Broader Impact Area #2
Broadening Participation of Underrepresented Groups

This document provides a summary of a series of group discussions on NSF broader impact area #2, broadening participation of underrepresented groups, that took place at the NSF CISE Broader Impacts Summit held on June 22-23, 2010.

1   Definition of Broader Impact Area: Broadening Participation

The second NSF broader impact area, broadening participation, refers to all activities designed with the goal of recruiting, retaining, or advancing members of groups that are underrepresented in the field of computer science. The targets of these activities include women, African Americans, Hispanic Americans, Native Americans, Native Hawaiians, Pacific Islanders, Alaska Natives, and all other underrepresented groups. These activities may target individuals at any educational level, from kindergartners to graduate students, as well as faculty, members of industry, and the general public.

2   Current Exemplary Activities for Broadening Participation

To initiate the discussion, the group compiled an extensive list of successful activities that were designed to attract, retain, or advance members of underrepresented groups in computer science. The following list groups these activities into five general categories. This list, while not exhaustive, can serve as a starting point for principal investigators (PIs) who are interested in broadening participation, but do not know where to begin.

Creating Opportunities for Participation in Community Events

- *Organize or help out with an established minority-specific conference or workshop.* Conferences such as the Tapia Celebration of Diversity in Computing[1], the Grace Hopper Celebration of Women in Computing[2], and the annual Academic Workshop for Underrepresented Ethnic Minorities and People with Disabilities[3] are designed to bring together underrepresented minorities in computer science for networking, mentoring, and education about careers in computer science. PIs can volunteer to help organize such conferences, or to simply participate in these conferences as speakers or panelists. In this way, they can serve as role models to students, and provide students with mentoring opportunities and career development advice.

- *Organize or help out with a regional workshop.* Based on the success of the national Grace Hopper Celebration, groups of local organizers are now able to apply to hold a Grace Hopper Regional Consortium near their own universities.[4] These regional events provide an opportunity for students who may not be able to obtain funding to attend the national event to network and receive career advice. PIs can volunteer to help organize a local Grace Hopper event, or organize a local event targeted toward an alternate underrepresented group.

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[1]http://tapiaconference.org

[2]http://gracehopper.org

[3]https://apply2.cse.tamu.edu/AcademicCareerWorkshop/

[4]http://ghregionalconsortium.org

- *Organize or help out with a discipline-specific workshop.* Discipline-specific workshops such as the annual Workshop for Women in Machine Learning[5] and the Women in Theory Workshop[6] provide an opportunity for underrepresented minority graduate students and postdoctoral researchers to network and learn from experienced researchers in their own fields. PIs interested in starting a new discipline-specific workshop specific to their research area can build on CRA-W's existing Discipline-Specific Mentoring Workshops program.[7] Similar discipline-specific workshops could be organized for other underrepresented groups too, in cases in which there are sufficiently many potential participants.

- *Develop supporting events at a major conference.* PIs can encourage the participation of underrepresented minorities at major conferences in their own fields by organizing special events such as poster sessions, dinners, or opportunities for students to meet with speakers. For example, there have been a number of ad hoc dinners for female graduate students and faculty held at machine learning conferences in recent years.

Creating a Supportive Community Within a Department or University

- *Develop activities to foster community among members of groups with similar backgrounds or interests.* Working on a degree in computer science can be an isolating experience, especially for women or members of other underrepresented minorities who may feel that they do not fit in with their peers. To help deter these feelings of isolation, PIs can organize various types of meetings for students with similar interests within a department or university. These can be informal student meetings, speaker series, technical discussions, or anything in between. While the activities may focus on retention and advancement of particular groups of students, it is imperative that such efforts are inclusive and create a welcoming environment for all participants.

- *Train faculty and students to be more supportive and inclusive.* PIs can organize training workshops, which are led by people with relevant expertise, for faculty and staff within their departments, on how to be inclusive and culturally-sensitive when dealing with students.

Developing Appropriate Curriculum

- *Promote analytical and problem-solving skills in entry-level courses.* Students with diverse interests can potentially be recruited by promoting useful analytical and problem-solving skills in entry-level computer sciences courses instead of focusing on programming alone.

