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A no-conflict approach to informal science education increases community science literacy and engagement

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Abstract

The National Center for Science Education's Science Booster Club Program piloted a no-conflict approach to free, informal science activities focused on climate change or evolution, holding 64 community events at two sites over the course of 15 months, engaging with more than 70,000 participants. In the participating communities science literacy increased over time as did community engagement as measured by local financial support, requests for programming, and event attendance.

Keywords Informal learning; Popularization of science and technology; Public engagement with science and technology

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Introduction

Climate change and evolution are prominent examples of areas of science that are scientifically well-established but societally contentious in the United States. Rates of science literacy with regard to these topics remain persistently low in American adults, hindering them from participating in informed civic engagement on these topics. A large plurality of American adults reject the deep scientific consensus on these topics. A consistent 40% of American adults report that they believe that humans were created in their current form by God in the last 10,000 years [Pobiner, 2016]. About 40% of American adults report that they believe that natural cycles are responsible for climate change, rather than human actions [Saad, 2014]. Almost 90% of Americans do not know there is a scientific consensus on climate change, and only one in ten Americans say they are well-informed about climate change, though 75% say they would like to know more [Leiserowitz et al., 2017].

The most common place for Americans to learn about evolution and climate change is in public school. Both topics are stressed in the Next Generation Science Standards [NGSS: NGSS Lead States, 2013] for current teaching in K-12 education, which have currently been adopted by 19 states and the District of Columbia.

However, the majority of American adults simply did not have the opportunity to learn about these topics during their formal educations [National Science Board, 2016]. For many American adults, exposure to science education ends in high school. The clear consensus that climate change is being caused by human activities was reached only in the mid-1990s and is still inconsistently included in textbooks, meaning that even many well-educated adults have not had the opportunity to learn about this scientific topic in a formal educational environment [AAAS, 2014].

While we can now rest the theory of evolution on well-understood genetic mechanisms, our understanding of how traits are inherited is fairly recent, with a substantial proportion of American scientists favoring Lamarckian evolution until the late 1920s, and DNA characterization and description occurring in 1953 [Watson and Crick, 1953]. Formal guidelines for inclusion of genetics even in medical school curricula did not occur until 2001 [Robinson and Fong, 2008]. Additionally, while evolution was scientifically established enough to be included in school textbooks in the 1920s, the social controversy manifest in, but not limited to, the Scopes trial helped to keep the topic out of classrooms until the 1960s [Grabiner and Miller, 1974] and beyond to the present day [Berkman, Pacheco and Plutzer, 2008]. Not surprisingly, incorporating emerging scientific discoveries into K-12 curricula does not happen overnight, and topics that are societally controversial can take even longer to be included in standards, textbooks, and curricula.

Comprehension of the basic physical and biological concepts underlying the scientific understanding of evolution and climate change is extremely low. In a comprehensive survey of content knowledge underlying climate change, such as the greenhouse effect, the role of carbon dioxide, and ocean acidification, only 8% of Americans received the equivalent of an "A" grade [Leiserowitz et al., 2017]. Only 40% of Americans correctly responded that both "normal" and genetically-modified tomatoes contain DNA [Wunderlich and Gatto, 2015]. Fully 80% of Americans support labeling food that contains DNA, indicating that many Americans do not understand on a basic level what DNA is or its prevalence in living things [Oklahoma State Department of Agricultural Economics, 2015].

Ideally, such misconceptions and knowledge gaps would be addressed in the course of students' K-12 education, but widespread reluctance on the part of teachers to cover evolution and climate change unequivocally diminishes the chances that community literacy on these topics will improve over time [Berkman, Pacheco and Plutzer, 2008; Plutzer et al., 2016]. Lacking direct familiarity with the topics, many people align their beliefs about these areas of science with their religious or political identities [Pobiner, 2016].

