on the bright side, students who hold Mental Models 3, 4, and 5 and probably students who hold Mental Model 2 have fairly well developed mental models that are likely to be easily modified with the appropriate curriculum and instructional experiences."

The authors suggest that, in teaching students about the greenhouse effect, instructors and curriculum developers should work to dispel the misunderstandings that the greenhouse effect "traps" all of the sun's energy, that carbon dioxide is the only greenhouse gas, and that all air pollution contributes to the greenhouse effect. In particular, the authors suggest that the following concepts should be addressed in educational materials dealing with the greenhouse effect:

- Carbon cycle, fossil fuels (energy), and greenhouse gases
- Other human and natural sources of greenhouse gases (e.g., forest fires, animal waste, landfills, land use)
- Greenhouse gases (e.g., water vapor, carbon dioxide, methane, nitrous oxide)

- Uniform distribution of greenhouse and atmospheric gases
- Absorption and radiation of energy—energy transfer
- Greenhouse effect, radiative forcing (infrared radiation), and the Earth's energy balance
- Distinction between types of solar radiation, and solar and terrestrial radiation
- Greenhouse gases and ozone depletion
- The greenhouse effect and global warming
- Natural versus human sources of greenhouse gases and personal solutions and actions

Finally, the authors urge educators to remind students that any model or demonstration of the greenhouse effect they might use in a classroom activity is not complete. Educators should stress the limits of these models and demonstrations and point out the ways in which they differ from reality.

THE BOTTOM LINE: Although many students may have a broadly accurate mental model of climate change, most students' understanding of how the greenhouse effect works is not complete, and some lack any meaningful understanding. Moving students toward accurate mental models will require instruction that more fully explains solar energy and the Earth's energy balance, all the greenhouse gases (not only carbon dioxide and those from human sources), distinctions between greenhouse gases and ozone depletion, and distinctions between greenhouse gases and other forms of air pollution.

Shepardson, D., Choi, S., Niyogi, D., & Charusombat, U. (2011). Seventh grade students' mental models of the greenhouse effect. *Environmental Education Research, 17*(1), 1–17.

WRITING STORIES BUILDS SCIENTIFIC LITERACY

International studies have uncovered an unfortunate trend: students are becoming less interested in science. Especially at the middle school level, students are finding it difficult to become excited about science. And, according to this study's authors, that's not just a problem for students' performance on tests: "This is an important issue for science educators because disengaged students are less likely to become informed future citizens who use natural, scientific, and technological resources responsibly for a sustainable future."

Increasingly, researchers are thinking about scientific literacy in terms of not only what students know, but also how they *apply* what they know. (For more on how students apply science, see the Other Research section in this Research Bulletin for analysis of the 2006 Programme for International Student Assessment results.) This study examined whether one technique—writing stories with embedded scientific concepts—could help students learn new concepts and also apply them in novel settings, thereby building their interest in science.

The authors point to previous research that suggests that writing tasks, including imaginative writing, can improve student learning and motivation. They considered a recent qualitative study in which fourth-grade students wrote an ecological mystery. That study found that students were engaged and interested, built scientific knowledge, and improved their literacy skills. The authors of this paper took that idea further by developing a short-story format (which they suggest is easier to implement) and devising a more rigorous research design to test the effects of the approach.

In this study, students completed writing tasks that involved the socio-scientific issue of biosecurity (namely, the threat of introduced species). The authors argue that socio-scientific issues are ideal for building applied scientific literacy because these issues blend scientific concepts and current social issues. Within the context of learning about issues such as biosecurity, students interpret data, evaluate

claims, analyze and generate arguments, and assess (and sometimes develop their own) moral viewpoints. (For more research on these kinds of issues, see the summary titled "Researchers Probe Students' Reasoning on Socio-Scientific Issues" in this section of the Research Bulletin.)

Conducted in Australia, the study involved two sixth-grade science classes of 28 and 27 students. One group served as a control group and received the standard curriculum on microorganisms. The other class served as a treatment group, and in addition to the standard curriculum, completed the writing task. Both groups completed an online questionnaire, the BioQuiz, that helped researchers gauge students' knowledge, interest, confidence, and scientific literacy. The researchers also followed up with interviews.

The writing task was to write short stories, which the researchers called BioStories. These stories were based on writing prompts that depicted a scenario (for example, the late Steve Irwin and a young girl discuss the need for quarantines at a customs checkpoint). A project website provided links to relevant scientific information, and instructors asked students to incorporate that information into their stories.

The researchers generated three key findings about the students who completed the writing project:

- The students became more familiar with and knowledgeable about biosecurity and related biological concepts than the students in the control group.
- The students' interest in science improved significantly more than the students in the control group.
- The students' scientific content scores for their writing samples improved significantly, which demonstrates an improvement in their derived sense of scientific literacy.

Interviews with the students supported these findings, with the students expressing enjoyment about learning new things, researching information, and writing their stories. In the words of one student: "It was kind of interesting writing about something I really didn't know about because I learned about the subject."

The researchers found the results to be promising and encourage middle school teachers to use these writing techniques. But further research, particularly with larger sample sizes, could confirm the results. And more research could help clarify which is more important: the topic or the writing approach itself.

THE BOTTOM LINE: Research and practice have suggested that middle school students can be difficult to engage through traditional science curriculum. This study tested a novel approach in which students used writing prompts to create original short stories that incorporated scientific information on a relevant socio-scientific topic. The researchers concluded that this approach can help students learn scientific concepts, become more interested in science, and improve their derived sense of scientific literacy. The researchers encourage middle school science teachers to adopt the approach where appropriate.

Ritchie, S. M., Tomas, L., & Tones, M. (2011). Writing stories to enhance scientific literacy. *International Journal of Science Education, 33*(5), 685–707.

OUTDOOR EDUCATION A NATURAL FIT FOR INCORPORATING DEWEY'S IDEAS

John Dewey's ideas about education have resonated with many environmental and outdoor educators. But while it may be easy to appreciate his ideas in theory, incorporating Dewey's ideas in practice can be challenging. To that end, the authors of this paper set out to provide outdoor educators and youth development leaders with a simple, usable theoretical structure for use in designing programs.

Educational philosopher John Dewey believed in an approach to education that is more like the type of education a student might have received in pre-industrial times. In those days, students' learning was situated within the context of home and community life. Learning

was directly tied to everyday life and, as such, was useful in a way that was easy for students to see. Dewey argued that after the Industrial Revolution, schools had become too separated from society and should instead adopt approaches that would allow a return to more social, useful education.

The authors summarize Dewey's ideas in the following framework for educators to use in thinking about activities and programs:

1. Activities must have the liveliness and purpose associated with informal learning.
2. The learning environment must be knowingly and intentionally shaped.
3. The activity must be undertaken with pedagogical purposes.
4. The activity must be "educative," meaning it must have (a) purpose, in the dual sense of engagement and meaning; (b) intelligent direction with student selection of means to meet ends; (c) discipline, intellectual and social, that is derived from the activity itself; and (d) an open-ended nature, leaving the student willing and able to go on.

The authors note that these tenets fit naturally into many outdoor education programs, as well as the positive youth development (PYD) movement. The authors explain that the PYD approach moves away from more traditional youth development programs that focus on risk factors and problems in young people's lives, and instead focuses on "youth strength and potential." PYD programs are social and purposeful and aim to engage students in order to prepare them for the future.

The authors' backgrounds are in sailing instruction and sail training, so they draw connections between their framework and sailing education. But they note that most forms of outdoor education and PYD offer similar fits. They note that outdoor instruction provides "clear and tangible purpose by giving real meaning and consequences to lessons." Learning environments are often thoughtfully designed so that students can not only learn the skills,

but also stay safe. Outdoor education is, by its definition, pedagogical—it is education for a purpose. And, they argue, outdoor education meets Dewey's standards, because it is purposeful and intelligent, involves intellectual and social discipline, and is open-ended.

The authors suggest that outdoor education is a natural fit for incorporating Dewey's ideas. And keeping their framework in mind can help simplify planning to help programs live up to Dewey's ideal. Programs should strive to minimize instruction and balance those lessons with action and, ideally, incorporate personal and social responsibility, when possible. The authors believe that "any program, in or out of a classroom, has the potential to live up to Dewey's ideas." But they acknowledge that it takes effort: "For Dewey, all education is experiential, but not all experiences are created equal."

THE BOTTOM LINE: Outdoor education and positive youth development are natural fits for implementing Dewey's ideas about education. But educators and program managers must be proactive. The authors offer a four-point framework that can help incorporate Dewey's ideas into outdoor programs: (1) activities must be lively and purposeful; (2) the learning environment must be intentionally created; (3) activities must be purposely educational; and (4) experiences must be educative, which means they must be purposeful, intelligent, disciplined, and open-ended.

Wojcikiewicz, S. K., & Mural, Z. B. (2010). A Deweyian framework for youth development in experiential education: Perspectives from sail training and sailing instruction. *Journal of Experiential Education, 33*(2), 105–119.

OUTDOOR PROGRAM HELPS GIRLS BUILD COURAGE

Many outdoor programs—and particularly those aimed at girls—have specifically identified building courage as a goal. Passages Northwest, based in Seattle, Washington, aims to inspire three types of courage in girls: physical, expressive, and inquisitive. The researchers in this study evaluated whether girls in Passages Northwest programs became more courageous.

