International Journal of Science Education, Part B: Communication and Public Engagement

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rsed20

Design and Impacts of a Youth-directed Café Scientifique Program

Michelle K. Hall [a], Susan Foutz [b] & Michael A. Mayhew [a]

[a] Science Education Solutions, 4200 W. Jemez Rd, Suite 301-22, Los Alamos, NM, 87544, USA

[b] Institute for Learning Innovation, Edgewater, MD, USA

Version of record first published: 28 Aug 2012

To cite this article: Michelle K. Hall, Susan Foutz & Michael A. Mayhew (2012): Design and Impacts of a Youth-directed Café Scientifique Program, International Journal of Science Education, Part B: Communication and Public Engagement, DOI:10.1080/21548455.2012.715780

To link to this article: http://dx.doi.org/10.1080/21548455.2012.715780

International Journal of Science Education, Part B
2012, 1–24, iFirst Article

Design and Impacts of a Youth-directed Café Scientifique Program

Michelle K. Hall[a]*, Susan Foutz[b] and Michael A. Mayhew[a]
[a]*Science Education Solutions, 4200 W. Jemez Rd, Suite 301-22, Los Alamos, NM 87544, USA;* [b]*Institute for Learning Innovation, Edgewater, MD, USA*

We have modified the popular Cafe Scientifique model for engaging adults in dialog on issues at the nexus of science and society to address the specific needs and interests of high-school age youth. Key elements of the model are Youth Leadership Teams that guide the program design and assist with implementation; a speaker preparation process to help scientists better connect with the teen audience; and a highly interactive program that goes beyond the typical short presentation and lively discussion by incorporating other means to actively explore the topic of the event. Our objectives in offering the program are to make science and scientists more engaging and accessible to youth; to help youth see science and technology research and discoveries as relevant to their daily lives; and to encourage positive attitudes toward science, scientists, and science, technology, engineering, and math careers. As a result of this project, we expected youth would develop:

- an informal community that engages in scientific discourse, thought, and exploration;
- a deep and nuanced understanding of current issues in science and technology and be able to communicate that understanding confidently and expertly;
- skills and attitudes for lifelong learning and an appreciation of science as a career and as a way of thinking.

The summative evaluation used a quasi-experimental design with matched control-treatment groups ($N = 383$) to study the impact of the program on (1) attitudes toward science, scientists, and science careers and (2) Positive Youth Development (PYD). The evaluation data demonstrated the program positively impacted participants' science-related attitudes; however, the degree to which the program's PYD outcomes were achieved is less conclusive.

Keywords: *Youth; Positive youth development; Science communication; Science café; Cafe Scientifique; Out-of-school program; STEM attitudes*

*Corresponding author: Michelle K. Hall, Science Education Solutions, 4200 W. Jemez Rd, Suite 301-22, Los Alamos, NM 87544, USA. Email: hall@scieds.com

ISSN 2154-8455 (print)/ISSN 2154-8463 (online)/12/000001–24

http://dx.doi.org/10.1080/21548455.2012.715780

Introduction

Anyone working with high-school age youth knows their passion for making a difference in the world and their strong opinions about how things should work. It is this youthful conviction to make a better world and a positive outlook on the future that provides all generations with hope (Ono, 2003; Tonn & MacGregor, 2009). Today, many of the most pressing problems facing the world require advances in science, technology, engineering and mathematics (STEM) to solve them. Yet, we have come to a time in which too few youth have interest in these fields and either have little knowledge about careers in STEM or regard them as boring. It is critical that we provide support for youth to reengage in STEM by demonstrating its relevance to their daily lives and making it interesting, relevant, and accessible (National Academy of Science [NAS], 2000, 2005).

Beyond making science interesting, relevant, and accessible, we also need to help youth begin to think critically about STEM issues. Often youth's opinions have a weak foundation in facts and evidence, especially when it comes to science and technology affecting their lives. Youth are not alone in this; there is growing evidence that few people seek information contrary to their personal perspective in forming their opinions and making decisions (McRaney, 2011; Nickerson, 1998; Pallant, 1995, 1996). This can have the effect of stifling a person's ability to develop and evaluate alternative hypotheses to find new solutions (Tierney, 2011), a core tenet of scientific thinking.

For most youth, access to scientists and exposure to scientific thinking are rare. The typical school science class often lacks the elements of scientific inquiry that make science exciting and that can open a student's eyes to scientific careers. Exposure to science outside of school also can be limited for older youth. Typically, parents take their children to science centers and museums until they are teens; then, the teens do not return until they have their own children. Through the Café Scientifique New Mexico program (cafenm.org), we are providing a means to engage youth with science and technology issues and discoveries through dialog and weighing evidence to help them better form their scientific understanding of how the world works and is impacted by advances in science and technology. Additionally, we hoped that our efforts might help them make a difference in this world by choosing to pursue science and technology careers.

A major challenge in engaging youth is that they are an exceedingly hard demographic to reach due to both time and interest constraints. Many youth have full schedules with after school activities, jobs, and family responsibilities. And, while owning the latest scientific or technological device is very trendy and cool among youth, knowing how to design or build one is of interest to only a few.

Given these challenges and using what we know about how people learn (NAS, 2000, 2009), the following questions informed how we developed this program including:

- How do we make science engaging and accessible to more youth?
- How do we help them see science and technology research and discoveries as relevant to their daily lives?

- How can we develop a positive culture around thinking scientifically and maybe even pursuing STEM careers?
- How can we prepare science and technology professionals to effectively engage youth in their research and discoveries through discussion and other activities?
- How can we build a program that will be professionally rewarding to the scientist participants?
- If we build it, will the scientists and youth come?

Our answers to the questions became key objectives in the program development and lead to the following goals for our Café implementation.

Program Goals

Youth will develop:

- an informal community that engages in scientific discourse, thought, and exploration;
- a deep and nuanced understanding of current issues in science and technology and be able to communicate that understanding confidently and expertly;
- skills and attitudes for lifelong learning and an appreciation of science as a career and as a way of thinking.

Our program summative evaluation results (Foutz & Luke, 2010) indicate that we were largely successful in achieving these goals. This article serves to provide a framework for understanding how we developed and implemented the program to achieve our goals and an overview of the impacts the program has had on both youth and scientist participants.

The General Concept of a Café Scientifique Program

Our youth-directed program was inspired by the popularity of the adult Café Scientifique program that was started in Leeds, UK, in 1998 (Dallas, 2006). The UK program was based on an earlier Café Philosophique program in France, and takes inspiration from the intellectually stimulating 'café society' of Paris in the 1920s and 1930s. Café Scientifique programs have proliferated in recent years to more than 30 countries (www.Cafés cientifique.org) with more than 71 in the USA and Canada alone (www. Sciencecafes.org).