Due to the complex social, cultural, and political tensions in the United States around the topics of climate change and evolution, and their deep involvement with identity issues, the approach used to communicate information on these subjects is crucial to successful outreach and education. Many people feel alienated or excluded from science in general [Bandura, 2006; Goodman et al., 2011; Hodson, 1999; Rossatto, 2007; Diaz-Rico and Weed, 2002; Duran, Dugan and Weffer, 1998; Hildebrand, 2001; Tobin and McRobbie, 1996; Lee, 1997; Lee and Fradd, 1996; Rakow and Bermudez, 1993; Rosenthal, 1993]. In designing our outreach approach, we drew on a body of research that applies a sociocultural and linguistic framework to create inclusive science learning environments [Richter, 2011; Schoerning, 2012; Schoerning and Hand, 2013; Schoerning, 2013; Schoerning et al., 2015]. This research suggests that an informal conversational style and explicit instruction in the conventions of scientific argumentation are the common factors that underlie many science teaching and learning approaches that have been shown to significantly improve the performance of underserved groups and close achievement gaps [Schoerning et al., 2015; Akkus, Gunel and Hand, 2007; Prain and Hand, 2016].

The goal of our research was to explore whether these findings could be applied successfully in the context of community-based informal climate change and evolution education. To address this question, the National Center for Science Education (NCSE) invested in a new community-based outreach program, led by the author, beginning in 2015 and which became known as the Science Booster Club program (SBC). To attain broadly applicable information on community science literacy, the author affiliated with a research university and engaged in formal survey work at research sites.

Consistent with the established findings about effective outreach, NCSE's Science Booster Club program utilizes a "no-conflict approach" to informal public education. Debate on climate change or evolution is stringently avoided. SBC exhibitors are trained to engage with the public using an informal conversational style when presenting information on scientific topics. Within the context of the activity, SBC exhibitors continually emphasize elements of scientific argumentation, such as developing questions, gathering data, and constructing evidence, which are not necessarily familiar to many American cultural subgroups [Choi, Nisbett and Smith, 1997; Gee, 1990; Peng and Nisbett, 1999].

The vast majority of the research cited here and utilized as a theoretical framework for the SBC's "no-conflict approach" was performed in the context of formal education, and measured learning gains in individual students. In this study we examine whether the no-conflict approach leads to sustained demand for informal science education activities about topics that are potentially societally contentious. We examine measures of the sustainability of such an approach as indicated by volunteer commitment, formation of local partnerships, and attraction of regional funding. Finally, we examine what effect, if any, the no-conflict approach, deployed in frequent opportunities for community members to engage in informal science activities over a long term, has on community-level literacy.

Methods

This study used a survey to see if community science literacy changed over time as NCSE's Science Booster Club Program began doing community outreach work involving science content. Community interactions around science are complex. As discussed in the introduction, in America science is often highly politicized, and many subgroups of the American population experience some degree of alienation from the scientific enterprise. Accordingly the method by which we approach communities around science outreach is essential. This methods section discusses the approach we utilized and how exhibitors were instructed in the approach in detail before describing other, more standard methods components, such as the instrument, research sites, data collection, and analysis. Although the approach we utilized is not a measurable study outcome, any person who wanted to replicate this study would need to understand the approach and exhibitor training utilized.

The no-conflict approach

The "no-conflict approach" rests on four basic principles: avoid debate, control emotional tone, utilize an informal and cheerful conversational style, and explicitly describe and utilize elements of scientific argumentation.

Debate on climate change or evolution is stringently avoided, both because it misrepresents the nature of scientific argumentation and, more importantly, because it is likely to provoke strong emotions, unnecessarily and counterproductively. Most people do not engage in argument in the framework of scientific argumentation; they engage in social argumentation. When most people argue socially, a strong and negative emotional component is involved. When dealing with socially controversial issues such as climate change or evolution, such arguments are particularly likely to involve community and identity issues, making it more difficult for the people involved in the argument to engage dispassionately with the evidence. By avoiding debate, we attempt to lower the emotional heat of the conversation.