According to the authors' literature review, "It is difficult to indentify a consistent, clear, and concise definition of courage." For some researchers, operationalizing courage involves overcoming a fear, while others suggest that fear need not be present. Others distinguish between physical and moral courage. Still others focus on personal, or everyday, courage, which involves overcoming personal limitations in everyday situations.

Research suggests that as girls become adolescents, they experience a decline in confidence and courage. To address this lapse in courage, Passages Northwest has created adventure-based programs designed to foster courage in girls. The organization focuses on three forms of courage: physical courage (often expressed through participating in challenging adventure activities such as rock climbing), expressive courage (enabling girls to express themselves clearly and creatively), and inquisitive courage (expressed by girls who explore, are curious, and ask questions).

The researchers conducted pre- and post-program surveys, which included open-ended questions in the post-program survey. The questions measured the girls' change in confidence as a measure of their courage. The open-ended questions asked the girls to define courage, asked them to give examples of how they showed courage in their program, and asked them how they might use their courage in the future. Respondents included 100 girls between the ages of 10 and 17 who completed one of several Passages Northwest programs.

The researchers found that the programs did inspire physical and expressive courage. (The results for inquisitive courage were inconclusive because the researchers decided there were not enough questions to effectively measure this aspect.) The open-ended questions revealed that the girls tended to think about courage in terms of "overcoming fear, being brave, and having moral courage." The vast majority (91%) of girls said that they had showed courage during their program, and 87% could describe at least one way that they would use the courage they developed when they returned home. The girls envisioned that their new courage would result in greater acceptance of themselves and greater self-confidence, perseverance, new and better interpersonal relationships, and using their voice to speak up and stand up for themselves and others.

The researchers acknowledge that this study measured only short-term changes in confidence. Follow-up research could establish whether these changes persisted, and could confirm if the girls did in fact use courage in the ways they envisioned when they returned home. Nevertheless, the researchers conclude that this program is effective in inspiring courage among participants, which they suggest is particularly important for girls of this age: "By delivering programs that intentionally target courage, adventure educators actively assist girls' development through adolescence by encouraging strength, resiliency, and a sense of competence."

THE BOTTOM LINE: Many girls experience a decline in confidence and courage as they enter adolescence. This study suggests that outdoor programs that are specifically designed to help foster courage in girls can be effective at boosting levels of courage, with beneficial impacts at least in the short term. The researchers call for additional studies to explore persistence of these effects and determine which program components contribute the most to developing courage.

Whittington, A., & Mack, E. N. (2010). Inspiring courage in girls: An evaluation of practices and outcomes. *Journal of Experiential Education, 33*(2), 166–180.

ARE PARTICIPANTS LOSING INTEREST? TRY MINDFULNESS

Even the most interesting outdoor education site or environmental education program can lose its appeal after multiple visits. Sometimes, educators must make a conscious effort to keep their audiences engaged or mindful. Mindfulness happens when people are actively processing information from their surrounding context, whether it's a classroom, nature center, park, or hiking trail. According to this paper's author, mindfulness feels like "lively awareness and involvement in the present moment." By contrast, mindlessness is a disengagement that feels "like being on autopilot."

This author suggests that keeping audiences mindful is likely to pay off: mindful audiences learn more, are more satisfied, and are more likely to engage in responsible environmental behaviors.

To facilitate incorporating mindfulness into outdoor education settings, the author provides the Mindfulness Model for Outdoor Education Settings. The model includes four phases. Phase One—Organization of Programming—serves as the foundation, and establishes the overriding principle that all communications between staff and participants should fall within a clear, themed structure that matches what participants already know.

Phase Two—Communication Factors to Be Used by Administrators/Staff—is the heart of the model. It lays out the following tactics that have been found to encourage mindfulness:

- *Introduce physical/social variety/change.* Varying the program's social nature, level of physical and mental activity, and media used can help keep people engaged.
- *Use multisensory techniques to convey information.* Help participants use as many senses as possible during programs.
- *Employ novelty, conflict, or surprise to get participants' attention.* Use extreme stimuli, unexpected outcomes, and other living things (such as animals) to capture attention.

- *Use questions to probe participants; encourage involvement.* Ask questions, use conditional language (for example, by indicating that "there is no one way to build a fire"), and offer choices to encourage creativity.
- *Facilitate participant control.* When possible, allow the participants to control aspects of the program, as research shows that people become more mindful when they feel they have control.
- *Make personal connections to participants to make the program relevant.* Use engaging stories and examples from participants' everyday lives to make the program relevant to the audience.
- *Have a good orientation plan and system for participants.* Helpful maps and signage can limit distractions from participants struggling to avoid getting lost.

Phase Three—separated into two sub-phases that deal with Participants' Interest and Mental State—acknowledges that some participants may be predisposed to mindfulness, but the tactics listed above in Phase Two can help those who are less mindful move toward greater mindfulness.

And Phase Four—Consequences—lists the consequences of mindful learning, which include increased learning, self-esteem, satisfaction, and responsible environmental behavior.

THE BOTTOM LINE: Audiences' attention can wander and their interest can wane for many reasons. Actively working to build mindfulness can be an effective tool for capturing the interest of audiences, resulting in more effective program outcomes. The Mindfulness Model for Outdoor Education Settings provides a framework for incorporating the concept of mindfulness in outdoor education.

Frauman, E. (2010). Incorporating the concept of mindfulness in informal outdoor education settings. *Journal of Experiential Education, 33*(3), 225–238.

IMPROVISATIONAL THEATER GAMES A SUCCESS AT BANFF NATIONAL PARK

Interpreters at Banff National Park have begun using improvisational theater games in an effort to boost the number and quality of interpretive programs for youth in the park. The games are designed to encourage groups of children to work together to solve problems creatively, interactively, and spontaneously. The researchers evaluated kids' enjoyment and perceived learning after participating in interpretive programs that featured the improvisational theater activities.

About 130 children, ranging in age from 4 to 14, completed a short open-ended evaluation form after participating in an interpretive program. The form included questions about which activities they enjoyed most and least, questions about which activities helped them learn the most and least, and several other questions. The two-hour interpretive program was offered at one of Banff National Park's campgrounds during the summer. Most of the program consisted of improvisational theater games, but it also included group activities, a nature walk, and an interpretive talk. The content of the interpretive program varied daily depending on the weather and the number of participants. As a result, all of the survey respondents did not experience the same mix of activities.

The results indicate that kids were most likely to name improvisational theater games as their favorite part of the program. The researchers explain that kids listed "having fun, running around, being silly, being creative, undertaking challenges, entertaining each other, and taking part in something new" as their most frequent reasons for enjoying the improvisational games. However, the kids rated the traditional nature walk and interpretive talk higher for perceived learning. (The researchers did not measure learning, but only asked about the participants' perceptions of how much they learned.)

The children were able to name specific concepts they had learned about Banff National Park. Natural history was the most commonly mentioned topic, which is consistent with the goals of the interpretive program. Based on these results, the authors conclude that "incorporating improvisation games into interpretive programs can contribute to enjoyment and perceived learning of children. Sensory awareness, physical involvement, collaboration, creativity, and guided interaction helped increase enjoyment and perceived learning."

The authors note that further study could help address some of this study's limitations, including the small sample size, the reliance on parents to transcribe young children's ideas, and program variability. Further research could also help clarify effects on children of different ages, compare effects of different types of dramatic activities, and explore the long-term effects of the program.

THE BOTTOM LINE: Although many interpretive programs are better suited to adults, improvisational theater games offer an interpretive approach that is developmentally appropriate for kids. This study suggests that kids find these types of games engaging, and the games appear to contribute to learning. More research is necessary to confirm these results and better understand the specifics of how improvisational theater games can be used effectively to build knowledge.

Macklin, K. E., Hvenegaard, G. T., & Johnson, P. E. (2010). Improvisational theater games for children in park interpretation. *Journal of Interpretation Research, 15*(1), 7–13.

AUDIO RECORDINGS REVEAL STUDENT CONVERSATIONS IN MUSEUMS AND CLASSROOMS

The researchers who conducted this study believe that learning is a social activity and, therefore, what people talk about influences what they learn. For example, they point to past research that examined the behavior of families visiting informal learning sites such as zoos and aquariums. That research found that families that talked more about the exhibit—asking and answering

questions and commenting on the exhibit—were most likely to learn. This study's researchers focused on student discussions, both during a class visit to a museum and back in the classroom. The researchers wondered if the students' discussions were "consistent with the kind of talk that could support learning."

The researchers analyzed five classes of students in late primary or early secondary grades. The students were visiting either the Science Museum in London or the New York Hall of Science. The researchers selected classes to represent a range of ages and visits to different museum galleries. (The students visited galleries with different types of exhibits with varying levels of interactivity.) All of the students' museum visits involved pre- and post-visit educational materials developed according to current best practices in museum education. The students selected topics or questions to explore during their visit, took notes and photographs during their visit, and then completed a project back in the classroom. For most students, the classroom project involved the production of a poster or PowerPoint presentation.

The teachers selected one pair of students from each class and recorded their conversations during their museum visit and during the follow-up classroom activity. The researchers instructed teachers to select students who they considered to be "average" (socially as well as academically). The researchers analyzed the overall character of the discussions, the cognitive level of the discussions, and engagement with the topic of conversation. The researchers only coded on-task conversations—in other words, those that were specifically related to the museum visit. Most of the students' talk was on task, with an average of about 83% of the talk being related to the visit or the classroom assignment.