- *Develop more interdisciplinary programs.* Another way to attract students with diverse interests is to highlight exciting interdisciplinary applications of computer science skills. Interdisciplinary programs provide students an opportunity to develop technical skills and put these skills to use on any application that they are passionate about.

- *Develop courses using different teaching methodologies.* Different students respond to different teaching methodologies in different ways. For some, a "studio-based learning" model or master-apprentice pedagogical model may be more effective than standard college lectures. For others, engaging in critical analysis with classmates or having the opportunity to resubmit a project after receiving feedback to improve their grades might work well. PIs can develop non-standard classes to engage these students.

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[5] http://www.wimlworkshop.org
[6] http://intractability.princeton.edu/blog/2009/11/women-in-theory-2010-workshop
[7] http://www.cra-w.org/dsw

- *Develop or assist with bridging courses.* Bridging programs and courses are designed to make it easier for students to transition into technical programs. For example, these courses might help college graduates with no computer science background transition into a computer science masters program, or community college students transition into a four-year undergraduate computer science degree. PIs can help by designing bridging courses or working within their university or community to get these courses approved.

Reaching Out to K-12 Students

- *Participate in science and engineering competitions.* Competitions such as Lego League[8] are a great tool for getting students interested and involved in science and engineering. These projects are always looking for volunteers to help out.

- *Develop cool computer science lectures that can be presented to high school students.* Some faculty members would be interested in visiting a high school to speak to students about career opportunities in computer science, but are unsure of how to best present interesting computer science material to high school students. PIs can help by taking the time to prepare engaging presentations at an appropriate level for others to use and making this presentation material publicly available, as well as by giving lectures in high schools themselves.

- *Engage and educate high school teachers.* High school teachers may not understand what is involved in a career in computer science. Talking to high school teachers about computer science and how to recruit students into computer science could have big impact. NCWIT[9] and other organizations already have material prepared on how to educate high school teachers about computer science.

Assisting or Leveraging Existing Programs

- *Contribute to or leverage one of the existing BPC alliances.* The Broadening Participation in Computing (BPC) community encompasses a wide variety of existing organizations and alliances that need volunteers. These include the CRA-W (Computing Research Association's Committee on the Status of Women in Computing Research)/CDC (Coalition to Diversity Computing) Alliance, the Empowering Leadership Alliance, the Computing Alliance of Hispanic-Serving Institutions (CAHSI), the Alliance for the Advancement of African Americans (A4RC), the Advancing Robotics Technology for Societal Impact Alliance (ARTSI), the Alliance for Access to Computing Careers (AccessComputing), the Students & Technology in Academia, Research & Service Alliance (STARS), the Grace Hopper Regional Consortium, and the National Center for Women in Technology (NCWIT). There are also a variety of smaller local or regional alliances, including the Caribbean Computing Center for Excellence (CCCE), Into the Loop in Los Angeles, Georgia Computes!, and the Commonwealth Alliance for Information Technology Education (CAITE). Links to each alliance (and many other interesting programs) are available on the BPC Gateway website.[10] These alliances also provide resources that can be useful to PIs who wish the organize their own events or activities. Other existing institutions like the Center for Minorities and People with Disabilities in IT need volunteers too.

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[8]http://www.firstlegoleague.org

[9]http://www.ncwit.org

[10]http://www.bpcportal.org/bpc/comm/projects.jhtml

- *Apply to host a summer researcher through the DREU program.* The Distributed Research for Undergraduates (DREU) program[11] matches undergraduate students from underrepresented groups with faculty mentors from other institutions who agree to host the students for the summer and engage them in summer research projects. This provides students with a close-up view of what life as a graduate student would be like, as well as an opportunity to gain research experience before applying to graduate programs. PIs can apply to host a DREU student directly through the program, but can also request funding for a DREU student in their own proposals.

- *Volunteer to mentor a K-12 student on a research or engineering project.* Programs like Citizen Schools[12] and National Lab Day[13] offer opportunities for PIs to get involved in the community as mentors to students.

3 Other Potential Activities for Broadening Participation

In addition to discussing successful existing activities for broadening participation, the group engaged in brainstorming to identify other broader impact activities.

- *Promote the use of culturally relevant examples in teaching.* PIs can strive to use examples in their own teaching that demonstrate the value of diversity. For example, there is research that suggests that there are some problems that can only be solved by having diverse viewpoints or contributors. Refer to the Culturally Situated Design tools website[14] for examples of culturally relevant activities centered in mathematics. Culturally-relevant ideas and examples can be included in assignments too.