There are other ways that SBC exhibitors work to manage the emotional tone of audience interactions. Our exhibitors are trained to utilize radical empathy. By radical empathy, it is meant that SBC exhibitors are trained to engage emotionally with audience participants, focus on the emotional responses and needs of the people with whom they are interacting, and be aware of their own emotional responses and how these responses can contribute to conflict escalation or resolution. Exhibitors are trained to recognize how exposure to negative or hostile persons changes their own body language and other non-verbal responses, to suppress their own negative reactions to hostility, and to project warmth and acceptance.

SBC exhibitors are also trained to engage in in-group-friendly social messaging if participants attempt to engage them in debate or hostile conversation, using strategies such as talking about the weather, local sports teams, or non-polarizing local current events. By engaging in this type of in-group signaling, SBC exhibitors are able to humanize themselves and show that they are not only in the community to present information but also to socialize. In many communities there is a prevailing view that outside experts may come in to "preach" rather than listen to or engage with local people. Accordingly, for successful community outreach, engagement beyond science is crucial. Volunteers who are visiting new communities are encouraged to talk with event participants about these social topics during positive as well as potentially hostile encounters. Through this type of casual interaction we are more able to learn about community needs and build connections with communities.

The casual social interaction encouraged above is linked to the informal conversation style SBC exhibitors are trained to utilize when presenting information on scientific topics. Exhibitors are encouraged to avoid a traditional pedagogical style. The goal is for presenters not to assume the traditional linguistic trappings of expertise, which often elevates the presenter in a social position above the recipient of knowledge, but rather, to present themselves informally, as fellow people interested in socially sharing knowledge. By utilizing informality, SBC exhibitors are able to create horizontal relationships rather than vertical or hierarchical relationships with audience participants.

SBC exhibitors explicitly encourage dialog with participants through frequent questioning, which actively models the forms of scientific discourse. Explicit instruction in scientific argumentation has been shown to benefit learners [Cavagnetto, 2010; Schoerning and Hand, 2013]. Frequent friendly questioning and prompting aimed at eliciting observations, generating conclusions, and producing new questions causes participants to engage in the scientific method rather than to marvel passively at the products of science. Engagement in the process of science is also manifested by the use of hands-on activities in the exhibits where participants genuinely can make observations, generate conclusions, and often find new ways to manipulate the exhibit to answer new questions. The use of accessible vocabulary by exhibitors is also important for engagement in the scientific process. Using familiar words whenever possible helps to include all participants, emphasizing understanding over the use of discipline-specific scientific language.

The goal of all the above elements combined is to create a cheerful, upbeat atmosphere, rather than a potentially tense, traditionally pedagogical, or debate-focused environment. The latter two strategies have been shown to discourage many Americans from engaging with science [Diaz-Rico and Weed, 2002; Duran, Dugan and Weffer, 1998; Hildebrand, 2001; Tobin and McRobbie, 1996].

Exhibitor training

Most exhibitors were volunteers. A minority of exhibitors were NCSE staff. Before exhibitions, exhibitors needed to be trained in both the no-conflict approach and in relevant content knowledge. This was accomplished through three interacting channels: weekly, monthly, and pre-event meetings.

Regular volunteers attended weekly meetings led by NCSE staff, where they discussed challenges they had experienced, ways they resolved them in the context of the no-conflict approach, new content being developed, scientific content they found interesting or challenging, and plans for new exhibits. This weekly meeting format provided a platform for ongoing, engaged conversation around applications of the no-conflict approach and relevant content knowledge.

Regular, new, and occasional volunteers attended monthly meetings led sometimes by NCSE staff and sometimes by regular volunteers. Monthly meetings provided a more formal overview of upcoming volunteer opportunities, more formal training on scientific content, and more formal review of the no-conflict approach. Specific instances of challenges or conflicts were reviewed within this context, which, in contrast to the weekly meetings, was often more like a lecture or presentation than a conversation. Breakout conversation was encouraged at monthly meetings after reviewing examples of conflict or challenge, to allow occasional volunteers to explore how they would address the issues in question.