Previous research has named four main categories of student talk while engaged in a task:
- Disputational—students disagree.
- Parallel—students speak in turn but do not pay attention to what the other is saying.
- Cumulative—students cooperate, but do not

collaboratively build knowledge.
- Exploratory—students cooperate, think critically, and respond to another student's ideas. Exploratory talk is the most closely associated with learning.

The students in this study were most likely to engage in cumulative talk, with disputational talk being the next most frequent. Exploratory talk was rare, but it occurred more often in the informal museum setting than during the classroom activity. The researchers note that exploratory talk is rarely recorded in student conversations, unless students have received specific training in how to do it. They conclude that "given [exploratory talk's] scarcity in most classrooms, it is promising that it occurred at all." And they suggest that because exploratory talk was more frequent in the museum, it "leaves open the possibility that the museum setting—or perhaps even the particular activity in which they were engaged—may support such talk."

The researchers found that most of the students' content-related talk was superficial, but "talk suggesting deeper engagement with the content appeared more often in the museum setting than in the classroom." The students were also more likely to be emotionally engaged in the museum than in the classroom—though both were infrequent.

The researchers conclude that the student conversations demonstrate that informal learning sites can encourage cognitive and affective engagement with the material. They suggest that educational materials to support museum visits should be moderately structured, offering students some focus during their visit and opportunities to connect the experience back to the classroom, while still allowing open exploration. They note that this research involved only a small number of students and no control group, so further research is needed to suggest what educational materials would encourage more exploratory talk among the students.

THE BOTTOM LINE: Students visiting a museum and then doing a follow-up activity in the classroom were very unlikely to engage in the exploratory talk, which is the most supportive of learning. But exploratory talk—in which students are actively engaged both cognitively

and emotionally, and are critically listening to each other and building on each other's ideas—was more likely in the museum setting than in the classroom. The researchers suggest that educational materials that support visits to informal learning sites should balance the need for student focus with the benefits of free-choice learning and exploration. They also suggest that more research would help clarify the results of this limited study.

DeWitt, J., & Hohenstein, J. (2010). Supporting student learning: A comparison of student discussion in museums and classrooms. *Visitor Studies, 13*(1), 41–66.

CHAPERONES PLAY A VARIETY OF ROLES ON FIELD TRIPS

The Children's Museum of Indianapolis works to facilitate learning that occurs as adults (principally parents) and children interact in the exhibits. Although the focus is on families, the staff wondered to what extent students visiting in small groups with a chaperone act like a family. In other words, do field trip chaperones act like parents?

Past research has indicated that students learn more on field trips when they are accompanied by a knowledgeable adult who shares information, reads aloud, and asks questions. But this potential to serve as an educator is balanced against another role for chaperones, namely the logistical escort who monitors behavior, counts heads, and keeps students on schedule. The researcher in this study sees a third option—playing the role of parent—situated in the center of a continuum of chaperone roles: "The chaperone maintaining the parent role falls somewhere in between escort and educator and will likely engage in a variety of behaviors, across the continuum. They will be interested in playing and interacting with children, they will monitor behavior, they will count students."

This study aimed to better understand how chaperones behave during school visits to the museum and to what extent the types of exhibits support interactions between chaperones and students that are more "family-like."

First, the research team mapped the exhibits to identify potential areas for adult-child interactions. They used a family learning framework developed by the Institute for Learning Innovation (ILI) to assess the museum exhibits. The researchers focused on three exhibits: World Cultures, a traditional exhibit with large numbers of artifacts and labels and relatively few interactive components; Science, an activity-oriented exhibit with minimal text; and Dinosaurs, an immersive exhibit created with family learning in mind. When evaluated with the ILI framework for family learning, the Dinosaurs exhibit scored highest, suggesting that this exhibit should elicit more family-learning behaviors among both families and school groups with chaperones.

The research team also observed chaperones as they accompanied students in the exhibits. They noted when chaperones interacted with the text (for example, reading or summarizing labels for students); interacted with an exhibit component (for example, helping students use an exhibit component or discussing an exhibit component with students); performed logistical tasks (such as addressing behavior, managing time, or taking what the researcher refers to as a "guard stance," which they defined as standing watchfully, typically with arms folded, often positioned near an exit); or exhibited non-interactive behaviors (such as walking by components without stopping or talking on a cell phone). The researchers also observed parent behaviors in the same exhibits. In total, they observed 179 chaperones and 91 families and recorded nearly 500 individual behaviors of chaperones while in the exhibit spaces.

The "guard stance" was the most common behavior observed in chaperones (36% of all behaviors observed). The next most common behavior (31%) was walking past exhibit elements. About a quarter of the behaviors observed were the positive behaviors of encouraging student participation (25%), participating with students (26%), and discussing with students (29%). Addressing time management and behavior issues were among the least-frequently observed behaviors (4% and 2% respectively). Statistical analysis of the behaviors and the exhibit spaces

suggests that the chaperones did not alter their behavior in the different exhibit types. The Dinosaur exhibit, which scored highest for family learning potential, did not elicit more interactive behaviors among the chaperones.

The comparisons of family and chaperone behaviors were mixed. In many cases, there were not significant differences between the behaviors of parents and chaperones, suggesting that chaperones did function much like a parent in some situations. And in the case of the Science exhibit, the chaperones were more likely than parents to take on educational roles related to collaboration and problem solving. But, the researcher notes that "overall, the ideal interactions along a family learning framework were limited for both parents and chaperones." The researcher concludes, "Based on the observations, the chaperones did appear to carry out all three roles of escort (logistics), educator (directing experiences), and parent (enhancing and participating)."

This study did have major limitations. First, the study did not include an analysis of the motivations or interests of the chaperones, and second, the researchers did not collect data on the kinds of instructions the chaperones received from the students' teachers or the museum staff. Further research in those areas could help educators in informal settings better leverage chaperones as educators, as this research indicates that "parents as chaperones do have the potential to provide meaningful interaction with students."

THE BOTTOM LINE: Chaperones can play a variety of roles during school visits to informal learning centers, including roles as an escort, educator, and parent. This research suggests that chaperones can engage in positive educational behaviors with students, but, in this case, the frequency of those behaviors was low. Instead, they were more likely to serve as a guardian and escort. Future research can help uncover how a chaperone's personal motivations and their preparation by staff and teachers might affect the kinds of roles they take on with students.

Wood, E. (2010). Defining the chaperone's role as escort, educator, or parent. *Visitor Studies, 13*(2), 160–174.

RESEARCHERS PROBE STUDENTS' REASONING ON SOCIO-SCIENTIFIC ISSUES

Social issues that are associated with science—issues such as global warming, energy use, and genetic engineering—are called socio-scientific issues (SSIs) and are a growing component of science education. Investigating these issues offers students the opportunity to apply their scientific knowledge in real-life situations. (For more on how SSIs are used in teaching, see the summary titled "Writing Stories Builds Scientific Literacy" in this section of the Research Bulletin.)

The researchers in this study investigated Taiwanese students' reasoning regarding the socio-scientific issue of nuclear power. The researchers describe psychological theories that explain human thinking when confronted with an ill-structured problem (such as an issue in which there may not be one correct solution). According to the researchers, people tend to tackle the problem in two phases that involve different ways of thinking. In the initial phase, a person makes an intuitive decision based on his or her past experiences, including knowledge and beliefs. That may be followed by a second deliberation stage in which the person employs logical and abstract thinking in a conscious way to arrive at a final decision. In other words, the authors explain, "People decide first and think afterward in order to justify choices that are unconsciously determined." This way of thinking is sometimes referred to as a "belief bias."

The authors used a series of questionnaires and interviews to examine high school students' reasoning on the SSI of nuclear power. Sixty-eight average-performing Taiwanese tenth graders (15- and 16-year-olds) in two high school classes participated in the study. The researchers used a questionnaire with closed-ended items to assess the students' beliefs about science and used a questionnaire

with open-ended items as well as an interview to assess their cognitive structures and reasoning.

The results of the research confirm the belief-bias phenomenon. Once students had declared a personal decision about the role of nuclear power, they were less able to articulate arguments that ran counter to their own decision. The researchers explain that "students will make their personal decisions toward an SSI first, and, after making their personal positions, their 'belief bias' will cause them to ignore some counterarguments they have known."

The researchers also found that although some students had extensive cognitive structures related to the nuclear power issue (meaning that they were particularly knowledgeable about the issue), they did not necessarily apply that knowledge; instead, they still made intuitive decisions. The authors suggest that these findings point to the need for science educators to help students both apply their knowledge and use more conscious, reasoned, and logical thinking in arriving at conclusions. In particular, the information processing mode of *comparing* (being able to state the relationships between two options) tended to be associated with better reasoning quality. This suggests that students should specifically be asked to compare contrasting positions as they apply their knowledge to an SSI.

THE BOTTOM LINE: Students' thinking about socio-scientific issues such as the use of nuclear power is complex and involves not just students' scientific knowledge, but also their beliefs. Students have a tendency to form an opinion through an unconscious process and then may later justify the opinion through a more conscious process. Science educators should help students use more conscious reasoning to evaluate issues. Specifically, students should be encouraged to compare contrasting arguments by applying prior social and scientific knowledge.

Wu, Y.-T., & Tsai, C.-C. (2011). High school students' informal reasoning regarding a socio-scientific issue, with relation to scientific epistemological beliefs and cognitive structures. *International Journal of Science Education, 33*(3), 371–400.

