Diversifying the Images of Computer Science: Undergraduate Women take on the Challenge!

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ABSTRACT
This paper tells the story of a student initiative, driven by a desire to diversify the images that surround the field of computer science and those who work in it.

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1. INTRODUCTION
This paper tells the story of a student initiative, driven by a desire to diversify the images that surround the field of computer science and those who work in it. We believe it may hold some helpful pointers for those interested in showing that computer science is so much more than "coding". We also offer a useful model for those interested in launching an outreach program for encouraging more girls and women (and boys and men) into the study of computer science.

2. BACKGROUND
Over the past few years we have become well aware of the declining numbers of girls and women entering the computer science major. The problem has been well researched and documented, and disseminated in such well known articles as Tracy Camp's "The Incredible Shrinking Pipeline" [1] and "The Incredible Shrinking Pipeline Unlikely to Reverse" [2].

More recently the issue of declining numbers of students has been felt across the board, as fewer men, as well as women, make the decision to enter the computer science major. Peter Lee, Professor and Associate Dean for computer science undergraduate education at Carnegie Mellon, points out "According to the 2002-2003 CRA Taulbee Survey,[1] enrollment in undergraduate computer science programs has dropped by more than a quarter since 2001. This is stimulating a growing amount of discussion in computer science departments nationwide."[2] [3] Indeed, what was a cause for concern for women's enrollment is now an overall concern.

The issue of declining numbers may actually be a much needed wake-up call for those of us in the field to re-evaluate, re-think and re-shape what computer science really means and how it is perceived in the public consciousness. We may expect greater attention to the issues and a diversity of recommendations and approaches to tackle the challenges. We may find that some of those aspects of the field that have been deterring women from entering are actually deterring all students, and strategies for change may well result in increasing enrollment overall and a more gender balanced environment. But numbers may not be the only issue here, and certainly the field in general should benefit from the resulting re-examination and strategies for action.

The *images* surrounding computer science represent just one among many issues that cloud our understanding of the field. Dominant images still suggest that the field is populated by geeky[3] guys, while at the same time the image of the field itself is seen as little more than coding. *The image of computer science as a broad and exciting field with the potential for diverse participants is, for the most part, missing from the big picture.*

Changing the big picture will be no easy task. Nevertheless, council members from our student organization, Women@SCS, at

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[1] 2002-2003 CRA Taulbee Survey: http://www.cra.org/statistics/

[2] For more on Professor Peter Lee's thoughts see the "Shrinking Pipeline"
http://pl.ug.cs.cmu.edu/csd/pmwiki.php?pagename=Main.ShrinkingPipeline

[3] The word "geek" seems to have entered the vernacular in the 1990s as a label for computer obsessed individuals. For an interesting discussion of the term see:
http://dictionary.reference.com/search?q=geek

Carnegie Mellon University, decided to take on the challenge at the local level.

2. WOMEN@SCS ADVISORY COUNCIL

The Women@SCS advisory council is made up of graduate and undergraduate students, and faculty, in the School of Computer Science. The council represents a thriving and significant body of women students[4] and works to create, encourage, and support women's academic, social and professional opportunities in computer science and computing-related areas and to promote the breadth of the field and its diverse community.

Lenore Blum, Distinguished Career Professor of Computer Science and faculty advisor to Women@SCS has noted "there is no dearth of ideas generated by the Council and, indeed, the level of energy expended is extraordinary". [4] The council organizes numerous networking, social and professional events on-campus and a busy program of outreach activities.[5] Blum also points out that, "in terms of their increased professional experiences, contacts and growth, their self-esteem, and their academic and leadership successes and awards" council members are deserving beneficiaries of their desires and efforts to reach out to others. [4]

So with the goals of promoting the breadth of the field and its diverse community in mind, council members took on the challenge of developing an outreach program based on their vision of how the field should be represented. And since many strategies that work well for women have been found to work well for all, we may find their contribution, though minor in the larger scale of things, can reach out beyond their initial goals and expectations.