Pre-event meetings were held before major events. In most cases two meeting times were offered to meet volunteer needs. These pre-event meetings were formal in structure. Overall event logistics were described and each volunteer's logistical role was explained in the group context. This way, everyone involved in the event knew where supplies were, how supplies were getting to and from the event, who had cars, and other matters of important practical responsibility. Content knowledge relevant to the event was formally reviewed and (when applicable) volunteers practiced conducting the exhibit activities. The principles of the no-conflict approach were reviewed, and NCSE staff would test volunteers with potential conflicts or challenges.

These three meeting types varied in their degree of formality. Volunteers participated in different types of meetings based on their level of involvement. All meetings worked to maintain a low-pressure, engaging environment that encouraged volunteer communication and agency. Suggestions, laughter, and stories were encouraged. Although the consistent review of content knowledge and the no-conflict approach were important functions of the meetings, all meetings also needed to function as positive third-space experiences for volunteers. Most effective learning is accomplished in engaging environments. For volunteers to learn and for the organization to achieve a high level of volunteer retention, volunteers need to have fun. As volunteers increased their involvement in the organization, they were given opportunities for greater team-bonding and increased agency in the organization, through participation in the weekly meetings. Regular participants in weekly meetings also received occasional gifts and rewards from NCSE, such as coffee mugs, t-shirts, pizza, and coffee.

Site description

This study was based in the United States in a Midwestern state with a mixed agricultural and manufacturing-based economy. For nearly a century, the state was an educational leader, boasting the highest literacy rate in the nation in 1897, and as recently as 1992 remained first in the nation in both mathematics and reading in the K-12 population [Duncan, 2011]. The state voted to adopt the Next Generation Science Standards in 2008 [NGSS Lead States, 2013] and retains overall education rankings in the top quintile according to most sources. However, this is likely to fall in the near future due to multiple factors, and some ranking systems already note the state as performing well below the top quintile. For example, 2016 ALEC ratings place the state 31st of 50 in K-12 education [Laffer, Williams and Moore, 2016]. In science education specifically, the state's current ALEC ranking is 38th of 50. Most disturbingly, a 2012 Harvard study ranked the state last in the nation in terms of education growth [Hanushek, Peterson and Woessmann, 2012].

Primary study sites consisted of two communities, described here as sites A and B, and the area around them at a radius of ten miles each. This type of sprawling community organization is common in the region of the United States where the study took place. These sites were both midsized cities with populations of the cities themselves and the surrounding areas around 150,000. Site A has a knowledge-driven economy, with a large university, a major teaching hospital, and a large veterans' facility serving as major employers. Site B has a manufacturing-based economy, with many factories offering high-paying, stable jobs. The average household income of Site B is about 20% larger than that of Site A; a figure which is somewhat complicated by the fact that a significant number of Site A households are made up of college students. The inhabitants of Site A are, on average, more highly-educated than Site B. Both sites have relatively low poverty rates. Both sites have White majority populations. Site B has active hate groups, as tracked by the Southern Poverty Law Center, whereas Site A does not have active hate groups [Southern Poverty Law Center, 2017].

Instrument description

A science literacy survey was developed for administration at free public science events at sites A and B. The instrument was utilized at both research sites at all time points. Surveys and protocol were approved by the relevant Institutional Review Board (IRB). This study's IRB approval did not permit the storage or tracking of individual identifying information.

Survey questions were selected from the National Survey on Science Literacy, which has been utilized for public longitudinal data collection by the National Science Foundation since the 1970s. Items were selected based on their historical statistical interest and relevance to NCSE mission topics. The full survey was not used due to length. Individual contact times at large public events are short, meaning that in order to collect survey data, items must be limited. The modified survey included 28 items, reduced from well over a hundred items. Science literacy is a complex characteristic, and can include at the most basic level simple knowledge of science fact, and at a more conceptual level the ability to apply scientific reasoning to complex situations. Given the constraints of surveying the general population at an informal event, we chose to adapt a well-characterized instrument of literacy to measure basic knowledge of scientific facts relevant to evolution and climate change.