RESEARCHERS OFFER TOOLS FOR USING IMAGINATION TO BUILD A SENSE OF PLACE

Many environmental education researchers have argued that people's connection to the places they live (or places they care about), often termed a "sense of place," is an important aspect of human identity, psychological health, and sustainability. The authors of this paper argue that teachers should help students build a sense of place (a process the authors call "place-making"), and that some important place-making tools have been ignored in the modern educational system.

"The model we propose here," the authors explain, "is intended to assist teachers in bringing imagination to the fore of their teaching." The authors argue that place-making and imagination share three key features: emotional engagement, active cognition, and a sense of possibility. According to the authors, "Imagination is fuelled not only by emotional engagement and intellectual effort, but also by the fullness of our physical being-in-environment." They believe that imaginative education and place-making can go hand in hand, if teachers are committed. The authors argue that "much in contemporary culture tends to stunt and deaden" children's imaginations.

The authors pull from Egan's theory of imaginative education and Fettes's tools of imaginative engagement to build an approach to place-making. Egan describes what he calls "cognitive toolkits," or styles of thinking. Mythic understanding refers to oral language and involves stories, rhyme, jokes, play, and mystery. This toolkit is most often used by children up to the age of about eight. Romantic understanding, used up to the age of about 15, refers to the tools of literacy and involves aspects such as building a sense of reality and the limits of reality, narrative understanding, a sense of wonder, and the capacity for idealism. Finally, philosophic understanding, employed in the last years of high school, refers to the tools of theoretical thinking and includes building a sense of abstract reality and a search for truth.

The authors explain that these tools are at work when children and adults use their imaginations in place-making. Children use their mythic imagination when they select one treasured object such as a bear or blanket or feel comfort in their family's structured rituals. These objects and rituals have the "capacity for representing home-ness to the child." Likewise, when older children build forts or decorate their rooms or lockers, they are using their "romantic predilection for creating special places." And, lastly, the authors argue that people use their philosophic imagination when they create maps and plans.

The authors give two examples of how these strategies— "enacting place through symbol and ritual, creating special personal places, and the making of maps and plans"—can be applied in traditional school settings to teach concepts from British Columbia's science and social studies curriculum.

Their first example relates to how a teacher might approach a set of grade 4 science concepts related to the habitats of local plants and animals, food chains, the Aboriginal concept of respect for the environment, and how personal choices affect the environment. In this example, the authors suggest that the teacher might begin by asking students to brainstorm about all the plants and animals that live nearby. The teacher can set up a basic tension that contrasts a human-centered view of the local area with the perspective of those plants and animals. The students could model or diagram the special places of each of the plants and animals that live nearby. The students could then imagine an urban planning conference of all the plants and animals: what would they need to thrive? And what would happen if humans requested permission to immigrate? The students might develop guidelines for how humans could enter the ecosystem and live in harmony with the other residents, introducing the topic of the Aboriginal point of view.

In another example, the authors demonstrate how even grade 10 social studies concepts can be approached with an imaginative place-making twist. The concepts covered include understanding identity, society, and culture in Canada from 1815–1914. The authors suggest that rather than relying on sweeping concepts and trends across the nation during the time period, the teacher could instead focus on the characters and changes in just one community during that time period. The students could imagine life in the community, and only after establishing a connection to one place would they consider how that place relates to the national picture, comparing and contrasting different communities and investigating the complex connections between the interlinked communities that formed the nation during that time period.

The authors see great value in helping students build a sense of place *and* build their imagination. And, they argue, approaches that engage the imagination will be more likely to help students build a sense of place.

THE BOTTOM LINE: Sense of place is a key element of environmental literacy. The authors believe that educational approaches that use students' imagination are more effective at helping them build a sense of place. They argue that place-based imaginative education is more effective than many forms of traditional environmental education and offer specific examples of how teachers can implement it.

Fettes, M., & Judson, G. (2010). Imagination and the cognitive tools of place-making. *The Journal of Environmental Education, 42*(2), 123–135.

TEACHER TRAINING
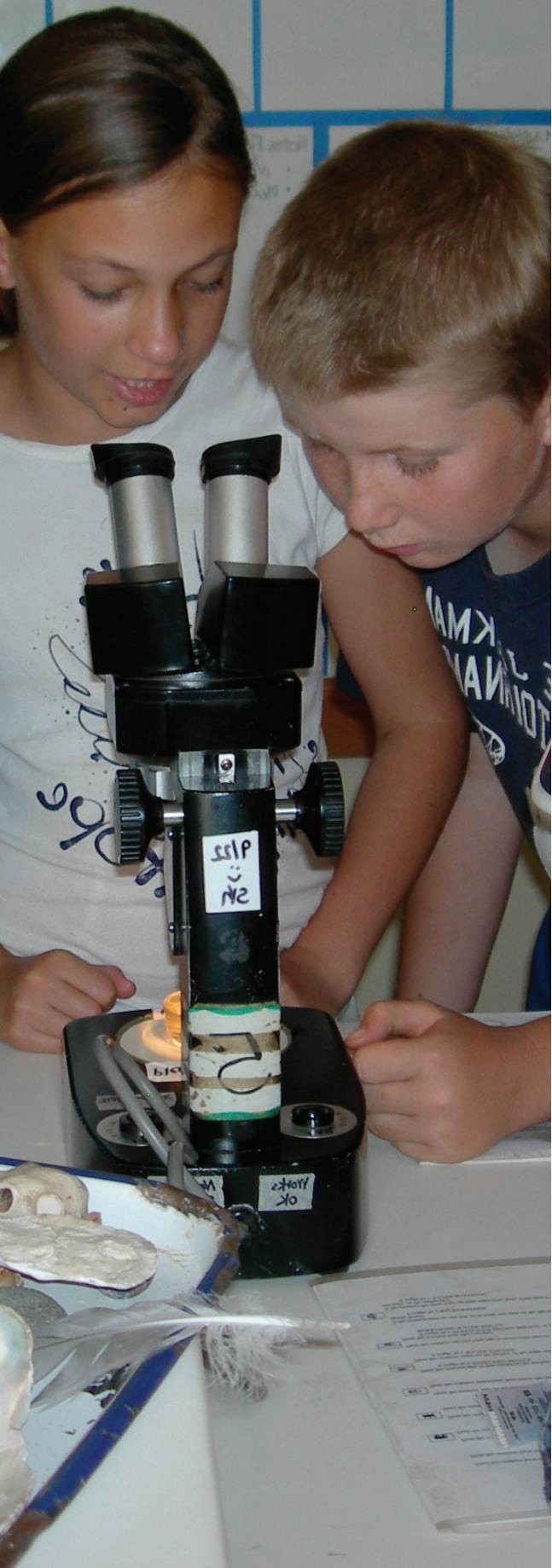
RIVER GUIDES WITH INTERPRETATION TRAINING PASS KNOWLEDGE ON TO CLIENTS

Typically, river guides receive extensive training on how to navigate guests safely down the river, with an emphasis on skills such as paddling technique, reading the river, and water safety. Interpretation training is secondary, if provided at all. But the organization Headwaters Institute has recognized that river trips represent a significant opportunity for interpretation about natural history and ecological issues of rivers. In an effort to provide more robust training to river guides, the Headwaters Institute holds seminars to educate river guides about natural history and ecosystem processes, as well as interpretive techniques. The seminars are designed to help guides better educate clients during river trips. This study aimed to assess the impact of those trainings.

The researchers surveyed 97 river guests on western North Carolina's French Broad River. Of the guests surveyed, 39 went down the river with a guide who attended the training; 58 went with guides who had not attended the seminar. The guests completed a survey that measured interest and knowledge before and after their trip. All of the river guests demonstrated an increase in knowledge and interest after their trip. But while there was no significant difference in the pre-test results for the two groups, the guests who went down the river with a Headwaters Institute-trained guide scored significantly higher on both knowledge and interest than those who did not. So while the experience of going down the river with a guide seemed to help improve guests' knowledge of and interest in the river environment, going with a guide trained in interpretation appeared to enhance the effect.

The researchers acknowledge that the study involved only a small number of participants and just one rafting company. In addition, the researchers note that the guides who attended the Headwaters Institute seminar may have self-selected for participation and may have already been more knowledgeable and enthusiastic about interpretation than guides who did not attend the training.

Nevertheless, the authors conclude that interpretive training for guides in a non-traditional setting such as a river trip can enhance affective and cognitive outcomes: "The results of this study suggest that other ecotourism and outdoor recreation providers should consider including specific area natural history, environmental information, and interpretive skills in their staff trainings, thus encouraging the embedding of interpretive messages within the recreational activity that they provide."

THE BOTTOM LINE: River guides who receive training in interpretation appear to more effectively educate and excite their clients about the river environment than guides who don't receive the training. Although more rigorous research is needed to better understand the specifics of how the training generates these effects, the study results suggest that interpretive training for outdoor leaders can lead to better outcomes for clients in terms of knowledge of and interest in the environment.

Harrison, M., Banks, S., & James, J. (2010). An evaluation of the impact of river guide interpretation training on the client's knowledge and interest regarding the environment. *Journal of Interpretation Research, 15*(1), 39–43.