3. THE ROADSHOW STORY

A little under three years ago a small group of our undergraduate women went to the Richard Tapia Celebration of Diversity in Computing Conference[6] and came back to school full of post-conference enthusiasm and energy. This was their first conference experience and it made a huge impact on their view of the field, an impact that would have been hard to replicate even at Carnegie Mellon, where although we have made huge steps forward in improving our gender balance, we still struggle to diversify our computer science undergraduate student body in terms of race and ethnicity.

Following the return of our Tapia contingent the group gave a report to the Women@SCS advisory council at their weekly meeting. They summed up their experiences by unanimously declaring (and I paraphrase): "We must do more Outreach! ….especially to middle school girls! We have to let them know there are women and minorities in the field and that it's not just about coding!" And I said "Okay let's do it!"

The following weekend a group of students worked together and made a powerpoint slideshow which tackled two image topics head-on: "Who can be computer scientists?" and "What can you do with computer science?" At subsequent meetings we talked more about our goals (see 6. below), and the logistics (see 7. below) of putting their plans into action; we improved and revised the content and added new slides and finally began giving presentations of what soon became known as the Outreach Roadshow, a title suggested by our faculty advisor, and soon claimed.

Since then the Roadshow has become a very popular and valuable program within our organization. It has captured the imagination of our undergraduate students and graduates alike. We have presented on campus, and at middle schools. We have "upgraded" the slideshow to be appropriate for high school students and have presented for middle and high school teachers. More recently we have developed a "research focused" version that is presented by our graduate women to undergraduates. We have provided an online downloadable version[7] and have welcomed requests from students and teachers to use it as their model. We have continually improved the Roadshow as we've collected, and responded to, feedback from students and teachers. When Bill Gates, Chairman and Chief Software Architect of the Microsoft Corporation, came to campus our group was called upon to give a demonstration of the "show".

Over the past year we have produced a more sophisticated version of the Roadshow in which our graduate women present at other campuses to undergraduate students. They discuss the variety of programs in computing related fields available at the graduate level. They talk about the need for more women in the field in academia and how to pay for graduate school. The students tell their personal stories, give overviews of their departments and give short talks on their individual research. At the last graduate Roadshow the students represented such diverse areas as Robotics, Language Technologies, Computational Neuroscience and Computer Science. [8]

Perhaps the most meaningful and exciting moment for us was going back to the Richard Tapia conference in 2003 and actually presenting our Roadshow at the site of its inspiration!

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[4] For the full story of how Carnegie Mellon reversed the trend with regards to numbers of women at the undergraduate level see: Blum, L. Women in Computer Science: The Carnegie Mellon Experience. http://www.cs.cmu.edu/~women/

[5] For more information about the Women@SCS advisory council and their program of activities please browse their web site: http://women.cs.cmu.edu/

[6] The Richard Tapia Celebration of Diversity in Computing: http://www.ncsa.uiuc.edu/Conferences/Tapia2003/index.html#PROGRAM

[7] http://women.cs.cmu.edu/What/Outreach/

[8] At Carnegie Mellon we have the advantage of having the School of Computer Science which is comprised of 6 departments representing a diverse range of areas. Our students are exposed, directly and indirectly, to a wealth of research areas and world-class faculty.

4. WHAT IS THE ROADSHOW?

The Roadshow is a presentation by a group of women undergraduates and graduates from the School of Computer Science at Carnegie Mellon who talk about their thoughts on the field, why and how they began studying the area, their early and current experiences, what computer science means to them now, and their future hopes and expectations. The presentation includes a slide show to illustrate the breadth of the field of computer science and computing related areas, question and answer interaction, a guessing game and (for younger audiences) a simple robot demonstration.

There are currently three versions of the Roadshow targeted at middle school, high school and undergraduate students. They all share the goals of a) bringing women's personal experiences of computer science and computing related fields to the audiences and b) getting students excited about the field and what it offers. In this way the Roadshow challenges stereotypes and promotes new images of computer science and computing related disciplines.