- *Engage parents and other student influencers.* Educating parents on STEM careers and financial support options available to students may make them more likely to encourage their children to pursue interests in science and engineering. This is especially critical in communities in which students are likely to be the first in their families to attend college.

- *Look into methods that have been successful for other scientific disciplines and figure out how to apply them to computer science.* Other scientific disciplines, such as biology, have been very successful at recruiting and retaining women and other underrepresented minorities. Computer scientists could learn from studying why this is true and what techniques have been used in these disciplines to attract underrepresented groups.

4 Characteristics of a Good Broader Impact Activity

The group next discussed some characteristics that make a broader impact activity good. Some of these characteristics apply to any broader impact activity, while others are specific to broadening participation.

Characteristics That Apply to Any Broader Impact Activity

The first few characteristics apply to any broader impact activity.

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[11]http://www.cra-w.org/dreu

[12]http://www.citizenschools.org

[13]http://www.nationallabday.org

[14]http://www.rpi.edu/ eglash/csdt.html

- *A good BI activity should be achievable.* PIs should consider how they will be held accountable for the activity or activities that they are proposing. If the activity is tied to a project that is measuring impact, then the PI should address how the activity connects with the project's evaluation component.

- *A good BI activity should be suited to the PI's skills, resources, and track record.* PIs should not propose elaborate broader impact activities that are unrealistically time consuming or complex. Similarly, they should not propose activities that require resources beyond what is available to them. Such activities are unlikely to be accomplished successfully. Instead, the PI should demonstrate that the activity is something that he or she is capable of completing in the specified period of time with the resources that are available.

- *A good BI activity does not have to cover all five broader impact areas.* PIs may feel pressure to touch on all five broader impact areas in each proposal. This is not necessary. While some activities may span multiple areas, there are many fantastic activities that focus only on one.

- *A good BI activity does not have to be novel (though it can be); it should be informed by existing work and based on good social theory.* PIs know that the intellectual merits they propose must be novel, and may assume that this requirement holds for broader impacts too. On the contrary, following best practices learned from existing BI activities and reproducing or adapting activities that have worked well for others should be encouraged. It is wasteful to ignore social theory and lessons learned by others.

- *A good BI activity should take actions beyond what any PI would do anyway.* "Mentoring a female student or student from an underrepresented group" does not qualify as a broader impact activity because mentoring students is simply part of the PI's job. Broader impact activities should go above and beyond what is already required of any PI.

Characteristics Specific to Broadening Participation of Underrepresented Minorities

The final few characteristics are more specific to activities designed to broaden the participation of underrepresented minorities. Some of these characteristics may be harder to achieve in practice, and harder to evaluate as well. More thought should be given to how to satisfy these criteria!

- *A good BI activity should avoid alienating or excluding majority members.* Sometimes activities designed to encourage the participation of one group can lead to the exclusion of another. Care should be taken to ensure that nobody is excluded.

- *A good BI activity should empower underrepresented group members.* Activities should focus on providing underrepresented group members with opportunities that help them become successful through their own efforts rather than because of special treatment. Every effort should be made to ensure that activities designed to encourage participation do not result in minority group members feeling stigmatized.

- *A good BI activity should have a "cool factor."* Activities designed to increase participation in computer science should be designed to showcase how exciting computer science is. These activities need to be engaging in order to capture the interest of people who might not have been interested otherwise.

- *A good BI activity which involves minority-serving institutions or organizations should include the collaborators in discussions early in the proposal-writing process.* Minority-serving institutions or

organizations need time to consider how well the proposed activities match with their mission and goals. It is important to have commitment from the PI that the activities will be supported if funded, and commitment from the collaborators to meet the goals of the proposed activities. There have been examples of minority-serving institutions and organizations being named in proposed activities but not being engaged or supported once the funding was awarded.

5 Suggestions to NSF

Finally, we discussed a number of recommendations we would make to NSF concerning how they might better promote and reward high quality broader impact activities.