ELEMENTARY TEACHERS BELIEVE IN INQUIRY APPROACH, BUT NEED SUPPORT FOR IMPLEMENTATION

Science education reform has focused heavily on infusing more inquiry-based practices into science teaching. At the same time, environmental education promotes an inquiry-based approach, both in learning about environmental issues and in decision making about issues. Because of this natural alignment in approaches, and because the elementary school setting lends itself to interdisciplinary teaching that can allow for the infusion of environmental topics, the authors of this study focused on how elementary teachers think about and use inquiry-based practices to learn about the environment.

The authors surveyed 121 teachers in 31 schools from communities surrounding their university. They found that the teachers felt strongly that they *should* use scientific inquiry to help students learn about the environment, but they felt less capable of actually doing it. The teachers were even less likely to report having used scientific inquiry to teach about environmental issues. More experienced teachers were more likely to report that they felt capable of using inquiry to teach about the environment and were more likely to have done so. Teachers who had completed a methods course in environmental education were more supportive of using inquiry to teach about the environment than teachers who hadn't taken a methods course. And teachers who had been exposed to four or more environmentally related professional development experiences were more likely to report feeling competent to use scientific inquiry to teach about the environment. But teachers who had taken an environmental studies course as part of their preservice education were no more likely to support or use an inquiry-based approach to teaching about the environment than those who had not taken an environmental studies course.

Although the teachers believed in using inquiry-based approaches in their teaching about the environment, they rarely did. The teachers surveyed in this study spent, on average, 15.1 hours per year teaching about the environment, which amounts to about 1.3% of their instructional time for the year. This study's results suggest that preservice and professional development opportunities can help teachers feel more supportive of and confident about using inquiry to teach about the environment. The next step in research, the authors suggest, is understanding "what specific characteristics of teacher education and professional development experiences can foster teachers' beliefs, competencies, and ultimately their practices to support students' learning about and for the environment through inquiry."

THE BOTTOM LINE: This study suggests that, although elementary teachers do support using an inquiry-based approach to teaching about the environment, they rarely follow through. But preservice and inservice

training does appear to help, especially in increasing educators' confidence in using inquiry to teach about the environment.

Forbes, C. T., & Zint, M. (2011). Elementary teachers' beliefs about, perceived competencies for, and reported use of scientific inquiry to promote student learning about and for the environment. *The Journal of Environmental Education*, 42(1), 30–42.

EVALUATION AND ASSESMENT

A REFINED INSTRUMENT FOR MEASURING ENVIRONMENTAL ATTITUDES IN CHILDREN

Building on previous work, the authors of this paper refined a survey tool to measure environmental attitudes among American children.

The survey tool the researchers used—called the 2-MEV scale—was first developed in Europe. The 2-MEV scale asks questions related to two main themes: Preservation of Nature and Utilization of Nature. In contrast with some other scales—such as the New Ecological Paradigm (NEP), which places people's responses along a continuum—respondents to the 2-MEV can be placed in quadrants that reflect the relative importance of each of the two themes.

The authors adapted the scale for use with 9- to 12-year-old American students. The research involved nearly 7,000 children over a four-year period. All of the students participated in one of two residential environmental education programs (Earthkeepers and Sunship Earth), and students attending the participating schools ranged from low to middle socioeconomic status.

The researchers conclude that "the revised scale is capable of detecting changes in children's environmental attitudes after they have attended educational programs." But they caution that "more research is needed to further test the use of the model with students from different socioeconomic backgrounds and a variety of environmental programs."

THE BOTTOM LINE: The 2-MEV scale for measuring environmental attitudes in children has been adapted for use with American children ages 9-12, but further research should be conducted to ensure validity beyond the two residential environmental education programs in which it was tested. An instrument, such as this one, that is valid for addressing environmental attitudes might be helpful to incorporate into evaluation or other research studies at environmental education organizations, institutions, or centers.

Johnson, B., & Manoli, C. C. (2011). The 2-MEV scale in the United States: A measure of children's environmental attitudes based on the Theory of Ecological Attitude. *The Journal of Environmental Education, 42*(2), 84–97.

NEW TOOLS AVAILABLE FOR MEASURING INTERPRETATION'S IMPACT

Although the literature is full of published results of evaluations of interpretive programs, the authors of this paper find most of the studies of limited use in informing other programs, because most evaluations tend to be time- and site-specific and use customized methods that are not appropriate for application in other settings. So the authors set out to create an evaluation package that's easy to use, inexpensive, reliable, flexible, ethical, and scientifically sound (among other considerations). The evaluation tools were developed for face-to-face interpretive programs at heritage sites.

To start, the authors defined indicators of visitor outcomes in the domains of cognition (for example, what visitors learn in interpretive programs), affect (such as how visitor attitudes are affected by interpretive programs), and behavior (for example, how interpretive programs affect what visitors do). The researchers gathered representatives from two Australian institutions that offer interpretive programs—Port Arthur and Sovereign Hill. The staff members were from all institutional levels, including front-line interpreters, program managers, and executive-level administrators. The groups brainstormed about indicators of "successful" or "effective" interpretation. An industry advisory group then revised and consolidated that list to yield eleven classes of outcomes, or indicators. Examples of the indicators include the extent to which the interpretive program contributed to a positive attitude toward heritage preservation, a desire to participate in more interpretive activities, an intention to purchase a souvenir related to the experience, a desire to stay longer at the site, and an intention to recommend the program or site to others.

Next, the researchers assessed the relative merits of a variety of data collection methods. They rated each method according to its cost, time required to implement, speed of feedback, burden on visitors and staff, validity, and reliability. Their analysis suggested that the questionnaire format best met their criteria "because it can produce high levels of validity and reliability at comparatively low cost and with a relatively small burden on visitors and staff." They also note that a questionnaire can gather cognitive, affective, and behavioral data in one instrument.

The researchers then developed and tested a particular questionnaire at multiple sites. The researchers administered the instrument post-visit; it typically required about three to five minutes for visitors to complete. The researchers used confirmatory factor analysis to validate the indicators. The final instrument includes 30 questions that measure 10 indicators (the eleventh indicator—visitor interaction with the interpreter—is measured through observation). The researchers have packaged the questionnaire and observation instrument into a toolkit that includes a manual explaining the development of the instrument, sampling methods, data collection and interpretation, and a customized database for analyzing and reporting results. The instrument has been used in a range of settings including national parks, zoos, botanical gardens, wineries, and ecotourism sites.

But the researchers note that, while this is an easy-to-use instrument that they advocate, it does have limitations. The instrument is based on the self-reporting of visitors of their impression of the program's impact. The researchers also note that the instrument does not measure "the longer-term, post-visit impacts of interpretation on visitors such as what they know, feel, and do after they return home." And although the instrument is intended to measure the impact of face-to-face interpretation, many visitors may actually respond to the questions based on their entire experience at a site, including more than just the interpretive programs. Finally, the researchers note that the questionnaire only reveals *what* the impacts of a program are, not *why* the program is or is not achieving the outcomes. More research is needed to determine cause-and-effect relationships.

THE BOTTOM LINE: An easy-to-use, low-cost, reliable evaluation instrument is available for assessing the impact of face-to-face interpretive programs at heritage sites. The toolkit package includes the evaluation instrument, a user manual, and a database for data analysis and reporting.

Weiler, B., & Ham, S. H. (2010). Development of a research instrument for evaluating the visitor outcomes of face-to-face interpretation. *Visitor Studies, 13*(2), 187–205.

NEW SCALES MEASURE RESPONSIBILITY, CHARACTER, AND ATTITUDES

A team of researchers working with staff at Maryland's NorthBay Adventure Center (see related summary "Residential EE Program Yields Positive Results, Especially for Urban Participants" in the Teaching Methods section) set out to measure the impact of NorthBay programs on middle school students. The center offers five-day residential outdoor education programs with an environmental education curriculum based on the Investigating and Evaluating Environmental Issues and Actions (IEEIA) model.

NorthBay's mission goes beyond affecting students' environmental responsibility, and includes a concern for fostering personal responsibility. As a result, the NorthBay staff who participated in the year-long planning process for the program evaluation identified three key outcomes: environmental responsibility, character development and leadership, and attitudes toward school.

The team created three scales with multiple question types to address each of the key outcomes. All of the questions were measured on five-point, Likert-type scales (ranging from "strongly agree" to "strongly disagree," or from "always" to "never," depending on the question). After pilot testing an initial survey, the researchers administered the survey immediately before and after the NorthBay residential program to 868 students over three weeks. Three months later, 349 students completed follow-up surveys.

The researchers then used structural equation modeling and confirmatory factor analysis to test and refine the scales. Through these analyses, they concluded that the scales are valid and reliable—in other words, that the scales measure the concepts faithfully and consistently.

The researchers encourage environmental education practitioners and researchers who work with middle school students to use the scales if their programs also aim to address the same outcomes. Although "character development and leadership" and "attitudes toward school" outcomes have traditionally been associated with after-school and positive-youth-development programs, increasing numbers of environmental education programs are becoming interested in these outcomes. The researchers note, "The convergence of these different concepts to measure the outcomes of the NorthBay program reflects not only the innovation of the program itself, but also signifies a first step toward acknowledging, quantifying, and evaluating the impact of environmental education programs on additional outcomes of common interest."

THE BOTTOM LINE: The researchers developed three scales to reliably evaluate environmental responsibility, character development and leadership, and attitudes toward school among middle school students. Programs that aim to address these outcomes with middle school students can use these scales to measure the impact of their programs.