Although the details of individual Café programs may differ somewhat (Adams, 2004; Cohen & Macfarlane, 2007; Dallas, 2006; Giles, 2004; Sink, 2006), all combine two essential ingredients. First, they take place in an informal social setting—usually involving food and drink—that encourages participants to interact with each other. They are often held in pubs, restaurants, and coffee shops, but may also take place in museums and science centers. Second, they build upon participants' existing knowledge and satisfy their curiosity about a science-based topic

through lively interaction with a scientist. It is this blend of the two ingredients that accounts for the Café model's growing popularity.

After learning about the popularity of the adult Café Scientifique model, we wondered if such a format could be used to engage youth in exploring science and technology in their lives. Could this kind of social interaction with a scientist get youth to see scientists as interesting people with great passion and excitement for their work? In 2007, we started up a novel Café Scientifque program for youth in New Mexico to explore these ideas.

Adaptation of the Café Scientifique Model for a Youth Audience

For the past 5 years, we have hosted Cafés in each of 4 New Mexico towns—Albuquerque, Española, Los Alamos, and Santa Fe—during the academic year. Our audience reflects the demographics of New Mexico (Table 1), which is over 56% minority (US Census Bureau, 2011). We targeted this audience for the diversity of socioeconomic factors across the four towns in which to test the model of a Café Scientifique for youth.

Focus group discussions with high-school age youth in these towns guided our initial design for the Café format. The benefit of experience and the feedback we have received from the youth participants, presenters, youth leaders, and evaluators helped to continually evolve and improve the program. The primary adaptation we made for youth is in the Café format. A typical Café program for adults begins with an informal 20-minute presentation, followed by a 10-minute intermission to refresh drinks and talk with a friend about the presentation ideas, and then an hour or more of open discussion. Cafés differ from a lecture in their length and informality, and differ from a forum by the structure of the discussion. Our initial plan was to have a Café of this traditional format early each month, followed two weeks later by a Café on a related topic that primarily offered active inquiry.

For the more traditional Café format, we encouraged the presenter to pose a relevant provocative question or conundrum to stimulate a spirited discussion or

Table 1. Demographics of communities served (from US 2006 Census and NM Department of Education)

	Albuquerque	Española/Pojoaque	Los Alamos	Santa Fe
Population	504,000	13,300	18,800	72,000
White (not Hispanic) (%)	49	11	81	47
Hispanic (%)	41	78	12	48
African American (%)	3	<1	<1	<1
Native American (%)	4	9	1	2
Asian (%)	2	1	4	1
Median household income	45,000	27,000	78,000	40,000
Graduation rate (%)	60	51/64	82	50

debate among the youth, but not all topic lend themselves to this. We used both small and large group discussion techniques depending on the size of the audience, with the scientist interacting with the groups' discussions. We sometimes provided questions to facilitate discussion. Only with the most provocative topics and a highly dynamic speaker did this format work for youth. And, in general, structured discussions felt a bit too much like school.

The second Café each month was generally a bigger success. Hands-on activities fostered greater interaction and enthusiasm. Feedback in comment cards and formative evaluation indicated that the youth preferred hands-on learning, yet the top-rated aspect of the Café was interacting with the scientist and learning about the scientists' own research. So, we had a bit of a dilemma about how to make each Café fully engaging. Also, we struggled to find hands-on activities that were simple and low cost enough to accommodate drop-in audiences of 30–130 youth, while keeping the program focused on informal learning. Over the first year, we ultimately evolved to a format in which each Café has some time for a presentation and discussion and some time for active learning.

Today our Cafés take the form of highly interactive 1.5 hour-long programs. Youth participants gather for an initial period of socializing with food and drink. Substantial refreshments are provided, as many youth are coming from a sports practice or after school job and have not had dinner. About 15 minutes after the start time for the event, the presentation begins and the food table is closed for the duration. Presentations are peppered throughout with questions to and from the audience. A typical 10–25 minute presentation is followed by related activities such as game play, computer challenges, experiments, and more. Youth have learned how to decipher remote sensed images that use Google Earth imagery to 'spy'; had a dialog with a person who has lived 19 years with the HIV virus; explored nanotechnology through experiments and games; matched victims to unsolved crimes using human skeletons and knowledge of how to determine gender, age, race, and cause of death from a skeleton; and built model fuel cell cars. We have even convened field trips to a television station, bronze foundry, and the National Weather Service.

What we have learned from participants' written comment cards and the youth leader's oral feedback is that, like the adult Cafés, the less formal and more interactive the program, the better the experience. Like others, we have also observed that programs that are mindful of, and build on, the prior knowledge and interests of the youth have richer discussions and questions (Dallas, 2006). Technical language is not important to stimulating interest and learning; in fact, it can easily quash learning. Focusing on teaching a single big idea or a single big concept is more effective than covering multiple concepts. The youth really appreciate balanced presentations that address both sides of a controversy or present both the positive and negative implications of new discoveries. Because of their more limited knowledge, youth generally do not feel comfortable challenging the expert on technical grounds. So, to ensure discussion, the expert must come prepared to talk about what is and is not known on the subject and alternative hypotheses to their own preferred hypothesis. Presentations that project only gloom and doom for the future are discussion killers. If presented

with a topic dwelling on a looming problem, youth want to hear about possible solutions and new directions for research.

Essential Elements of a Successful Café Program for Youth

Through trial and error, supported by summative evaluation data (Foutz & Luke, 2010), we have learned that there are a few essential elements for a youth Café to work well. The following questions served to guide the study of the program model:

(1) Which components of this project are most vital to its success? Which are optional?
(2) What are key factors to ensure successful implementation of this model?

The most essential elements of the Café model are the people involved (program leaders, scientist-presenters, youth leaders, and youth attendees) and the implementation of the program at multiple, diverse sites.

Additionally, there are other details that must be attended to for success. While organizing such a program is not a trivial venture, interacting with the youth and the scientists, experiencing the excitement and enthusiasm of both, and showing an evolution in the youths' perceptions of science and scientists provide some very significant rewards. We discuss the importance of these elements below.

Youth Leadership of the Program

We believe that having youth leadership is extremely important to keep abreast of the needs and interests of the target audience month-to-month and to keep the program fresh and vibrant. To the greatest extent possible, we have allowed the youth to embrace the Café program as *their* program. This is what we mean when we describe the Cafés as youth-led. An important aspect of this is the Youth Leadership Teams (YLT) formed in each town.

The YLTs, like the program, operate in a less formal context than a youth internship or apprenticeship program, but still allow for youth to develop new skills and have strong input into the program. Youth leaders run all aspects of the Café meetings, with adults in the background providing support as needed. They advise on what topics should be presented, and assist with preparing, introducing, and thanking the presenter. They are key to promoting the program in their respective communities. They enthusiastically recommend food menus and then help to serve the food at the meetings. They greet people as they arrive and gather their contact information for a drawing at the end of the meeting. This contact information allows us to remind youth about upcoming meetings. At the end of the evening, the YLT clean-up crew gets to work. In contrast to their typical experience in school or at home, we give them every opportunity to run the show and take charge. We have found that this is a pivotal aspect of the program, which sustains the youth leaders' ongoing enthusiasm for and commitment to it. The enthusiasm of the youth in turn sustains the adult leaders' enthusiasm and commitment.