Sample items from the literacy survey can be found below in Table 1.

Table 1. Sample items from survey instruments.

Survey	Sample Item
Literacy	Electrons are smaller than atoms. True or False?
Literacy	The earliest humans lived at the same time as the dinosaurs. True or False?

Activity and engagement description

These activities took place between January of 2016 and March of 2017. The majority of SBC activities took place in the context of larger community festivals or markets, where our group presented modular exhibits at one or more tables. At many community festivals or markets we provided the only science or STEM-themed content, with other exhibitors providing religious content, popular activities like face-painting, or anti-addiction materials. Some STEM-themed community festivals also presented science-based content, most commonly hands-on basic physics experiments. During the period of data collection, the state Department of Natural Resources also exhibited information about flooding. We did not encounter any other organizations talking about either climate change or evolution at any community event in our study area.

The modular displays we presented were on topics including ocean acidification, sea level rise, evolution through the state fossil record, the greenhouse effect, and genetics and evolution. All exhibits had numerous components that audience members could interact with and touch. The majority of exhibits, excluding fossil-based exhibits, allowed audience members to measure and/or change elements of the exhibit.

This was accomplished with a minimum of technology. For example, to teach about the impact of climate change on species survival, a foosball table was modified so that the pegs on one side represented threats to monarch butterfly survival, such as the increased frequency of severe weather events and seasonal shifts caused by climate change. The pegs on the other side represented strengths for monarch butterfly proliferation, such as high reproductive potential, and human actions such as increased milkweed planting and habitat preservation. These threats and strengths were depicted pictorially. The threat and strength sides could be made more or less powerful by the exhibitors adjusting the ease at which the pegs could be moved by participants.

In an activity on ocean acidification, participants were encouraged to use straws to blow into cups of water containing pH indicators so that they could see that the carbon dioxide in their breath acidified the water. An aqueous solution of the end-pH was then shown in contact with mussel shells, allowing participants to see that the shells visibly dissolve in acid of a pH that can be easily achieved through their own breath. Participants were encouraged to think of other shelled organisms that might be affected by ocean acidification, and the resulting impact on the economy and ecosystem. When possible, organisms such as live shrimp purchased from a pet store or sea urchins borrowed from a biology lab were brought along to encourage further participant connections. Many participants had never seen or interacted with these live animals, creating significant audience interest.

Exhibitors encouraged audience members to interact with exhibits while utilizing the no-conflict approach. This approach, as previously described, requires exhibitors to avoid debate, control emotional tone, utilize an informal, cheerful conversational style, and explicitly describe and utilize elements of scientific argumentation. SBC exhibitors focused on engaging in explicit instruction on the scientific method, driving questions about observation, and encouraging audience members to make predictions. Content knowledge was generated in this way by audience members through interaction with the exhibit. In the event of topic-related discomfort or conflict, exhibitors worked to connect with audience members about shared personal interests, and then return to questioning and engagement based around the scientific method rather than content. By maintaining a sensitivity to emotional tone, exhibitors were able to reduce discomfort if it developed during participant interactions, allowing for longer and more positive contacts.

Data collection & privacy concerns

Community engagement in the SBC program overall was measured by tracking over time the number of events, the number of participants at each exhibit, the number of volunteer hours devoted to each event, the number of followers of the clubs' Facebook page, and cash and in-kind financial contributions. These data were not separated by study site and are presented as aggregates in the results section. This is because most financial contributions were from regional businesses, rather than site-specific donors, and because some events were large enough to attract regional, rather than site-specific, participation. The number of participants at each event was gathered after the fact from the event organizer. These event organizers typically gathered numbers of participants from having their volunteers count participants at event entrance and exit points.