Powell, R. B., Stern, M. J., Krohn, B. D., & Ardoin, N. (2011). Development and validation of scales to measure environmental responsibility, character development, and attitudes toward school. *Environmental Education Research, 17*(1), 91–111.

PHOTOS SHED LIGHT ON OUTDOOR EXPERIENCES

In New Zealand, outdoor education is compulsory: every year through tenth grade, all students receive some form of outdoor education. Many schools organize "school camps," in which students spend several days at a residential camp with their class participating in activities such as ropes courses, kayaking, camping, orienteering, and others. The programs are designed to be challenging and fun, giving the students new opportunities for social interaction and skill and character development. The researchers set out to better understand the ways that New Zealand teens experience these school camps.

The authors applied a tried-and-true research approach to investigate the camps. They asked students to take pictures that depicted their experience and then used the photos to guide open-ended interviews about the students' time at school camp. According to the researchers' literature review, only one previous study had used this technique in an outdoor education setting.

The researchers distributed disposable, 27-exposure cameras to 32 students (11 males and 21 females) between the ages of 14 and 15 who attended the three-day camp as a part of their school curriculum. The researchers wanted to limit the directions given to the students about what to photograph, but, recognizing that the students might find this lack of direction confusing, the researchers offered the following guidance: "Pretend you are going to post the series of photographs you take on your personal web page (e.g., Bebo, MySpace, or Facebook) so you can show your friends what your time at Year 10 camp was like for you." The researchers indicated that the photos could be of anything at all, as long as they showed what camp is like.

The researchers collected the cameras at the conclusion of the camp, and then for two weeks following the camp they used the photos to guide interviews with the students. The students and researchers both saw the photos for the first time during the interviews. The researchers recorded the interviews and then analyzed the content for patterns. Analysis revealed that the students' experience at camp was overwhelmingly social; the students rarely talked about the outdoor environment in discussing their experience. The students viewed the camp as fun, and, the researchers note, "The fun nature of what students did appears to have been primarily generated by the presence of peers." Not only did the students explain that the social interactions are what made the camp fun, their photos also reflected this finding. According to the researchers, "A large majority of the students' photographs depicted people and social situations." The students also noted that the novel setting changed the social context. The students seemed to see each other in a new light in the outdoor setting, and the setting seemed to foster more inclusivity in the group.

The researchers indicate that the students' focus on social interactions is not surprising, given the students' developmental stage and its associated focus on peers and social interaction. But, they also note that it's possible that the research methods could have had an effect on the results, too. Previous research has shown that amateur photographs tend to be social in nature and portray happy scenes of friends and family. These cultural expectations of what to include in photos could have influenced the students' decisions about what to photograph. What's more, the researchers question whether the example given in the instructions—namely, to imagine they'll post the photos on their Facebook page—might have also influenced the kinds of pictures the students took. Because social networking sites are just that—social—it's possible that this instruction caused students to emphasize the social aspects of the camp in their photos.

Nevertheless, the researchers think this approach may help researchers and practitioners understand the student experience in an outdoor setting. This research serves as a reminder of just how socially focused teens are, and outdoor recreation seems to create positive social situations that can be leveraged to improve results for programs and for students.

THE BOTTOM LINE: Few outdoor education researchers have used photo-elicitation interviews, in which participants take photographs that are used to guide interviews, to evaluate programs. This study employed a photo-based research method, and the results suggest that this technique may be a useful evaluation tool for outdoor educators. The findings from this study indicate that teens participating in the school-based outdoor education program focused more on the social aspects of the experience and less on the outdoor environment in which it took place.

Smith, E. F., Steel, G., & Gidlow, B. (2010). The temporary community: Student experiences of school-based outdoor education programmes. *Journal of Experiential Education, 33*(2), 136–150.

ZOO USES VIDEO CAMERAS TO MEASURE VISITOR ATTENTIVENESS

The Chester Zoo is the United Kingdom's busiest zoo, serving over one million visitors each year. And because of the zoo's commitment to education and the significant investment it has made in its interpretive talks, the researchers in this study—all zoo staffers—conclude that evaluations of interpretive programs are critical. To fill this need, the researchers used what their research indicates is a novel approach to program evaluation in the zoo setting: video recording of visitor behavior during interpretive talks.

Interpretive talks at animal enclosures are a central feature of the Chester Zoo's educational offerings for the public. The zoo offers 9 to 12 talks a day, with each lasting about 10 minutes. Before this study, these programs were principally evaluated by estimating visitor numbers and with exit surveys of zoo guests. The researchers opted to use video recordings to develop more objective, observational data of guests during programs.

Over six days, the researchers analyzed visitor behavior during six of the zoo's programs (three that included interactive elements with the animals, such as animal feeding, and three that did not). Researchers made recordings before, during, and after every one of the selected talks (except for one that was missed for logistical reasons) each time it was offered during the six-day study period. The researchers used two cameras: one recorded a front view and the second recorded a rear view. Control recordings were made at each of the enclosures where talks were held during times when no talks were being offered. In all, 35 talks were filmed and 36 control recordings were made.

Researchers used the front-view camera to measure visitor numbers and attentiveness. Attentiveness—defined as looking at the exhibit—was monitored both by taking instantaneous counts of people who were attentive at one-minute intervals, and by selecting one easily observed individual whose attentiveness was continuously monitored throughout the recording. The rear-view camera was used to estimate visitor densities and inattentiveness. From the rear view, the researchers found it difficult to determine whether a visitor was looking at the exhibit, but it was easy to see if they weren't. Therefore, the researchers analyzed inattentiveness (looking away) from the rear view.

The results indicate that zoo visitors begin to gather at the exhibit well before the talk begins, indicating that many visitors intentionally attend the scheduled talks and do not simply join in as they see a talk in progress. The talks appear to hold visitors' attention for about five to six minutes, and then attention drops continuously until the end of the talk. In fact, attentiveness drops even below control levels before the talk ends.

The rear-view camera data indicate that visitors in rear rows are less attentive than visitors in the front, and their inattentiveness easily exceeds the control group by the end of the program, suggesting not only that they have lost attention but also that "visitors were negatively affected by some variable when they were in the rear rows at talks." The only exception to this trend was in talks that included animal activity (such as feeding or enrichment activities): in those cases, visitor inattentiveness did not exceed the control group.

The authors conclude that "the findings indicate that presenter talks at animal enclosures increase attentiveness in visitors above control levels. From an educational perspective, this can only be viewed in a positive way. Whatever the educational output of the animal talks program actually is, it would not succeed in any measurable way without the attention of the visitor." The video method alone does not suggest why visitor attention wanes in the second half of the talk.

The authors also conclude that the video recording method has proven valuable in evaluating the zoo programs. The recordings have given the staff new insights into how the visitors plan for and attend to the programs. And the researchers also note that the method would not be useful if not for the control shots. "Without these, there would be no meaningful way of saying what a good attention level might be. The controls provide a benchmark for comparison."

In practical terms, the researchers used the results of the video evaluation to fine-tune their programs. They concluded that interactive elements such as animal feeding are essential for holding visitor attention. They revised talk schedules, made improvements to sound quality, installed dedicated presenter podiums to boost visibility, and adjusted the content of the talks to build anticipation and interest around the four-minute mark. Looking to the future, they suggest that controlled trials that explore the effect of different variables (such as program length, content, and style, among others) could yield greater insights into visitor behavior.

THE BOTTOM LINE: Video recordings can provide useful insights into visitor attentiveness during interpretive programs. The use of several camera angles and, most importantly, control recordings improves effectiveness of this method. Researchers and staff members at the Chester Zoo used this method to analyze visitor behavior and make appropriate changes to improve programs.

Moss, A., Esson, M., & Bazley, S. (2010). Applied research and zoo education: The evolution and evaluation of a public talks program using unobtrusive video recording of visitor behavior. *Visitor Studies, 13*(1), 23–40.

RESEARCHERS ARGUE FOR A GREATER FOCUS ON FIDELITY

The authors of this paper—including a professor of social work—argue that the legitimacy of the fields of adventure education and adventure therapy are lagging behind other fields because of a lack of evidence-based practice. They argue that theory, not research, guides programs and that more quantitative, sound research is needed not only to improve programs, but also to demonstrate their success, replicate results, and gain funding. (For another take on evidence-based practice in outdoor education, see the summary titled "Questions Raised About Evidence-Based Practice in Outdoor Education" in this section of the Research Bulletin.)

Program fidelity is a key component to evidence-based practice that the authors think is often overlooked in adventure education and therapy. According to the authors, "The term fidelity refers to the consistency and quality in which interventions and programs are being implemented." Fidelity means that program evaluators can clearly establish that programs are being conducted as planned. The authors ask, "How can adventure professionals know if they are doing something well if they do not know what it is that they are doing?"

There are two components to fidelity: adherence and competence. Adherence refers to the precision and consistency with which programs are delivered. Measuring adherence involves evaluating the extent to which the planned sequence of activities is followed during a program. In addition to adherence, the leader's competence is also a component of fidelity. A group of leaders with varying levels of competence, for example, might adhere to the program schedule, but because of variations in their competence, the programs could vary widely.

For researchers, measuring fidelity is necessary for increasing internal validity. When evaluators know that programs

are being delivered as planned with appropriate levels of competence, the authors argue, "the more confident one can be that the outcomes are the result of the adventure therapy and education program as described and not due to certain characteristics of staff or particular activities favored by specific staff that were not part of the protocols." This kind of evidence can be critical for establishing best practices and securing funding. And the authors cite research in other fields, including psychotherapy and education, that has revealed that program fidelity is a critical component of program success.