Any high-school youth that wishes to can join their town's YLT. Each season, we bring the YLT volunteers to a lively meeting shortly before school starts, where they bond and learn (or are reminded) about the different responsibilities as youth leaders. We also discuss topics for the upcoming Café season and ideas for hands-on learning. We have found that this meeting sets the tone for the coming year because the youth leaders understand what will happen and what their responsibilities are. In our evaluations, the youth leaders have told us that they appreciate having the opportunity to have their voices heard, take on responsibilities, and learn leadership skills.

Each month during the academic year, the adult leader in each town meets with the YLT to plan the next month of Café meetings. At the end of each Café, youth leaders are asked for their candid feedback on the program overall and the evening's event to assess how things are going and what changes might need to be made. A sense of camaraderie and shared purpose typically emerges within each town's YLT because of this process.

Summative evaluation data indicates that most youth participants feel a sense of belonging at the Café meetings, but only the youth leaders report having a feeling of ownership of the program. This is not unexpected, as most youth simply participate in a planned activity twice a month. However, our youth leaders have shown great pride and expressed a strong sense of ownership through their words and actions to continually help to improve the program. As one youth leader told us, 'Adults often tell us it is our program, but you actually let us make the decisions and run the program.'

Ensuring Dynamic and Well-Prepared Presenters

Recruiting presenters. Over the years, we have learned that the best presenters have a good science story to tell and—importantly—are able to grasp the challenge of successfully interacting with our particular audience. These are our guiding principles in recruiting. The process for recruiting a presenter begins with asking the youth leaders for interesting topics, topics that they are drawn to or ones about which they would like to learn. We make every attempt to satisfy the youths' wishes.

The key to finding good presenters is to simply ask around. We are fortunate to have a national laboratory, a major university, and several smaller colleges, and both Federal and State government agencies in our area to draw from. We ask contacts in these organizations for recommendations on colleagues who are doing some particularly interesting research and have given successful public talks. An organization's public relations office can be a good source of information about skilled presenters. We make further inquiries about the skills of likely presenters that have been recommended to us. Then, we extend an invitation and, with few exceptions, we have found presenters eager to participate.

Preparing the presenters. It is a challenge to get the scientists to give presentations appropriate for the youth and the informal setting, as opposed to what they are

used to: presentations to peers. We provide them with written guidelines and suggestions for their presentation. The guidelines stress the importance of knowing and connecting to the audience. Our youth will readily engage with a presenter on some hot science topics if it is accessible to them. It is best to assume the youth have little background on the topic. The presentation needs to be free of jargon and delivered in an engaging manner at an entry level so that youth will be pulled in and have a chance to develop some new mental images. Typically, we help the presenter simplify the language and complexity of the content by removing jargon and excess information. Unlike the classic Café model, we use visual presentations to help the audience better understand the big ideas. So, we also help to ensure the images, diagrams, and charts are easily interpreted and the text is very limited.

We ask the presenters to *tell a story* organized around one essential provocative idea or concept, which we refer to as the *Most Important Thing*. It is desirable that the *Most Important Thing* includes an unanswered question, a dilemma, or a controversy that is accessible enough to the youth that they can engage in discussion of it. Our goal is to promote informed discussion at a level that challenges them to think critically about the value, impact or merits of the idea or discovery. We coach the presenters to seek out interaction with the youth audience throughout the Café session by asking questions and posing challenges, using props and demonstrations. This has the added benefit of allowing the presenter to gauge continuously whether and what the audience understands.

It has proven to be essential for presenters to do a dry run with a small group before presenting to a full house of youth. Initially, we did dry runs with an audience of science peers. It was generally eye opening to the presenter to learn that scientists from other fields could not effectively sift through the jargon any better than the public. Later, the youth leaders suggested that dry runs be done before a group of youth after school; this has proved exceedingly valuable in getting the presentations pitched at the right level. However, it also takes a bit of coaching of the youth to get them to constructively critique the presentation. When prompted by an adult leader, youth will tell the presenter whether or not they understood a graph or major point that was made, though they might not feel comfortable spontaneously making the same comment. Interestingly, because the time and effort for creating this presentation is higher than the speaker may put into other professional presentations, several have commented that giving the presentation multiple times at our four sites makes the investment worth it.

The result of the dry run is that the speakers have a better sense of what youth know and how they will respond to the presentation. Several speakers who doubted the importance of the dry run presentation to the youth later told us that it had been a watershed experience. They had not realized how little they knew about the variation in background knowledge and the level of critical analysis among the youth. For others, the experience relieved them of their fear of this unknown audience.

Prior to the dry run, we ask the presenters to write two 1-page essays, one a summary of the science topic as they will present it, the other a very personal biographic sketch intended to capture the real person. This is a key step to helping the

presenter begin thinking about the needs and interests of the youth audience. We work with them on the essays by providing constructive feedback and editing. The essays are posted on the Café website in advance to stimulate good questions and substantive interaction during the Café event.

In the biographic sketch, the presenter tells his or her own personal story. We encourage them to stay away from the usual formal professional biographic sketch. It is much more engaging to the youth if a picture of the real person emerges—where did they come from, how did they get to where they are, what has grabbed their interest along the way, what their lives are like in their present research position. We want to get across that a scientist is a real, complex, multidimensional human, with his or her own unique set of motivations, delights, abilities, and foibles. The formative and summative evaluation suggests this seems to be working as the youth find the speakers to be interesting and the best part of the program. They enjoy learning about the scientists and their careers.

We encourage presenters to get across that—in part because of a career in science—he or she is having a particularly interesting life. Scientists are typically not used to thinking in terms of their personal stories—but each has had an interesting and unique story to tell. The essays have developed into a very interesting collection on the Café website at http://Cafenm.org. A serendipitous aspect of the program is that a large-cadre of scientist-presenters are better equipped to share the fruits of their science with the public.

Recruitment and Retention of Youth Participants

Recruiting. Our recruiting is designed to attract all youth, whether or not they have a strong interest in science, engineering, and technology, and we have been successful in this effort. Schools are critical to our recruitment. The school day and after school activities dominate the schedule and routine of youth's lives. Within school, they are reminded many times of upcoming events. We advertise the program at the schools using flyers, school marquee signs, daily announcements, email to teachers and youth participants, and the Parent–Teacher organization. We also collect the contact information of any parent who comes to the program and send them program announcements.

