ABSTRACT

Outreach programs communicating the importance and diversity of computing to K-12 students are essential to improving attitudes toward computing. However, the effectiveness of outreach programs, and roadshows in particular, has only recently come under study. Just Be is an outreach roadshow program at Indiana University. It directly addresses stereotypical attitudes towards computing. This paper demonstrates, through statistical analysis of surveys given to college students who participated in a Just Be presentation prepared for high school students, that the Just Be roadshow effectively shifts attitudes for the better.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]: Computer science education

General Terms
Human Factors

Keywords
K-12, Outreach, Roadshow, Changing Attitudes, Stereotypes, Broadening Participation, Gender, Diversity

1. INTRODUCTION

The effectiveness of outreach programs is largely unknown, even for programs that have run for several years. Just Be is an interactive K-12 outreach program developed and managed by Indiana University’s Women in Informatics and Computing (WIC) group over the past five years [6]. It is based on the roadshow model pioneered at Carnegie Mellon University [8]. Just Be attempts to expand interest in computing-related fields and dispel myths about computing professionals. This paper presents evidence for the effectiveness of Just Be in changing attitudes towards computing.

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Figure 1: Middle-school girls run toy cars through a sorting network during a Just Be activity.

At the CSTA Roadshow Workshop in May 2008, Lecia Barker questioned the practice of roadshows directly addressing myths, under-representation, and job security [1]. Barker strongly encouraged programs to regularly assess the effectiveness of their efforts and update content based on recipient feedback. This paper presents such an assessment with respect to the Just Be program. Particularly, Barker warned that talking about misconceptions can actually reinforce them; a result that was demonstrated for older adults about commercial product claims over short periods of time in [5]. Significantly, the Just Be program directly addresses common misconceptions and thus is an important test to see if the lessons learned in marketing transfer to outreach activities.

To assess the impact on attitudes about stereotypes, educational requirements, and job prospects, we administered surveys to college students before and after they participated in a Just Be presentation (using college students to assess a K-12 program is discussed in Section 3.2). These surveys included open-ended and Likert-scale delimited questions. This paper gives an overview of the Just Be program (Section 2 and the results of the Likert-scaled questions (Section 3).

2. JUST BE PROGRAM

Just Be is an outreach program started by the WIC group at Indiana University. WIC is an organization for students,
faculty, staff, and professionals who wish to create a better environment for women in computing at Indiana University and beyond. The Just Be roadshow is one way we are working towards a more inclusive, friendly, and productive computing field.

Just Be was inspired by roadshow presentations done at Carnegie Mellon University and described in Unlocking the Clubhouse [3]. Over five years of activity, the Just Be presentation has been given to 46 groups, covering more than 3000 different students aged 10 to 25 (primarily middle and high school students). Since this effort relies heavily on volunteers, we only serve schools within 50 miles of the Bloomington campus of Indiana University. This includes Indianapolis schools, many rural areas, and the city of Bloomington itself.

While the Just Be program has been geographically constrained, we have participated in broader education activities encouraging other groups to develop outreach programs. Central to this effort are the Bring IT On! workshops held in 2006 and 2007 (with a follow-up in 2008), where many undergraduate students and educators were trained on roadshow creation [4]. Additionally, Just Be was featured in the Computer Science Teacher’s Association (CSTA) Roadshow Workshop at Google in 2008, SIGCSE workshops in 2007 and 2009, and contributed to the upcoming National Center for Women and Information Technology (NCWIT) Roadshow-in-a-box.

2.1 Goals

The Just Be program is constantly evolving, but we have remained focused on these desired outcomes:

- Increase awareness of the true nature of computing: An exciting, diverse, cooperative, and interdisciplinary field that benefits from the involvement of people with different interests, backgrounds, and experiences.
- Contradict prevailing negative stereotypes about people in computing and their work by providing real-life examples.
- Engage students by employing interactive demonstrations, and providing information about next steps at their school.

Our presenters, undergraduate and graduate students at IU, also gain confidence and experience creating presentation materials, practicing public speaking, and taking on leadership roles.

2.2 Format

The Just Be presentation is an interactive experience that integrates a slideshow with a personal response system and physical props to facilitate discussion and engage students. The content of the presentation is customized for each visit based on the age-group and time allotted. Two presenters typically take turns presenting the content. This provides different points of view for the students. Most presentations follow this outline:

Introduction: The presenters introduce themselves and the program. They typically describe (verbally and in pictures) an activity that they enjoyed when they were at the same age level as the audience participants, how they first became interested in computing, what they are doing now in computing, and what they like to do for fun. The idea is to demonstrate that there are many paths to a career in computing and that the presenters are well-rounded individuals.

Stereotypes examined: Computing stereotypes are elicited from the audience by asking how they imagine computing professionals look and work. Descriptions of geeks in basements are offered freely, indicating that such images firmly entrenched. After a good laugh at the stereotypes, we all decide they are not always true.

Real people in computing: The students are asked to identify the occupations of various people based on their pictures using a classroom voting system. It quickly becomes clear that this is an unreasonable request and people should not be judged based on appearance. After each question is answered, we go over what the people in the pictures actually do.