For the evaluation of science literacy at the two study sites, survey participants were recruited from the general population at the outreach events. Participants were asked if they would like to take a science survey to let us learn more about what people in their communities knew and cared about. They were not offered financial compensation for taking the surveys. They were assured that they would not be asked any personal or identifying information, and that their answers would be kept private. Survey participants were asked if they were over the age of 18. No surveys were taken of minors.

Survey participants were self-selecting from the general population attending and participating in community events, not only those who were actively participating in SBC activities.

Once collected, surveys were stored in a locked, secure location. Surveys were analyzed for population-level data only. Individual identifying information was neither stored nor tracked.

Scoring of surveys was not subjective. Items were straightforward true/false or multiple choice questions. After the researcher scored the surveys, raw total scores were entered into an SPSS database. The number of correct questions was used, without further manipulation, for further analysis. Original surveys were returned to a locked filing cabinet for future reference.

Analysis

Analyses of survey data were performed using SPSS. ANOVA was utilized to look for significant differences across time points.

Results

Community engagement

Table 2, below, provides aggregate program data. Community engagement over the entire study area, as represented by number of events, participants, volunteer hours, and financial contributions, grew steadily over the 15-month pilot program with some seasonal variation. The number of participants was especially large in the summer of 2016, when the SBCs were able to take advantage of greater volunteer availability and funding to exhibit at major outdoor festivals. Comparison of the first quarter of 2016 with the first quarter of 2017 reveals substantial growth in all measures of engagement. Measures of engagement are pooled across the study sites because most financial contributions were from regional businesses, rather than site-specific donors, and because some events were large enough to attract regional, rather than site-specific, participation. Because of these confounding factors, statistical analysis of program growth and engagement between sites was not performed. The growing, substantial in-kind donations throughout the reported study period represent graduate student funding obtained through grants written by collaborators at the University of Iowa. Both cash donations and in-kind donations as presented indicate dollar amounts, rather than number of donations.

Table 2. Measures of community engagement as program aggregates.

	2016 Q1	2016 Q2	2016 Q3	2016 Q4	2017 Q1	Total
Number of Events	14	15	10	9	16	64
Number of Participants	4,500	11,720	24,000	14,500	16,200	70,920
Volunteer Hours	80	110	376	110	160	836
Facebook Followers	248	271	314	359	437	437
Cash Donations	360	5,295	2,319	7,023	6,900	21,927
In-Kind Donations	6,000	6,800	16,540	10,500	13,194	53,034

Community literacy

Table 3 details the events at which survey data were collected at sites A and B, including the total number of participants in the activity and the number of participants taking the survey. Surveys were administered only at local events that were unlikely to attract participants from across the region.

Table 3. Event sizes and N-values for surveyed events.

	Site A Surveyed Event Size	Site A Number of Surveys Collected	Site B Surveyed Event Size	Site B Number of Surveys Collected
2016 Q1	200	12	1,400	12
2016 Q2	500	11	250	15
2016 Q3	450	15	550	18
2016 Q4	2,200	14	3,000	16
2017 Q1	1,400	15	1,800	15

A relatively small number of participants were surveyed at each event. Typically, only one person on the exhibitor team at any given event was trained to administer surveys and each participant took 10–15 minutes to complete the survey. As events tended to be two to three hours long, it was typically possible to collect only 12–15 surveys at each event, with the number constrained not by the size of the event but by the fact that it was not possible to dedicate more than one trained exhibitor to survey acquisition at any given time.

Analysis of mean raw survey scores over time at both sites A and B showed increases over time, as seen in Figure 1.

Both sites show a clear upward trend over the course of the study. After an initial period of rapid change in site B, the trend line for improvement in site A and site B became similar. While raw score increases for both sites are measurable, with 8% increase for site A and 24% increase for site B over the course of the study period, only site B's increase is statistically significant, with a p value of 0.04. Standard deviation at site A did not change in a consistent way, with values throughout the time course ranging between 1.5 and 2.6. Standard deviation at site B narrowed as time progressed, with an initial SD of 4.6 gradually reducing to 2.8.