Teachers are important partners in broadcasting information about the program. Some offer extra credit to help us get youth to the program at least once. But, we have also found that when extra credit is the only reason to come, many only come once. Extra credit does not matter as much, if at all, to the youth interested in the program and science. Regular attendees often do not sign in for our door prize, which provides us the information on who attended and who might get extra credit.

We also announce the program meetings on our Cafenm.org website, our Café Scientifique NM Facebook page, public and community radio stations, in the community calendar of the local newspapers, and even on the community websites of the local television stations. All of our advertising is free.

As we serve three smaller towns and a mid-sized city, we have also been able to get stories published in local newspapers on a number of our Café programs. We encourage the employers of our presenters to highlight the event on their website. The employer for the majority of our speakers has written stories about the program for the daily and weekly news that is distributed to all employees. This is an important audience, as this reaches a significant number of parents of the youth audience we serve in three of our towns, Los Alamos, Española, and Santa Fe. These articles also raise the profile of the program and our speakers, making it easier to recruit future speakers.

We email all youth about the program twice each month and have over 400 youth participating as friends on our Facebook site. While we have not been successful in engaging the youth in an online discussion, many tell us that they read our Facebook postings about the program and current science in the news. Text messaging and cell phone are effective means of communicating with the Youth Leaders, especially when there are changes in our program schedule.

Retention. Retention is achieved through these regular and frequent communications; however, it is the experience at the Café that makes youth come back again. We make it fun with food, socializing, and active learning. We treat them as young adults, and focus on topics that appeal to them. Youth leadership retention is high, due to the sense of community they develop, and about half remain leaders for multiple years. The youth leaders themselves extend a sense of community to their friends and peers, making the Café a welcoming place for all.

Retention is increased by paying attention to the school and community calendar and avoiding conflicts. This is especially important in our smaller towns, where 'everyone' attends the school play or the sports event against the rival school, but it can also be a factor in large cities with major events. We offer the program in seven months of the school year, starting in September and ending at the beginning of April, with no Café in December due to holidays. We found that by mid-April College Board tests, Advanced Placement tests, and State performance tests begin to consume the youth's academic lives, and by May youth are too focused on end-of-school-year activities to attend.

For both youth leaders and general participants, we do not expect them to attend each Café. Many are athletes and cannot attend during the season of their sport. Others have concerts, plays, debates, and other activities that may conflict. Even with schedule conflicts, we have youth leaders who stay involved in the planning meetings throughout the year and attend dry run presentations, even if they cannot attend the regular Café meetings. We believe this increases our overall retention of youth and strengthens the program by encouraging long-term commitments, even if they are sporadic.

Two other factors have significant impact on retention: the location of the meeting and transportation. Youth are often dependent upon others for transportation or may have restrictions on their driving. Thus, the location chosen for the meetings can have a big influence on who is able to attend. Below, we note the importance of parental

engagement in the program on youth participation; however, choosing a good location is an important first step. Due to the rural areas we serve, we provide carpooling incentives to youth drivers to offset the cost of gas if they bring one or more of their friends or siblings, thereby, increasing the likelihood of a positive experience and return visit.

Secondary Elements for a Successful Café

Venues

The venue for the Café is very important. It must be conducive to social interaction and small and large group discussion. It must encourage movement among groups and allow for hands-on activities. Moveable tables and chairs are optimal. Theater style or other fixed seating inhibits people from clustering or being able to easily talk in groups. Poor acoustics or lack of a proper audio-visual system in a large meeting can invite unrest and side conversations. Venues can be hard to find for youth programs, without paying a rental fee. Churches, non-profits, local colleges, and businesses with large meeting space have allowed us to use their space freely, as long as we leave it just as we found it. We avoid school environments, because then the Café feels like school.

Role of Parents

Parental support is important to our program. At most meetings, there is a small cadre of parents in the audience. They are often there because they drove their child to the meeting. We get contact information from the parents and include them on our program email announcements. We welcome the parents, but ask them not to speak during the discussion and to leave any questions that they have for the speaker until the youth program is over. They seem genuinely engaged and respect that it is a youth program. In all cases, parents in the audience have been a benefit to the program. The feedback we get from parents is that they are very appreciative that their child gets such an experience.

Impacts of the Café Scientifique Program

We started this project with some trepidation: what if we build it and they do not come? But the program actually has proven popular far beyond our initial expectations. Attendance has continued to grow. Over 50% of the youth return for multiple Café events each year, a high-retention rate for a drop-in program. Additionally, on average more than 25% of the youth who attend one Café come to at least half of the events that year. Given the many competing activities and demands on high-school youth and the work, club, and sports schedules that vary throughout the year, we consider these retention rates to be very high. The impacts on youth are visible in their enthusiasm for the program and commitment to keep it running.

Youth have said in our formative evaluations and in comment cards collected at the end of a Café session that they increasingly see science everywhere in their lives and better understand its importance; can put the science they learn in school within a more relevant context; discovered that scientists are interesting people leading enjoyable lives in science; and have gained interest and knowledge in STEM and STEM careers.

The summative evaluation for this project had two foci: (1) an outcome evaluation of youth participation in the Café Scientifique program and (2) an assessment of the program model for future replication, including its impact on scientist-presenters. Researchers at the Institute for Learning Innovation conducted the summative evaluation in the spring of 2010 (Foutz & Luke, 2010). All results and analyses are available in Foutz and Luke (2010). We reported above on the key elements of the model, drawn from the summative evaluation. We report here on the impacts on youth and scientist participants.

Evaluation of Impacts on Youth

The following questions guided the youth impact evaluation:

(1) Does engagement in the program enhance youth participants'
   (a) understanding of current STEM content and issues?
   (b) sense of confidence and competence in their ability to develop and communicate factually supported positions on STEM issues?
   (c) appreciation for and interest in STEM careers?
   (d) attitudes toward science, the process of science, and scientists?
   (e) personal development, such as growth in character, perceived contribution to their community, and leadership skills.
(2) To what degree do youth feel a sense of belonging to and ownership of the Café community?

The evaluation drew from a framework described in the field of Positive Youth Development (PYD). PYD programs focus on a suite of issues that face youth as they transition to adulthood and has evolved to approach children and youth as individuals with positive *assets* to be developed (Catalano, Berglund, Ryan, Lonczak, & Hawkins, 2004). It offers a framework for creating and evaluating programs with a distinctly positive focus (Eccles & Gootman, 2004). PYD focuses on the whole person interacting within a network of influences that support healthy, successful youth development. This study used an outcomes-based framework described by Lerner et al. (2005), where six outcomes, called the six 'C's' (competence, confidence, connection, character, caring and compassion, and contribution), are the basis for a successful program. Non-PYD-related participant impacts, such as attitudes toward science, were also important to the program model, and therefore were also investigated. This learner centered approach to evaluating dialog events, such as a science Café, is supported by the work of Lehr et al. (2007).