Fields of computing: This section is dedicated to interesting and practical applications of computing. We focus on occupations that employ computing, rather than on the computing techniques. After asking the students what they think computing is used for, we show them a variety computing research projects. We emphasize the collaborations, diversity and required skills in the projects. We include grade-appropriate activities students can do now to prepare for similar projects. Our examples illustrate the ubiquity of computing and its applicability to a variety of fields.

Computing skills: To give students a sense of the thought processes of computing professionals, we conduct a number of interactive group activities (e.g., logic games and algebraic word-problems using slides or props, see Figure 2). The presenters facilitate the activities so that all students are encouraged to share opinions and explain why they think they are correct. Throughout these activities, we emphasize that a variety of viewpoints are important in complex problem-solving as the first suggestion is rarely the correct one. Tim Bell’s “Magic Parity Board” is an activity that we use [2].

Career information: We often take time to discuss the practical issues of job security and salary with high
school students. During this section, we typically discuss how computing can be used in conjunction with skills typically associated with other professions.

Conclusion: The presentation concludes with contact information for the presenters and an open question and answer session.

Hands-on tasks: Acting on feedback from students, presenters, and teachers, we have developed a library of hands-on activities (e.g., Scratch-based [7], adaptations of Computer Science Unplugged [2] lessons, controlling scribbler robots; see Figure 1). We deploy these activities at science fairs, residential summer camps and in school visits when time permits.

3. STUDY

To evaluate the effectiveness of the Just Be program, we measured the attitudes of college students before and after a Just Be presentation. A pre-survey was made available to students one week before the presentation was scheduled. The same survey (minus demographic information) was made available for one week after the presentation. The survey includes ten questions (see Table 1) regarding the student’s personal attitude towards computing. We used a 5-point Likert scale to measure degree of agreement with a given statement in the survey. In the analysis, the top two values (Strongly Agree, Agree) and bottom two (Disagree, Strongly Disagree) are grouped.

The surveys were administered in multiple sections of two courses over six semesters. A110 is an introduction to computer concepts and applications course; it is typically taken by non-majors to fulfill general education requirements. The other course is our CS1 course and is comprised primarily of freshman and sophomores, about half of which are considering computer science as a major or minor. The majority of responses are from A110 because it has substantially larger class sizes; however, the results of both courses are combined except where indicated.

The surveys were conducted online; students could participate anytime during the week before (for the pre-survey) or after (for the post-survey) the presentation. Responses tended to spike very close to the closing times of each survey.

### Table 1: The ten Likert-coded questions, the pre- and post-percent agreement and t-test change significance (N = 520). The Keyword column shows how the question is referred to in other tables.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Statement</th>
<th>Pre-survey</th>
<th>Post-survey</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverse</td>
<td>Computing is a sufficiently diverse field</td>
<td>57%</td>
<td>84%</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Life-long</td>
<td>Understanding computing is an important life-long skill</td>
<td>84</td>
<td>93</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Programming</td>
<td>Computing is mostly about writing programs</td>
<td>24</td>
<td>17</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Employable</td>
<td>Taking 2+ computing classes will make me more employable</td>
<td>73</td>
<td>83</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Limiting</td>
<td>A degree in computing will limit the places I could work</td>
<td>11</td>
<td>8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Exciting</td>
<td>Computing is full of exciting opportunities</td>
<td>55</td>
<td>81</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>White&amp;Male</td>
<td>Only white males do computing jobs</td>
<td>7</td>
<td>5</td>
<td>&lt;.0049</td>
</tr>
<tr>
<td>Geeks</td>
<td>Computing professionals are geeks</td>
<td>25</td>
<td>16</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>No People</td>
<td>Most computing jobs do not involve working with people</td>
<td>22</td>
<td>12</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>High School</td>
<td>Students who do not take computing in high school are ill-equipped to major in computing in college</td>
<td>25</td>
<td>15</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

#### 3.1 Methods

We are interested in the shift of attitudes experienced by the populations between their pre- and post-survey. To accomplish this, we used a paired t-test. For each question, students who did not respond to both the pre- and post-survey for that question were eliminated. A significant t-test result indicates that the null hypothesis, that there was no shift in attitudes, should be rejected. In addition to t-test values, the mean, standard error of the difference, and p-value of the t-test were calculated and examined. We further examine the results that had p-values less than .05, a common cutoff for high significance.

#### 3.2 Limitations

Evaluation forms were obtained from 666 students over three years, however only the 613 that returned both a pre- and post-survey are considered in this study. Additionally, if a student did not answer a particular question in either the pre- or post-survey, the data from that question was omitted from both surveys results. The data collected on individuals who only returned one survey may be useful to discover prevailing attitudes, but our analysis is concerned with the change in attitudes over time. Non-responses for a single item occurred from 12% to 25%. Such omissions may introduce bias in the same way that any convenient sample does.