A description of the Roadshow fails to do it justice. It is the students themselves who give the presentation the potential to be effective. Their energy, visibility, technical know-how and interaction with the audiences combine with the slideshow images to challenge stereotypes and offer new images of the field and the people in it. With that in mind, below is a description of what the Roadshow looks like and includes:

- images of the students to illustrate their personal stories as they introduce themselves (these include their baby pictures or photos from outside of the work situation.)
- an interactive guessing game (diverse images of computer scientists and of non-computer scientists)
- an interactive discussion on what is computer science and what you can do with it? (children are asked about their use of the internet, instant messenger, etc.)
- a step by step math puzzle and introduction of the term algorithm (answers and more puzzles are provided)
- the breadth of the field is illustrated with a "talking heads" demo, simple robotics videos, the CAPTCHA project (which serves to identify humans from robots as they log in to such things as Yahoo), video graphics, speech recognition, computer science and biology, and more
- depending on the age of the audience the students will add information about the classes they take, job opportunities, the companies they can work for, and graduate school options
- depending on the age of the audience we use simple robot demos such as a "lego robot bug" and a Sony Aibo Robot dog
- the students conclude with a question and answer session (they encourage questions throughout) and then leave contact addresses and the web site address in case members of the audience want more information or have further questions

5. AUDIENCES

The content of the Roadshow changes to suit audiences such that the presentation for younger students is fast paced and fun with a guessing game and puzzles, while the undergraduate audience gets a taste of real research areas and advice on funding and applying to graduate school. While targeting girls and women, we nevertheless are inclusive of boys and men, because one of our primary goals is to show women in leadership and teaching roles to all audiences.

We feel the Roadshow is appropriate for the following audiences:

- middle school girls and boys
- high school students
- parents and teachers
- undergraduates from computer science and other fields
- representatives from industry
- all who are interested in gender equity and computer science

Our presentation for undergraduates has been given to small audiences at three universities thus far and we are currently preparing to present at the University of Pennsylvania and at Columbia University. We will also be presenting the graduate level Roadshow at the Grace Hopper conference[9] in Chicago this October.

6. GOALS

The Roadshow serves a variety of goals, in fact we deliberately want to make the most of all such presentations.

- to increase the visibility of young women in computer science
- to challenge traditional stereotypes
- to show the breadth of fields that computer science and related areas can encompass
- to spark interest in the science
- to provide an interesting and enjoyable learning experience
- role modeling
- to provide leadership/mentoring opportunities for our young women computer science students
- to challenge current images of the field and those in it
- to diversify current images of the field and those in it
- to expose undergraduates to the possibilities of research
- to provide opportunities for our graduate women to network with faculty and students from other schools

7. LOGISTICS

My current motto is "Be prepared for anything!" Although our Roadshows are carefully arranged we never quite know the make-

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[9] The Grace Hopper Celebration of Women in Computing 2004 http://www.gracehopper.org/

up of the audience and the setting until we arrive on the scene. The range has been surprisingly wide. We have presented in private schools to the entire student body in splendid auditoriums, and to public school classes in the main cafeteria having struggled in with our own screen, laptop and projector. In all cases, however, we have found the audiences to be wonderfully responsive! Perhaps the most meticulously and diligently arranged Roadshow, with numerous emails going back and forth, turned out to be the most disappointing because the session was set for a time when, unfortunately, undergraduate students were busy with classes and unable to attend. The rest of the day, however, was carefully thought out, with productive meetings, and our graduate women were able to network with faculty and other graduates so that overall it became a very worthwhile experience!

8. FEEDBACK
We are currently reviewing how best to evaluate the effects of the Roadshow program. Getting enough feedback is perhaps one of the most difficult aspects of the Roadshow. Ideally we would like to know if the presentation has had any impact and if there has been any follow-up or other initiatives as a result. We have a teacher questionnaire that has proved to be very helpful and we have listened closely to their comments and incorporated them where possible.