Methods. Written quantitative surveys were used to investigate the program outcomes for youth participants. A quasi-experimental design was used, allowing for a matched (non-randomly selected) control sample. The design allowed for two types of comparisons: (1) between youth who participated in the Café program (treatment group) and youth who did not (control group), and (2) retrospective pre-program participation and post-program participation for youth who attended the program.

Program participants and non-participants rated their interest, attitudes, and knowledge toward science, STEM careers, and measures of PYD; it is important to note that the items measured self-perception without reference to an external norm or criterion. Program participants rated these items twice, a retrospective pre-program participation rating and a post-program participation rating. Program participants also rated their sense of belonging to and ownership of the Café program. Therefore, there were two versions of the survey, one for program participants and one for non-participants. Independent variables included: location of program attendance (town), program participation (e.g. the number of years, the number of events attended in a year, whether the person was a youth leader in the program), year in high school, number of high-school science courses taken, participation in other science-related programs, and proxy measures for socio-economic status and family values for education (e.g. number of adults in their household who are employed, number of adults in their household who attended college, parental expectations for the youth to attend college, and whether there was a scientist in their family).

One limitation of the study was that all items were worded positively (i.e. no items were reverse worded); the decision to use all positively worded items was made with consideration to the already complex nature of completing retrospective pre/post items. As a counter-balance, our rating scale introduces a negative bias, as it ranges from negative values on the left to positive values on the right (Belson 1966; Friedman, Herskovitz, & Pollack, 1994; Holmes, 1974).

Survey data were collected in April 2010 at Café-related events and at selected high schools in each town that Café participants attended. Data from the treatment group were collected at the Cafés and at the high schools; data from the control group were collected only at the high schools. Program staff at three of the four towns collected data during their April Café program (all except Española/Pojoaque). There was no incentive given at the Cafés for completing the survey, although the Café events always include food and door prizes for participants. At the high schools, surveying was done during lunch periods with the prior approval of the school principals; food (such as a sandwich, candy, or ice cream) was used as an incentive for completing the questionnaire.

Findings

Demographics and psychographics. The treatment and control samples ($N = 383$) were well-matched in terms of gender, number of employed adults in the household, number of adults in the household that had attended college, parental expectations

their child will attend college, and the number of high-school science classes taken. Youth in the program were significantly more likely to have a scientist in their family (38% compared to 23%; χ^2 (1, $N = 361$) = 9.11, $p < 0.01$) and were significantly more likely to participate in a summer time STEM-based program (7% compared to 3%; χ^2 (1, $N = 382$) = 4.38, $p < 0.05$) than were non-participants. In the extreme, participants from Los Alamos were significantly more likely than youth in other towns to have a scientists in their family (χ^2 (3, $N = 173$) = 39.604, $p = 0.000$). However, 34% of Los Alamos Café participants did not have a scientist in their family.

This indicates that youth who participate in the Café program may be self-selected; they may have higher exposure to science opportunities outside of school because of personal interest or a family culture that supports science interest. However, as we discuss below, a comparison of the overall science attitudes and PYD measures before starting the program for participants and non-participants showed very few significant differences.

Science-related impacts. Data related to the first evaluation question above were collected using Likert-type ratings scales for a series of items (scale: 1 = Disagree to 7 = Agree). Items on the survey included science-related statements and PYD-related statements (Table 2). Two levels of analysis were completed to answer the first evaluation question: (1) a comparison of the participant group's ratings to the non-participant group's ratings and (2) a comparison of the participant group's retrospective pre- to post-ratings.

Comparison of participants and non-participants in the Café program. Analyses indicate that the Café program succeeded at positively influencing attitudes about science. All the items designed to measure attitudes toward science, scientists, and science-based careers showed statistically significant differences between the participant and non-participant groups (Table 3). The study design also allowed for comparisons between participants' retrospective pre- and post-ratings; statistically significant differences were found between the retrospective pre- and post-measures for all science-related items.

The results for the PYD-related items painted a more complex picture than for the science-related items. The Café program positively impacted participating youth's perceptions of their cognitive competence; when compared to non-participating youth, youth participating in the Café program rated these impacts significantly higher (Table 4). However, there were no differences in how participants and non-participants rated items related to social competence. Note that the majority of the cognitive competence items mentioned science, whereas the social competence items were domain-free.

The item designed to measure the PYD concept of caring and compassion (within the dialog-based format of the Café) was rated significantly higher by Café participants than non-participants. One item designed to measure confidence (i.e. *I feel confident sharing with others what I know about current science issues*) was rated significantly

Table 2. Rating statements from the survey

Attitudes toward science, scientists and science careers	PYD ('C' related to that statement)
Science is interesting	I have a good understanding of the process of scientific research (cognitive competence)
I like science	I have a good understanding of science issues that I hear about in the news (cognitive competence)
I am interested in the process of scientific research	When talking to others about science, I use facts to support my point of view (cognitive competence)
I am interested in hearing more about science issues that are in the news	Before I make up my mind, I consider multiple sides of the issue (cognitive competence)
People should understand science because it effects their lives everyday	I am good at working with a team (social competence)
I can connect science to my daily life	When working on a team, I am willing to take on leadership roles (social competence)
Scientists make important contributions to daily life	I am confident speaking in front of a large group (social competence)
I know what scientists do	I respect people's ideas that are different from mine (caring and compassion)
I am interested in talking to scientists about their work	I seek out opportunities to serve my community (contribution)
I know about a variety of careers in science	My actions can change the world around me (contribution)
I am interested in a science-related career	I feel confident sharing with others what I know about current science issues (confidence)
	I am a self-confident person (confidence)
	I have a positive future ahead of me (confidence)
	I will go to college (confidence)

higher by Café participants than non-participants. There were no differences in how participants and non-participants rated the remaining confidence items or the items related to the PYD outcome of contribution.

Analysis of pre-program differences among groups. To determine if participating youth differed from non-participants on science attitudes and PYD measures before starting the program, the non-participants' ratings were compared to the participants' pre-program ratings. This comparison showed very few significant differences. For the few items that did have statistically significant differences (*Science is interesting, I can connect science to my daily life, I am good at working with a team, and When working on a team, I am willing to take on leadership roles*), non-participants had higher ratings. This demonstrates that, before starting the program, participants had very similar attitudes as those youth who did not participate.