Enhancing fidelity in a program involves clearly defining and describing the specific aspects of a program or intervention; properly training staff not only in how to implement the specific program elements, but also in the role and importance of program fidelity; and closely supervising staff to ensure that programs are implemented as planned. The authors note that, especially in adventure education, "there consistently seems to be resistance to the notion of manualization and/or standardization, which is often due to the fear of losing flexibility to respond to unique situations as they arise." But, the researchers note that fields such as psychotherapy have found ways to balance fidelity and flexibility with "flexible manualized treatment protocols" that allow facilitators to choose among a set of protocols as they see fit. An approach such as this can allow groups to shift their approach as the weather, group dynamics, or student needs demand.

Measuring program fidelity can be as simple as using a checklist to monitor programs as they're being evaluated. To do this, evaluators create a list of the specific program components, clearly define each component, and then record whether or not each component was present as they observe the program as it is being delivered. Competence can be evaluated through observation (either direct or taped) and can be measured with the use of a rubric that defines specific tasks or skills of the leader and descriptions of different levels of competence. (The paper includes a sample rubric.) Other more indirect methods of measuring fidelity include self-reporting from leaders, interviews, and analyzing participant products, such as written work, presentations, or assessment products.

The authors conclude that "in the pursuit of documenting evidence-based best practices in order to gain credibility as a legitimate field of practice, adventure facilitators, clinicians, and evaluators need to be more intentional in their use of competence and adherence fidelity measures." They see attention to fidelity as a key component in knowing if programs are truly effective.

THE BOTTOM LINE: When evaluating programs, it is critical for researchers to know exactly what they are evaluating. Fidelity—a measure of the consistency with which programs are delivered—is not often measured in adventure education and therapy. Fidelity refers both to the degree to which leaders adhere to the program's planned sequence of activities as well as their competence in leading the program. Evaluators can measure fidelity with simple field checks to ensure that programs are delivered with consistency and quality. Establishing program fidelity can increase evaluators' confidence that the outcomes of a program are the result of the program itself, and not other factors related to the ways that individual leaders may stray from the program plan. This kind of rigor is essential in evidence-based practice.

Tucker, A. R., & Rheingold, A. (2010). Enhancing fidelity in adventure education and adventure therapy. **Journal of Experiential Education, 33**(3), 258–273.

QUESTIONS RAISED ABOUT EVIDENCE-BASED PRACTICE IN OUTDOOR EDUCATION

Funders in a growing number of fields are placing increasing emphasis on evidence-based practice (EBP) in making decisions about the kinds of programs to fund. The author of this paper, who works for Outward Bound Canada, raises questions about whether this trend is appropriate in the realm of adventure education and therapy.

Broadly, evidence-based practice refers to a way of managing, and especially funding, programs based on research results that demonstrate programs' effectiveness. Evidence-based medicine, social work, and health services

are now common. In this system, some research results carry more weight than others: Anecdotal evidence, testimonials, and personal communications rank lowest. Next are observational studies, interviews, qualitative studies, and expert opinions, among other research approaches. The next group includes quasi-experimental designs, cohort-controlled studies, and case-controlled studies. The highest ranking goes to random controlled trials (RCT) with experimental designs.

The author raises questions about whether this emphasis on experimental designs for evaluating programs is the best way to understand how effective outdoor education and therapy programs are. He believes that "EBP's value system suggests most published forms of evidence gained from non-RCT methodologies, along with practitioner knowledge and the collective history of a field, are treated as near irrelevant, effectively ignoring alternative knowledge claims." He cites others who have criticized the shift toward EBP in medicine, as it ignores physician knowledge, basic research, and the field's shared knowledge.

Another potential problem with the EBP approach is that, typically, a funder will designate a program that has demonstrated success through experimental methods as a "model" program that other programs should follow in order to receive funding. The author urges caution that this kind of approach does not lead the field to over-replicate one model, eliminating creative new and different approaches. And the author also points to research that has found that some model programs in substance abuse—including the D.A.R.E. program—were based on tenuous scientific conclusions. Yet these programs were considered models, and many programs followed based on early, questionable research results.

The author expresses deep concern that a move toward EBP "may compromise the development of a meaningful and inclusive research agenda in adventure education and therapy." He urges program managers and researchers to think carefully about the extent to which the field should adopt the EBP approach. "There is no doubt that research in experiential education can be improved and that flirting with the EBP paradigm will move researchers to pursue more rigorous research designs, regardless of methodology. I simply recommend proceeding with caution."

THE BOTTOM LINE: Many fields are moving toward evidence-based practice (EBP)—a system that funds programs according to their demonstrated effectiveness. In this system, the most highly respected and valid way to demonstrate effectiveness is through rigorous, randomized, and controlled experimental methods. But the author of this paper argues that this emphasis on controlled experiments may not be entirely appropriate in outdoor adventure education and therapy as it could deemphasize the importance of the perspectives of outdoor leaders and participants. The author also raises concerns related to the effects of replicating only those programs that have demonstrated success through controlled experimental methods. Although most researchers and practitioners agree that increased rigor in evaluating experiential programs is good, fully embracing the EBP approach might lead to problems for the field, including ignoring more qualitative, practice-based evidence and alternative knowledge systems.

Harper, N. (2010). Future paradigm or false idol: A cautionary tale of evidence-based practice for adventure education and therapy. *Journal of Experiential Education, 33*(1), 38–55.

OTHER RESEARCH

RESULTS OF AN INTERNATIONAL TEST OF SCIENTIFIC LITERACY AND ATTITUDES

The *International Journal of Science Education* devoted its first issue of 2011 to reporting on the results of the 2006 Programme for International Student Assessment (PISA). The test is sponsored by the Organization for Economic Cooperation and Development (OECD) and is administered every three years to students in OECD countries and other participating countries. The exam measures competence among 15-year-olds in the areas of reading, mathematics, and science. Each time the test is administered, the primary subject area changes. The test was introduced in 2000, and 2006 was the first time that it focused on science.

The PISA survey is unlike other assessments of scientific literacy in two key ways. First, the test is forward-looking. Rather than looking back at what students should have learned up until a certain point, the survey looks forward and gauges the extent to which students can apply what they've learned in science in novel settings. In this way, organizers hope that the test better examines how students actually use science in their lives.

Another way in which the PISA survey is different from traditional standardized tests is that it includes measures of students' attitudes toward science. The test's organizers recognized that the ways that students apply science in their lives depends not only on what they know, but also on emotional elements such as their interests, attitudes, values, and so on. To better understand both cognitive and affective aspects of scientific literacy, the test includes questions addressing student attitudes.

The test examined the following areas: scientific literacy; science content; scientific competencies; personal, social, and global contexts; and attitudes toward science. The attitudinal dimension included questions related to students' interest in science, support of the process of scientific inquiry, and responsibility toward resources and environments.

Interestingly, the results indicate that students in countries with lower mean scores on the science knowledge scale show high levels of

interest in science, while students in countries with higher scores show lower levels of interest, a finding that confirms results of other international studies. On average across OECD countries, males show significantly more interest than females in learning science. Males also are more confident in their science skills, but their confidence does not seem to be related to their actual level of competence.

In looking forward toward future careers, few students in OECD countries (21%) reported an interest in spending their lives doing science, although a majority enjoy science and find it important for future studies. In thinking about possible future careers in science, girls tend to favor "soft science" jobs such as health-related careers, while boys favor "hard science" jobs such as engineering.

All students showed a preference for topics related to their own lives, such as health and safety, and less interest in topics with little personal relevance. But, interestingly, students' patterns of interest in science varied by large groups of countries that researchers categorized as European and non-European. The non-European students (broadly, from Arab, Asian, and Latin American countries, among others) showed a distinct interest in life and health issues, while the European students (broadly from Europe, North America, Australia, and other countries) preferred physical/technological systems. Researchers Olsen and Lie speculate that "this suggests that students in the non-European supercluster tend to favour items relating to basic needs for survival, such as learning about fertilizers and the ways plants spread their seeds, while students in the European countries seem to take issues like these for granted and instead express relatively stronger interest for issues relating to technology and the frontiers of science."

THE BOTTOM LINE: Researchers Ainley and Ainley found similar results in analyzing students' patterns of interest in science and their cultural backgrounds. The students' background influenced how students' knowledge and attitudes affected their interest in science. The researchers conclude that "programmes of science education that are perceived by students to be personally important and that they enjoy doing will be associated with stronger interest in learning about science."

Bybee, R., & McCrae, B. (2011). Scientific literacy and student attitudes: Perspectives from PISA 2006 science. *International Journal of Science Education, 33*(1), 7–26.

Ainley, M., & Ainley, J. (2011). A cultural perspective on the structure of student interest in science. *International Journal of Science Education, 33*(1), 51–71.

Olsen, R. V., & Lie, S. (2011). Profiles of students' interest in science issues around the world: Analysis of data from PISA 2006. *International Journal of Science Education, 33*(1), 97–120.

Kjaernsli, M., & Lie, S. (2011). Students' preference for science careers: International comparison based on PISA 2006. *International Journal of Science Education, 33*(1), 121–144.