This analysis indicates changes in beliefs for the responding students. However, as the students were not randomly selected, generalizing to other groups of students should be done with caution. Further, the pre- and post-surveys were administered within a short time period, immediately before and after the Just Be activities. It is not known if the changes in beliefs measured in this study will be sustained over time. A further potential cause of bias is in the presentation method itself. Each section of each course was given the presentation separately, often by different people in subsequent semesters. We make no attempt to account for or measure this effect, but the presentation method is consistent with how Just Be is conducted in the K-12 arena. A major limitation of this study is that K-12 students were not directly studied. The Just Be program is delivered in various forms across the K-12 age range, but we studied its effect on college students. To minimize the difference, the presentation given during the study was identical to a presentation given to high school students. To help gauge shifts that occur with age, we separately analyzed college
freshman, typically only one year older than our target population (see Table 5). Given the small difference between college freshman and high school seniors and the size of the shifts that occurred between college freshman and the rest of the study group, we believe that these results can be applied to presentations given in high schools. However, a study using participants in the target age ranges would provide greater confidence.

### 3.3 Results

Analysis of survey responses have been divided into a number of significant comparisons which are analyzed separately in this section. The overall results and question text can be found in Table 1.

Demographics of the respondents are found in Table 2. Consistent with other observations, women are significantly under-represented in CS1 while the general education course (A110) is similar to the gender division in the university at large (females are slightly over-represented). Freshman represent 39% of respondents, sophomores 30%, juniors 15% and seniors 15%. Interestingly, one-third of the respondents are first generation college students, (meaning that neither parent had completed a four year degree or they grew up in foster care).

Our demographics questions included questions about prior and planned computing related education. Overall, 1 in 10 students said they were considering an undergraduate degree in Computer Science or Informatics. Following current norms, males were 5 times more likely to say this than females (4% females vs. 20% males). Ten percent of respondents said they were taking or had taken other classes in the School of Informatics and Computing (SoIC), 8% of females and 12% of males. This result corresponds well for females indicating interest in a computing related field (7%), but is substantially less than the number of males considering a computing related field (25%). Even before participating in the Just Be program, many students were planning on future computing related courses (15% of females and 39% of males). The higher numbers of students planning on computing courses vs. planning on computing-related degrees is interesting, but its cause is unknown.

#### 3.3.1 Statements

All of the questions analyzed showed a significant change between pre- and post-survey at the .005 significance level (see Table 1). Increases in percent agreement were encouraging. The statements that showed the largest increase in percent agreeing were:

- Computing is a sufficiently diverse field (57% in the pre-survey to 84% in the post-survey)
- Computing is full of exciting possibilities (55% to 81%).

Similarly, the statements that showed the largest decrease in agreement are also indicative of successfully communicating the desired ideas. The statements that showed the largest decrease in percent agreeing were (1) “Most computing jobs do not involve working with people” (22% agreed in the pre-survey compared to 12% in the post-survey) and (2) “Students who do not take CS in high school are ill-equipped to major in CS in college” (25% agreed in the pre-survey compared to 15% in the post-survey).

Table 3 shows the percent of students agreeing with the ten statements in the pre- and post-survey by gender. Notable results indicate that females in the pre-survey generally had a lower of opinion of the social aspects of computing careers, but those impressions improved on the post-survey. Examples of this include:

- In the pre-survey, males were more likely than females to agree that “Computing is full of exciting opportunities” (49% of females and 66% of males). In the post-survey, 79% of females and 84% of males agreed with this statement.
- The gap between males and females narrowed from the pre-survey to the post-survey for the statement “Computing jobs do not involve working with people.” In the pre-survey, females were twice as likely as males to agree with this statement (26% females; 13% males). However, in the post-survey 14% of females agreed compared to 11% of males.

Table 4 shows the percent of students agreeing with the ten statements in the pre- and post-survey by course. A110 is a general-education course with sections covering office applications and basic HTML.
Table 5: Results split by class year.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Freshmen (N=234)</th>
<th>Others (N=431)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverse</td>
<td>Pre-</td>
<td>Post-</td>
</tr>
<tr>
<td></td>
<td>58%</td>
<td>88%</td>
</tr>
<tr>
<td>Life-long</td>
<td>86</td>
<td>96</td>
</tr>
<tr>
<td>Programming</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>Employable</td>
<td>74</td>
<td>86</td>
</tr>
<tr>
<td>Limiting</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Exciting</td>
<td>55</td>
<td>83</td>
</tr>
<tr>
<td>White&amp;Male</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Geeks</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>No People</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>High School</td>
<td>25</td>
<td>16</td>
</tr>
</tbody>
</table>

The roadshow technique is a straightforward, low-cost, easily replicable method of conducting outreach activities. An interesting evaluation challenge is to compare the effectiveness of a roadshow to other programs (e.g., computer clubs, competitions, weekend workshops), with attention to the time and financial investments required by each.

5. CONCLUSION

Just Be is an exemplar roadshow outreach program. It directly confronts stereotypical attitudes towards computing. Our study provides evidence that countering stereotypes with vibrant images of real people doing real work results in a more positive attitude toward computing-related fields, persisting up to a week later. How long the effect continues thereafter is an open question.

6. ACKNOWLEDGMENTS

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7. REFERENCES