Additional analyses were done to determine if independent variables such as demographics and participation in science-related activities resulted in differences between the participants and non-participants' ratings on the science-related and PYD-related items. Independent variables for which the ratings' between groups were significantly

Table 3. Attitudes toward science and science careers: impact ratings for the Café program, non-participants compared to participants (post-program ratings)

Item	Mean rank		Sample size		*U*-value	*p*-Value
	Participants	Non-participants	Participants	Non-participants		
Science is interesting	195.26	171.07	172	192	14,318.0	0.023*
I like science	200.75	163.74	163	197	12,754.5	0.001**
I am interested in the process of scientific research	205.41	158.15	166	193	11,801.0	0.000**
I am interested in hearing more about science issues that are in the news	214.67	157.54	170	197	11,531.5	0.000**
People should understand science because it effects their lives everyday	197.94	173.82	171	198	14,715.5	0.024*
I can connect science to my daily life	199.11	168.64	172	193	13,827.0	0.005**
Scientists make important contributions to daily life	208.68	164.55	171	198	12,880.5	0.000**
I know what scientists do	205.55	155.14	165	191	11,295.0	0.000**
I am interested in talking to scientists about their work	212.91	153.69	170	192	10,980.0	0.000**
I know about a variety of careers in science	219.50	154.45	170	198	10,880.0	0.000**
I am interested in a science-related career	206.04	160.25	168	194	12,173.0	0.000**

Notes: The Mann-Whitney *U* test was used to test for statistical significance.

*Significant at the $p < 0.05$ level.

**Significant at the $p < 0.01$ level.

different were: town; gender; year in high school; having a scientist in the family; number of adults in the household who attended college; number of employed adults in the household; number of high-school science classes taken; and, participation in additional science-related extracurricular activities.

The differences between the towns in which the Cafés were held were readily apparent to the Café program staff during implementation. The impacts by town were different also, lending support to their hypothesis that the variable of town was important. When looking at the science-related impacts based on town, Albuquerque,

Table 4. PYD: impact ratings for the Café program, non-participants compared to participants (post-program ratings)

Item	Mean rank		Sample size		*U*-value	*p*-Value
	Participants	Non-participants	Participants	Non-participants		
I have a good understanding of the process of scientific research (cognitive)	203.98	163.47	171	193	12,828.5	0.000**
I have a good understanding of science issues that I hear about in the news (cognitive)	214.67	157.54	171	198	13,349.5	0.000**
When talking to others about science, I use facts to support my point of view (cognitive)	203.25	165.35	170	195	13,133.0	0.000**
Before I make up my mind, I consider multiple sides of the issue (cognitive)	200.00	170.19	170	197	14,024.5	0.006**
I am good at working with a team (social)	168.05	182.30	167	183	14,036.0	0.167
When working on a team, I am willing to take on leadership roles (social)	167.84	177.68	164	181	13,995.0	0.334
I am confident speaking in front of a large group (social)	173.14	174.78	165	182	14,872.5	0.876
I respect people's ideas that are different from mine (caring and compassion)	189.48	160.83	166	182	12,618.5	0.006**
I seek out opportunities to serve my community (contribution)	180.82	166.75	166	180	13,725.0	0.180
My actions can change the world around me (contribution)	181.14	164.35	167	177	13,336.5	0.105
I feel confident sharing with others what I know about current science issues (confidence)	211.36	160.35	170	197	12,093.5	0.000**
I am a self-confident person (confidence)	178.88	172.38	168	182	14,719.5	0.531

(*Continued*)

Table 4. Continued

Item	Mean rank		Sample size		*U*-value	*p*-Value
	Participants	Non-participants	Participants	Non-participants		
I have a positive future ahead of me (confidence)	183.62	165.17	166	181	13,425.5	0.059
I will go to college (confidence)	182.32	166.54	164	183	13,641.5	0.065

Notes: The Mann-Whitney *U* test was used to test for statistical significance.

*Significant at the $p < 0.05$ level.

**Significant at the $p < 0.01$ level.

Española/Pojoaque, and Los Alamos all demonstrated significant levels of difference between the participants and non-participants on the majority of items; Santa Fe did not. Very few of the PYD-related aspects were rated higher by participants as compared to their non-participating peers, and there were no patterns within these differences that could be explained or isolated by town. All independent variables played a role in how the items were rated, indicating that many factors are involved in how the program impacted participants. For readers interested in the full analysis and results presented in this section, see Foutz and Luke (2010, Appendix 2).

Comparison of participants retrospective pre-program and post-program ratings. The study design also allowed for comparisons between the treatment's retrospective pre- and post-ratings. When these data were analyzed, statistically significant differences were found between the retrospective pre- and post-measures for all science-related items (Table 5) and PYD-related items (Table 6).

Café participants reported that their attitudes toward science and their attainment of PYD indicators had changed over time. Very few independent variables had a meaningful significant impact on how participants rated the items pre-to-post. The data are inconclusive as to whether greater participation led to higher changes over time. One of the four variables that did impact ratings was membership on the YLT. However, data also indicate more years of program participation were not linked to higher ratings.

Participants' sense of belonging to the Café community and ownership. Café participants rated a series of six statements to better understand the degree to which they felt a sense of belonging to (the 'C' of connection) and ownership of (the 'C' of contribution) the Café community. The statements were rated on a 7-point scale (1 = Disagree and 7 = Agree). The highest mean rating was for *I feel comfortable coming to the*

Table 5. Impact ratings for attitudes toward science and science careers: participants' retrospective-pre-program ratings compared to their post-program ratings

Item	Mean		Sample size	*Z*-value	*p*-Value
	Retro-pre	Post			
Science is interesting	4.8	5.7	160	−7.280	0.000**
I like science	4.9	5.7	148	−6.654	0.000**
I am interested in the process of scientific research	4.6	5.4	153	−6.488	0.000**
I am interested in hearing more about science issues that are in the news	4.7	5.8	158	−7.065	0.000**
People should understand science because it effects their lives everyday	5.1	5.7	157	−5.701	0.000**
I can connect science to my daily life	4.8	5.7	156	−7.040	0.000**
Scientists make important contributions to daily life	5.3	6.1	156	−5.108	0.000**
I know what scientists do	4.8	5.6	147	−6.820	0.000**
I am interested in talking to scientists about their work	4.8	5.7	153	−7.165	0.000**
I know about a variety of careers in science	4.8	5.8	155	−7.294	0.000**
I am interested in a science-related career	4.7	5.3	147	−5.764	0.000**

Notes: The Wilcoxon Signed-ranks test was used to test for statistical significance.

*Significant at the $p < 0.05$ level.

**Significant at the $p < 0.01$ level.

Cafés (Table 7). This makes sense because feeling comfortable is a prerequisite for attending in the first place. If a youth did not feel comfortable, they would not come. Overall, participants rated the statements designed to measure connection higher than the statements measuring contribution. Again, this makes sense because contribution is a 'higher bar' than connection. The contribution statements also had standard deviations above 2.0, an indication that there was more variability in how participants thought about contribution to the Café community.