When we work with high school and middle school teachers we hear again and again how much they need, and appreciate, the examples and materials we use to demonstrate the breadth of computer science. There seems to be a desperate need for teaching resources that situate programming in the wider context of the field. Teachers seem to share our desire to try to break down the stereotypes that surround the field but rarely have the resources to do so.

Teachers also repeatedly affirm that the personal stories of our students, "their energy and enthusiasm" are what make the Roadshow so effective and unique. Something as simple as young women explaining how and why they decided to major in computer science can be very valuable and effective parts of such presentations.

Quotes:

"Some day I hope to be a computer scientist just like you" (7th grade girl)

"I think what you do is really awesome" (6th grade girl)

"The show is unique, you should keep it this way." (high school teacher)

"I liked that you showed a mixture of races" (high school teacher)

At one presentation a computer science professor pointed out that the "show" glossed over the grunt work of computer science in favor of the exciting parts. I had to admit this was absolutely true and somewhat deliberate since our focus was always on trying to get the students excited about the science. I was rescued by a young African American woman in the audience who argued that while our culture was so intent on getting kids excited about football and sports, we paid so little attention and energy to getting them excited about science!

My favorite feedback comment, though frivolous, came from a young child at an on-campus presentation. The children were asked by their summer camp organizer what they had leaned about computer science. One little boy put his hand up and said very seriously "I've learned that computer scientists are very pretty"!

9. BENEFITS FOR OUR STUDENTS
Our undergraduates and graduates are in very intensive academic programs. I am always amazed that they manage to volunteer so much of their time, energy and expertise to outreach work. The Roadshow is a clear example of the activism of the Women@SCS council members and their strong drive to give back to the community. I also hear again and again from our students that doing the Roadshow is such fun. When pressed they often explain that they wished they had been given similar presentations in their own schools.

Quotes from Student Presenters:

- "I really enjoy sharing my experience and enthusiasm with others while gaining valuable presentation experience."

- "I participated in the Roadshow because it is one way I can help students understand the boundless opportunities an education in computer science can bring."

- "What I got out of the Roadshow was a chance to improve my presentation skills and even learn some applications of computer science that I didn't even know of."

- "I see the Roadshow as a way to hopefully generate an interest in technology and its applications so that students will consider pursuing the field in the future."

Both the undergraduate and the graduate Roadshows provide our students with leadership and public speaking opportunities. By having graduates and undergraduates team up together to develop and implement the presentations, numerous opportunities for mentoring and learning from each other arise. The Roadshows help our students with confidence building and provide them with opportunities to illustrate their knowledge in a fun environment.

10. Conclusion
We live in a culture which specializes in manipulating our thoughts and attitudes through images. Image so easily becomes reality. But culture is constantly changing and we can challenge current images and try to change them as much as be affected by them. Indeed, as I listen to students' perspectives (men and women) as they discuss computer science stereotypes I hear them constantly redefining and reshaping the images that surround them.

The students who initiated the Roadshow did so with the aim of challenging and diversifying current images. As women they did not see themselves fitting naturally into the traditional image dominated by "geeky guys" but, *perhaps more importantly, as students of computer science, they did not see images of the field that matched their learning and exposure to an exciting field of study with the potential to impact many lives.*

Professor Lee suggests that to address the current state of computer science "demands a concerted effort by top scientists" [4]. In the meantime some of our women students are making one small contribution to meet his "call to action".

While it remains to be seen if the Roadshow has any real local impact, for the students involved it is clearly a very worthwhile experience, as one students commented: "Knowing that even one kid changed their views of computer science after all the presentations we did is enough for me to feel like I've made a difference!"

ACKNOWLEDGMENTS

Our thanks to the wonderful students who have created and presented the Roadshow and have given their time and energy to try to impact the images surrounding computer science. And our thanks to all the children, teachers and students who have participated as Roadshow audiences and organizers.

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