CHILDREN AND ADULTS HAVE DIFFERENT PREFERENCES IN ONLINE ACTIVITIES

Although many organizations are developing more online learning opportunities, surprisingly little research has been done to understand people's preferences for different types of online activities. The researchers who completed this study—a collaborative team of media developers and museum researchers—asked this question: What is the relationship between learning style, age, gender, and preference for learning activity?

The team surveyed and interviewed 154 middle school children at a Philadelphia science museum and at a nearby school. The general public was also offered an almost identical online survey through links on 13 museum websites. Everyone surveyed was asked to: answer questions that assessed their learning style, rank six types of online activities according to their preference, try sample activities, and rate the sample activities.

The surveys included a learning style inventory based on Kolb's experiential learning theory. According to this

theory, learners fall along two axes. One axis represents perception, and ranges from concrete experience to abstract conceptualization. The other axis, processing, ranges from experimentation to reflective observation. Based on a person's responses to the questions in the inventory, he or she can be placed in one of four quadrants related to his or her position along these two axes.

The four quadrants represent four basic types of learning styles. The authors of this paper have simplified the names of the learning styles and describe them as:

- *Social learners*, who are action-oriented and prefer to tackle problems within a group
- *Creative learners*, who are imaginative, open-minded, and seek out multiple points of view
- *Practical learners,* who are both thinkers and doers, enjoy experimentation and technical challenges, and are goal-oriented
- *Intellectual learners,* who are organized and logical, enjoy reading and contemplation, and find facts and information fascinating

The six types of online activities the researchers offered people were:

- *Design* activities, which use open-ended inquiry and experimentation
- *Interactive reference* activities, which allow self-directed browsing of multimedia content
- *Puzzle-mystery* activities, in which users use evidence in logical reasoning to reach a solution
- *Role-play,* in which users adopt a persona and interact with others
- *Simulation*, which allows users to manipulate a model in order to understand something complex
- *Discussion,* in which users communicate with each other and experts

In all, over 1,000 middle school students and 1,000 adults took the survey. About 350 high school students also took the survey, but because the sample was small, and because their scores consistently fell between the adult and middle-school scores, their data were omitted.

The researchers found that the learning styles were not evenly distributed. Practical learners (39% of children and 35% of adults) were far more common than creative learners (8% of children and 9% of adults). Learning style was also more firmly established in adults. When plotted in quadrants, the children's learning styles tended to cluster near the origin, while the adults extend out farther, suggesting that the children were more flexible and less consistent in their responses while the adults were more consistent and set with their responses. In children, there was no significant difference in learning style between males and females, but among adults, females were more likely to have a social learning style.

Among the children, just two learning styles showed a preference for a certain type of activity: social learners preferred discussion while intellectual learners preferred interactive reference. Among adults, however, all four learning styles were associated with a specific preference: creative learners preferred discussion, intellectual learners preferred interactive reference, practical learners preferred puzzle-mystery, and social learners preferred role-play. The researchers' conjecture that the learning style-activity preference link is stronger in adults because adults' learning styles are better established.

Adults and children tended to prefer different types of activities. Children preferred role-play and design, while adults preferred interactive reference and puzzle-mystery. Gender seemed to play some role in people's preferences for activities, but the connection was not as strong as for learning style or age group.

The researchers suggest that there are several practical implications of these results on multimedia design. They point out that among children and adults, the practical learning style was most common, and these learners may not be satisfied with open-ended activities in which there is "no right answer." They might instead prefer goal-oriented activities.

The researchers also suggest that activity developers might offer a range of games to appeal to a variety of learning styles.

Developers can also explore how to integrate elements that appeal to different learners in a single activity. Developers might also prioritize design and role-play activities for middle school youth and interactive reference and puzzle-mysteries for adults. And they might also keep in mind that interactive reference activities scored relatively low among children, suggesting that developers should limit its use to "homework and research sites and to topics in which children have a strong intrinsic interest."

THE BOTTOM LINE: Middle school students' and adults' preferences for online activities vary by age, gender, and learning style. When developing online activities, it is important to note these different groups. Some practical considerations include: offering a range of different activity types for different learners, remembering that practical learners are the most common, offering interactive reference and puzzle-mystery activities for adults, offering design and role-play activities for middle school students, and limiting the use of interactive reference activities for middle school students, who tend not to prefer those types of activities.

Borun, M., Schaller, D. T., Chambers, M. B., & Allison-Bunnell, S. (2010). Implications of learning style, age group, and gender for developing online learning activities. *Visitor Studies, 13*(2), 145–159.

NOVEL SIGNS GET MIXED RESULTS IN CAPTURING VISITOR ATTENTION

National parks and other informal learning sites often rely on signs to convey important information to guests. Unfortunately, the ability of signs to capture visitors' attention and convey messages varies widely. This study's authors aimed to find out if they could increase people's attention to signs in Yosemite National Park by applying communication theory when developing several test signs.

The researchers developed five types of signs—four novel signs and one control that represented a "typical" park sign. The content of all signs was similar: Instructors focused on the importance of food storage for bear safety. They placed the signs in three locations within the park (the Upper Pines campground; Curry Village, which offers more developed accommodations; and the Wilderness Trailhead) and observed visitors as they passed the signs, noting if they ignored, glanced at, or read the sign for an extended period of time.

Based on their review of communication theory, the researchers developed the following five signs, which were similar in graphic design and length but varied in content:

Empathetic Appeal (Title: Attention Humans!). Written from the perspective of a bear, this sign was designed to arouse empathy with the use of the first person and an appeal to save the lives of bears. Part of the sign reads, "Sometimes we get hurt or killed just for liking your food. Don't help a good bear go bad."

Narrative (Title: My Bear Story). Because research has shown that narratives can capture and hold attention, this sign tells the fictional story of a boy who has an encounter with a bear because of improperly stored food. The story begins, "A bear broke into my family's car last night. I was real scared."

Humor (Title: Top Ten Reasons to Put Your Stuff in the Locker). Some studies suggest that humor can be an effective communication tool. This sign, with its reference to a popular late-night comedy sketch, was designed to use humor to capture attention. The number-one reason the sign offers for putting your stuff in the locker: "Keep bears from drinking all the beer in your cooler."

Telegraphic (Title: Leave It in the Locker—Not in Your Car!). Because research shows that few people read beyond the title, the title of this sign conveyed the sign's main message. The remaining text is straight-forward and factual. For example, one sentence reads, "Store all food and scented things in the bear-proof storage lockers."

Control (Title: Black Bears and Human Food). The researchers included a sign created from existing park messages about bears and food storage. The title did not convey any specific instructions, and the sign did not

incorporate novelty, narrative, humor, or emotion. It includes the following sentence: "Proper food storage is required by federal law. Help protect your property and yourself."

In addition to observing and interviewing visitors, the researchers also conducted manipulation checks to be sure that viewers perceived the characteristics the researchers intended. For example, did visitors think the "Top 10" sign was humorous, or that the "Attention Humans" sign made them feel sympathetic toward bears? The researchers found that while each sign performed as intended, the experimental signs were not considered any more "vivid" than the control.

And, related to that finding, the control sign representing the existing approach did not fare as poorly as the researchers had expected. It ranked third or fourth (depending on location) in the number of people who ignored it, and ranked second to fifth in extended viewing.

The "My Bear Story" sign was most likely to capture visitor attention: it generated extended views from visitors and was least likely to be ignored. "Attention Humans" was likely to be ignored, but, when people did read the sign, they read this sign the longest. The "Top 10" sign was least effective at sustaining attention, and it generated the most critical and confused comments in interviews. "Leave It in the Locker" was judged by viewers to seem very familiar, and most campers and those staying at Curry Village ignored it. Most hikers, though, glanced at it. And because the title conveyed the message, a quick glance might've been all that was needed to glean the relevant information.

The researchers conclude that humor does not appear to be an effective approach in this setting, but the narrative structure is effective. They also believe that an informative title, or one that indicates the content of the sign, as in the "My Bear Story" sign, does appear to help. And given that in all the locations, fewer than half of all visitors viewed the signs for an extended period of time (which researchers defined as more than two seconds, far less than the time required to read the sign), conveying information quickly may be critical.

The authors also note that one reason for the large differences in performance between the signs could be the different audiences encountered at the different locations. Trail heads and campgrounds likely contain very different types of visitors with varying interests and motivations. The researchers conclude, "A sign that is relatively attention grabbing in one location might well be largely ignored in another." And they note that had they only tested the signs in one location, "we would have been misled about the ability of most of the signs to attract and hold attention."

Finally, the researchers conclude that "the highly variable attracting power and holding times for the different messages across locations suggests resource managers need to attend closely to audience and site characteristics if they expect to communicate effectively with signs."

THE BOTTOM LINE: In developing signs to communicate with visitors, it appears that narratives can be an effective tool in capturing and holding attention, while humor failed to generate positive results in this experiment. However, the results varied widely according to where signs were placed, and a typical park sign that did not include attention-grabbing tactics performed equally well as the experimental signs. Overall, few visitors read the signs for any length of time. Capturing and holding visitor attention with signs remains difficult, but tactics such as the use of a narrative and an informative title can help. Finally, managers must keep in mind that different locations may draw different audiences, and signs may need to be adjusted to meet the needs and interests of unique audiences.

Hall, T. E., Ham, S. H., & Lackey, B. K. (2010). Comparative evaluation of the attention capture and holding power of novel signs aimed at park visitors. *Journal of Interpretation Research*, 15(1), 15–36.