It was hypothesized that those Café participants who had higher levels of involvement with the Café program would have higher ratings on the connection and contribution items than their less-involved peers. This hypothesis was true for two out of the three variables used to determine levels of involvement. Youth who were on the YLT had significantly higher ratings than non-YLT youths on two items (*If I have an idea about how the Café should be run, I know who to share my idea with* [$U = 1{,}150.0$, $N = 143$, $p = 0.001$]; *I have a say in what goes on at the Cafés* [$U = 1{,}220.0$, $N = 143$, $p = 0.002$]). Attendance at higher numbers of Café events over the past year yielded significant differences on every item as compared to lower attendance (Table 8). The number of years attending Café events did not impact how participants rated these items.

Table 6. Impact ratings for PYD outcomes: participants' retrospective-pre-program ratings compared to their post-program ratings

Item	Mean		Sample size	*Z*-value	*p*-Value
	Retro-pre	Post			
I have a good understanding of the process of scientific research (cognitive)	4.7	5.3	157	−6.401	0.000**
I have a good understanding of science issues that I hear about in the news (cognitive)	4.4	5.2	157	−6.657	0.000**
When talking to others about science, I use facts to support my point of view. (cognitive)	4.6	5.3	155	−5.231	0.000**
Before I make up my mind, I consider multiple sides of the issue (cognitive)	5.1	5.7	155	−6.237	0.000**
I am good at working with a team (social)	5.2	5.6	154	−4.287	0.000**
When working on a team, I am willing to take on leadership roles (social)	5.3	5.7	150	−3.738	0.000**
I am confident speaking in front of a large group (social)	4.6	5.0	152	−3.521	0.000**
I respect people's ideas that are different from mine (caring and compassion)	5.6	5.8	153	−3.296	0.001**
I seek out opportunities to serve my community (contribution)	5.1	5.4	153	−3.525	0.000**
My actions can change the world around me (contribution)	5.2	5.7	154	−4.126	0.000**
I feel confident sharing with others what I know about current science issues (confidence)	4.5	5.5	157	−7.431	0.000**
I am a self-confident person (confidence)	5.4	5.7	155	−3.791	0.000**
I have a positive future ahead of me (confidence)	5.8	6.2	153	−3.695	0.000**
I will go to college (confidence)	6.2	6.4	151	−2.203	0.028*

Notes: The Wilcoxon Signed-ranks test was used to test for statistical significance.

*Significant at the $p < 0.05$ level.

**Significant at the $p < 0.01$ level.

Table 7. Participant ratings for connection and contribution to the Café program

Item	*N*	Mean	SD
I feel comfortable coming to the Cafés (connection)	164	5.8	1.689
Attending the Cafés is important to me (connection)	164	5.2	1.829
My ideas are respected at the Cafés (connection)	162	5.1	1.891
I have built closer relationships with my peers because of the Cafés (connection)	164	4.8	2.076
If I have an idea about how the Café should be run, I know who to share my idea with (contribution)	163	4.6	2.167
I have a say in what goes on at the Cafés (contribution)	164	4.5	2.100

Program benefits. As part of a focus group, members of the YLT were able to talk about the benefits of the Café program on two levels: (1) as attendees of the presentations and (2) as members of the YLT. When reflecting on benefits of attending the presentations, participants talked about the benefit of being introduced to and learning about science and that the Cafés are a unique experience that they cannot get in school. A few people emphasized the benefit of getting to engage in hands-on activities and interact with real objects, such as the brain and human bones. One youth called these types of experiences 'active learning.' Explaining more why those types of active learning experiences are so valuable, participants said that you gain richer memories and that you often 'change your perspective.' Another benefit participants' discussed was getting to talk with real scientists who have passion for their careers, which, they say, increases their own interests in science. Youth also said that learning about science in the Cafés is fun—different than the typical school learning. When reflecting about benefits that come from participating on the YLT, participants described a range of benefits, including gaining leadership experience, increasing focus and concentration, and improving public speaking skills, all of which, they say, 'look good on a resume.' Another benefit of the YLT is that participants have choice and control over their learning experiences; they get to 'have a say' in the choice of topics and the organization of the Cafés.

Table 8. Participants' mean ratings on Café-specific PYD items by the variable number of Café events attended in the past year

Item	Number attended				Significant difference?
	Very few ($n = 78$)	About half ($n = 31$)	Most ($n = 33$)	All ($n = 11$)	
I feel comfortable coming to the Cafés (connection)	5.5	5.6	6.3	6.6	Yes, $X^2 = 10.133$, $p = 0.017$
Attending the Cafés is important to me (connection)	4.6	5.2	5.9	6.2	Yes, $X^2 = 15.520$, $p = 0.001$
My ideas are respected at the Cafés (connection)	4.8	5.2	5.4	6.3	Yes, $X^2 = 8.160$, $p = 0.043$
I have built closer relationships with my peers because of the Cafés (connection)	4.4	4.9	5.6	5.5	Yes, $X^2 = 8.947$, $p = 0.030$
If I have an idea about how the Café should be run, I know who to share my idea with (contribution)	4.0	4.7	5.4	5.8	Yes, $X^2 = 15.046$, $p = 0.002$
I have a say in what goes on at the Cafés (contribution)	3.8	4.8	5.2	6.3	Yes, $X^2 = 20.238$, $p = 0.000$

Impact on Scientists

There was widespread agreement among the scientist-presenters that the program had personal benefits. Four benefits were mentioned by participants in both scientist focus groups: (1) the personal satisfaction that comes from doing outreach; (2) the opportunity to share their enthusiasm for their work with the youths; (3) practice in presenting their work at a level that is different from how they present to their peers; and (4) the opportunity to think differently about their research and how it connects to the broader field or society. Another benefit expressed by some was a recognition that effectively communicating their science to new audiences has fed back into their thinking about their own research. These results align with the findings of Feldon (2011).

In addition to the focus group associated with our summative evaluation, we surveyed the presenters on the personal benefits of participating in the program. A sampling of responses is below:

> Both the preparation period (with the dry run and the 'telling stories' workshop) and the presentations themselves were challenges that taught me a lot about giving a technical presentation to a non-technical audience. I also emphasize that participating in the whole process and interacting with the youth was very enjoyable.
>
> I found the Café experience very helpful, as it forced me to focus on the really basic elements of my research and how to communicate them. This is a skill that is important not only for engaging with the community, but also for engaging with decision-makers and funding agencies. In addition, since I am a social scientist and my presentation included an exercise asking students to evaluate the resilience of their own communities to disasters, I gained useful information from the students on the resilience of New Mexico communities. This helped me think more clearly about some of the main issues in disaster resilience.
>
> The Café experience was beneficial to me as a scientist in that preparing an interactive talk for an audience of young people helped me identify the critical issues in my work: why I was doing it, why it is challenging, what we are trying to accomplish (vs. being bogged down in technical details). This really focused my thoughts about my work.
>
> It helped me to understand how the next generation of adults will think about issues in which science intersects with public policy. In my area, nuclear waste disposal, there is a significant component of societal input into the controversial issue of what to do with radioactive that will pose a hazard far into the future. I learned that issues of long-term stewardship as well as inter-generational equity resonate strongly with youths. Inasmuch as radioactive waste disposal is an inter-generational topic, it was highly instructive to me to learn that youths feel a long-term responsibility for ensuring that their generation takes responsibility for future generations, given that people today are the ones benefiting from the electricity generated with nuclear power.
>
> Professionally, I feel it improves my ability to teach to a broad range of people. Sometimes trying to explain science in more simplistic terms helps me see the questions and potential new means of investigating them in a fresh and helpful light.
>
> I think that the most beneficial part of presenting to the students was to see the true curiosity and love of learning new things that the students expressed. Their enthusiasm for learning was contagious. I was concerned that some of the students might be a bit hesitant to view and handle a human brain, which was a part of my presentation. Instead, they were quite curious and that portion of the session lasted longer than I anticipated.
>
> It takes a lot of energy and effort ... but it was really, really rewarding ... I got a lot out of it.