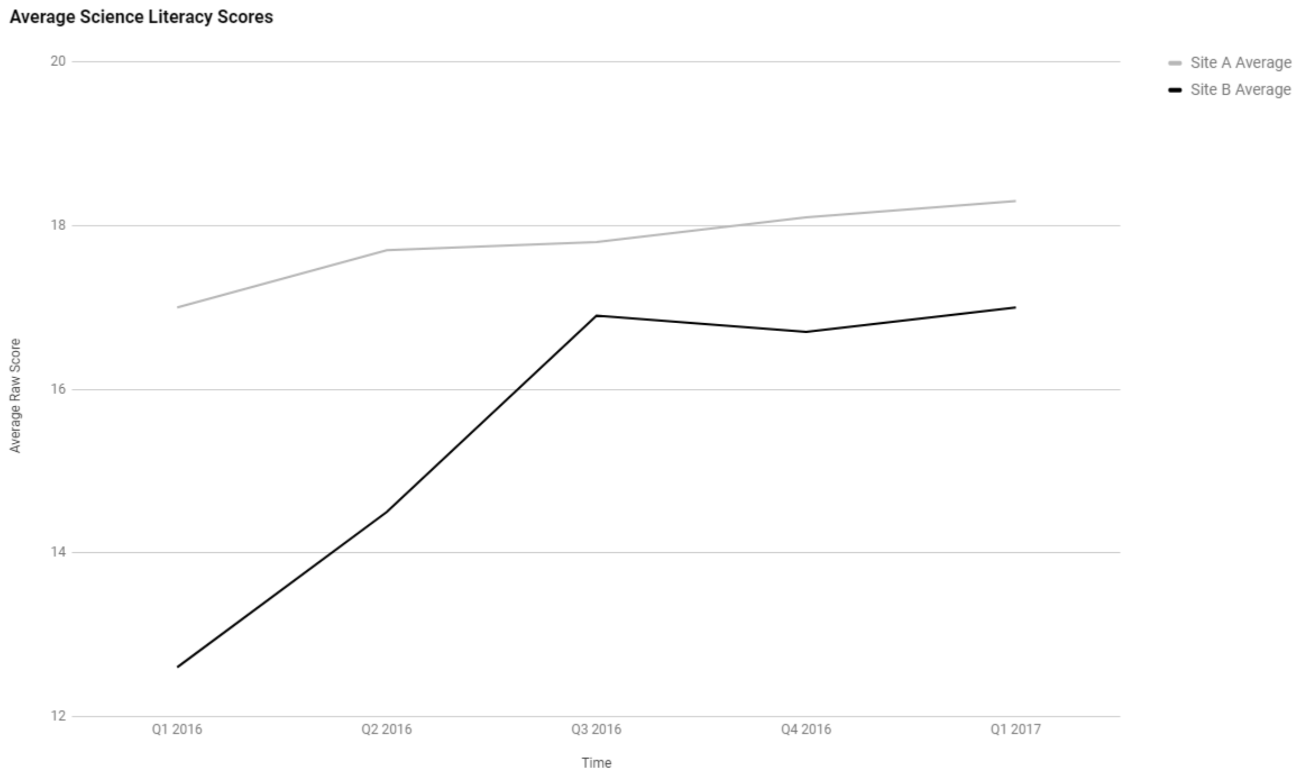

Figure 1. Science literacy scores over time at sites A and B.

Discussion

When communities are afforded access to free, engaging science material, they appear enthusiastic about participating in these opportunities. As the Yale climate survey has shown, the majority of Americans want more information about climate change [Leiserowitz et al., 2017]. At our study sites, we have been able to experience the intensity of this desire. There is evidence from the literature that learning and engagement are positively correlated, which provides additional context for the literacy gains seen in our analysis [Carini, 2012; Ainley, 1993].