5.1 Challenges in Broader Impact Activities

One of the biggest challenges in designing and implementing a broader impact activity is finding out what has already been done and exactly what resources are available. Many summit participants noted that PIs frequently try to reinvent the wheel when it comes to broader impact, because they are unaware of existing efforts. In doing this, they are unable to benefit from the past experiences of others. To combat this, we believe that NSF should promote the generation and dissemination of best practices for BI.

- *Advertise existing repositories of activities.* There is already a huge amount of information available on existing broader impact activities, such as the list of alliances and demonstration projects available on the Broadening Participation in Computing online portal mentioned above. However, many PIs, especially junior faculty, are not aware that these resources exist. NSF should promote these existing resources and encourage PIs to look into existing broader impact projects that need help.

- *Continue to generate research on best practices.* By researching best practices and making this research readily available to the community, NSF could help ensure that PIs do not keep repeating the same mistakes and instead engage in activities that are known to work.

- *Share measurable best practices and assessment tools developed by social scientists.* Social scientists have already developed techniques and resources that can be used to evaluate the success of BI activities. We recommend that NSF creates a repository of these evaluation resources that is easily searchable by PIs. This repository can be used to pool results from smaller efforts and make sure lessons learned are being shared.

Promoting best practices should also be helpful for PIs struggling with how to best meet the criteria outlined in the previous section, especially for tricky issues such as making sure that activities do not alienate majority members or make underrepresented group members feel awkward.

5.2 Reviewing Guidelines

While every NSF proposal is required to touch on broader impacts, there is a general consensus that the broader impact section is frequently ignored in the review process, with much more emphasis placed on intellectual merit. While intellectual merit is clearly very important, we believe that steps can be taken to ensure that the presence of broader impact activities is not just a formality.

- *Set aside time during panel discussions to discuss proposed broader impacts.* Many of us have been involved in NSF panel discussions in which panelists checked for the phrase "Broader Impacts" in proposal abstracts, but spent no real time discussing the scope and merit of the particular BI activities proposed. We recommend that program directors explicitly set aside time during panel discussions for panelists to comment on the appropriateness and merit of the particular broader impact activities described in each proposal.

- *Alter the language of panel instructions to make it clear that broader impact activities need not be novel.* Most NSF panelists are familiar with the requirement that intellectual merits must be novel, and may assume that this requirement holds for broader impacts too. However, there is no requirement that broader impacts be novel. If anything, following best practices learned from existing BI activities should be encouraged. We recommend that the panel review instructions be altered to explicitly state that broader impact activities need not be novel.

- *Score broader impact and intellectual merit separately, and require every NSF program to set aside funding for broader impact projects.* Currently NSF panelists assign each proposal a single score, which is typically based almost entirely on the intellectual merit of the proposed research. We recommend instead assigning separate scores for IM and BI, and requiring each NSF program to fund a portfolio of proposals with an average broader impact score above a set threshold. This would not mean that proposals with strong IM scores but weak BI could not be funded, but would mean that at least some of the proposals funded in each program would have to have high BI scores.

- *Create an additional round of consideration for proposals that are very strong in broader impacts but not quite competitive enough to be funded on intellectual merit alone.* As an alternative to the previous suggestion, one could imagine adding a "second chance" panel review for proposals across all CISE programs that have sufficient intellectual merit scores and exceptionally high broader impact scores but were not chosen for funding initially. The funding for these proposals could come from a separate pot of money that is shared across programs.

In addition to changing the review process, we believe NSF should change the way that broader impact activities are tracked. NSF already has a variety of mechanisms in place to track the progress of funded intellectual merit activities. Each of these mechanisms could be used to track broader impact activities too.

- *Introduce specific questions about broader impact activities into the Fastlane annual report.* PIs are currently required to fill out annual reports tracking their progress on the intellectual merit activities they have proposed, but are not required to report on broader impact activities. As a result, there is no way to track whether or not the proposed BI activities occur. Adding questions about BI activities to the existing annual report would give NSF a way to track progress.

- *Require a discussion of broader impact activities in the "Prior NSF Support" section of new proposals.* Similarly, when applying for new NSF grants, PIs are required to describe the results of research supported by prior NSF grants. We recommend that NSF require progress on broader impact activities to be reported in each new grant proposal too.

- *Include a broader impact session at each PI meeting.* The same idea applies to PI meetings. Progress on proposed broader impact activities should be discussed there too.

6   Names/Organizations of Participating Members

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