Conclusions

The most essential elements of the Café model are the people involved (program leaders, scientist-presenters, youth leaders and attendees). The strength of the model is that it has been implemented and evaluated at multiple, diverse sites. The program is successful because the benefits of participation outweigh the challenges for both the youth and the scientist-presenters. Evaluation data show very clearly that Café program positively influenced participants' attitudes toward science, including interest in science and science careers, knowledge of scientists' work, awareness that science affects their daily lives, and interest in science careers. It also positively influenced their self-efficacy and cognitive competence toward science including understanding of the nature of scientific research, their understanding of science issues in the news, the ability to use facts to support scientific points of view, and considering multiple sides of an issue before making a decision. This was true both for analyses that compared the ratings of participants to non-participants and for the retrospective-pre-to-post ratings of participants. Additionally, scientist presenters find real value in participating in the program.

Learning from experience, as well as our formative and summative evaluations, we have made continual improvements in the program—both on the teen side and the scientist-presenter side. The maturity of the program and its clear impacts make a strong case for our program to be a model for other communities to start their own programs.

Acknowledgements

This research is supported by the National Science Foundation (NSF# 0714762). Any opinions, findings, and conclusions or recommendations expressed in this report are those of the author and do not necessarily reflect the views of the National Science Foundation. NSF has not approved or endorsed its content.

References

Adams, J.U. (2004). How to start a science café. *Scientist*, *18*(10), 50–51.

Belson, W.A. (1966). The effect of reversing the presentation order of verbal rating scales. *Journal of Advertising Research*, *6*(4), 30–37.

Catalano, R.F, Berglund, M.L., Ryan, J.A.M., Lonczak, H.S., & Hawkins, J.D. (2004). Positive youth development in the United States: Research findings on evaluations of positive youth development programs. *The Annals of the American Academy of Political and Social Science*, *591*(1) 98–124.

Cohen, J., & Macfarlane, H. (2007). Beer and Bosons at the Café Scientifique. *Museums & Social Issues*, *2*(3), 233–242.

Dallas, D. (2006). Café Scientifique—Deja Vu: Is the Café Scientifique a fashionable by-product of a comfortable age or an indicator of the changing relationship between science and society? *Cell*, *126*(2), 227–229.

Eccles, J., & Gootman, J.A. (Eds.). (2004). *Community programs to promote youth development*. Washington, DC: National Academy of Sciences.

Feldon, D.F. (2011). Graduate students' teaching experiences improve their methodological research skills. *Science*, *333*, 1037–1039.

Foutz, S., & Luke, J. (2010). A youth-directed science Café: Impacts on teen participants. Institute for Learning Innovation, 68 p. Retrieved from http://informalscience.org/project/show/731

Friedman, H.H., Herskovitz, P.J., & Pollack, S. (1994). Biasing Effects of Scale-Checking Style in Response to a Likert Scale. *Proceedings of the American Statistical Association Annual Conference: Survey Research Methods* (pp. 792–795).

Giles, J. (2004). Pop science pulls in public as café culture goes global. *Nature*, *429*, 333.

Herskovitz, P.J., & Pollack, S. (1994). Biasing Effects of Scale-Checking Style in Response to a Likert Scale. *Proceedings of the American Statistical Association Annual Conference: Survey Research Methods*, (pp. 792–795).

Holmes, C. (1974). A statistical evaluation of rating scales. *Journal of the Market Research Society*, *16*(2), 87–107.

Lehr, J.L., McCallie, E., Davies, S.R., Caron, B.R., Gammon, B., & Duensing, S. (2007). The value of 'Dialog Events' as sites of learning: An exploration of research and evaluation frameworks. *International Journal of Science Education*, *29*(12), 1467–1487.

Lerner, R.M., Lerner, J.V., Almerigi, J.B., Theokas, C., Phelps, E., Gestsdottir, S., & von Eye, A. (2005). Positive youth development, participation in community youth development programs, and community contributions of fifth-grade adolescents: Findings from the first wave of the 4-H study of positive youth development. *The Journal of Early Adolescence*, *25*(17), 17–71.

McRaney, D. (2011). *You are not so smart*. New York, NY: Penguin Group.

National Academies, Committee on Science, Engineering and Public Policy. (2005). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: National Academies Press.

National Academy of Science, Committee on Developments in the Science of Learning with additional material from the Committee on Learning Research and Educational Practice. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academies Press.

National Academy of Science, Committee on Learning Science in Informal Environments. P. Bell, B. Lewenstein, A.W. Shouse, & M.A. Feder (Eds.), (2009). *Learning science in informal environments: People, places, and pursuits*. Washington, DC: National Academies Press.

Nickerson, R.S. (1998). Confirmation bias; A ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*(2), 175–220 (Educational Publishing Foundation). doi:10.1037/1089–2680.2.2.175, ISSN 1089-2680.

Ono, R. (2003). Learning from young people's image of the future: A case study in Taiwan and the US. *Futures*, *35*, 737–758.

Pallant, E. (1995). Teaching critical thinking using controversial issues. *The Teaching Professor*, *9*(10), 6–7.

Pallant, E. (1996). Assessment and evaluation of environmental problems: Teaching students to think for themselves. *Journal College Science Teaching*, *26*, 167–171.

Sink, M. (2006, February 21). Science comes to the masses (you want fries with that?). *New York Times*, Retrieved from http://www.nytimes.com/2006/02/21/science/21cafe.html

Tierney, J. (2011). Social scientist sees Bias within. *New York Times*, Retrieved from www.nytimes.com/2011/02/08/science/08tier.html

Tonn, B., & MacGregor, D. (2009). Individual approaches to futures thinking and decision making. *Futures*, *41*, 117–125.

US Census Bureau (2011). *State and County QuickFacts*. Retrieved from http://quickfacts.census.gov/qfd/states/35000.html