The expansion of the SBC program in the area, as seen in Table 2, was driven by community interest. Community partners, such as nature centers, museums, and other informal festivals and venues, sought out our programming, and we were able to form partnerships with civic institutions, such as schools, libraries, and parks and recreation departments.

The work being done by the SBC program takes place in understudied public spaces. Informal science education has been shown to provide meaningful gains in public knowledge [Falk and Needham, 2011; Norton and Nohara, 2009; Navid and Einsiedel, 2012]. However, much of this work, as in the sources cited, takes place in STEM-designated spaces such as museums, science cafes, and STEM festivals, where community audience members are actively seeking out supplemental science education. About half of SBC activities took place outside of this STEM-designated sphere, in public spaces where people would not necessarily be seeking out educational opportunities, such as farmers markets and community festivals whose primary purposes were entertainment and community cohesion.

As discussed in the introduction of this paper, many subgroups of the American population have been shown to feel that STEM and science education are not for them; that they are socially excluded from STEM. It seems likely that people who feel that way about the scientific disciplines might not seek out, or might even actively avoid STEM festivals, museums, or other explicitly STEM-designated space. By bringing science out of discipline-designated spaces, both formal and informal, and into a non-discipline-designated public sphere, it seems possible that we are reaching people who might not otherwise interact with scientific content. Surveys addressing this question would be a logical future addition to our research.

The possibility that
we are reaching a different and perhaps broader population segment is interesting given the warm and enthusiastic response we received at these community events, and the fact that SBCs have been invited back to provide more scientific programming at every venue we have visited. Perhaps there is an indication that, if we reach out to these subgroups more actively and work to meet them where they are, greater public literacy gains are possible, as well as desirable social changes, including a de-stigmatization of both scientific topics and science in general.

Although the interactions and effects involved are not yet fully understood, the success of this programming outside of the discipline-designated sphere, and the enthusiasm of the general public for science content in this space, is worth emphasizing as a potentially rich area for further work in education and communication. As noted by a 2016 SBC volunteer, Claire Adrian-Tucci:

> "I remember that at one county fair, we had such a large crowd. Me and another volunteer were completely swamped with people. I could barely clean up the materials from one round of activities before being rushed with another eager group. I felt like I had been speaking with participants for at least an hour, it turns out that only 15 minutes had elapsed. And when I had the brief opportunity to go to the bathroom, I noticed none of the other vendors were nearly as busy, even though they were giving out candy and had cute animals."

Another 2016 SBC volunteer, Jorge Moreno, wrote of his experience at the Iowa State Fair:

> "There were people waiting in line to see our stuff. The lane coming up to us would be blocked up, so people knew there was something good, and more people would get in line. It was like a chain reaction. You never got a break. The Answers in Genesis people [a young-earth creationist ministry] had a setup the next lane over. They were giving out fake money and calling people in, they had a big toy train, they didn't have any crowd like our crowd. They had to call people in, people waited in line to see us."

Although we frequently noted strong public interest in non-discipline-designated space, we did not perform statistical analysis to look at literacy changes or differences as related to space classification with our current data set. Although we have data collected from events in both discipline-designated and non-discipline-designated space, the statistical power of our current data is too low for meaningful analysis. We plan to return to this question with additional data collected from a variety of events through 2017.

Conclusion

NCSE's SBC program performed well in its pilot stage, generating significant community engagement and correlating with increased community science literacy over time. The conclusion that public informal education on the potentially controversial topics of climate change and evolution can be acceptable and even welcomed in socially and politically conservative communities in the United States may come as a surprise to some readers. The pilot shows that diverse communities have a significant interest in learning about these topics, and that there appears to be great potential for civil discourse and engagement. As the program expands, we plan to continue to measure its impact on communities' impressions, opinions, and feelings about climate change, evolution, and science in general.

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