

Pre- to Post-Conference Differences: Celebrations of Women in Computing

Gloria Childress Townsend
Department of Computer Science
DePauw University
Greencastle, United States
gct@depauw.edu

Kay Sloan
Rockman et al
Bloomington, United States
kay@rockman.com

Abstract—In 2004, the Association for Computing Machinery's (ACM) Council on Women in Computing (ACM-W) launched a series of regional conferences for women in computing, called Celebrations. Celebrations adopted several components of the well-known international conference, the Grace Hopper Celebration of Women in Computing (GHC). This paper will describe the Celebrations' components and rationale for these components, based upon research into the causes for the underrepresentation of women in computing. Recently, two papers [26, 27] compared GHC's and Celebrations' common post-conference survey items for the first time, indicating that Celebrations' attendees rate identical questions about the conferences positively at a rate that meets or exceeds percents of GHC attendees. The papers' results provide important contributions to the literature of gender issues in computing, because another independent set of papers cites the advantages of attendance at GHC. Experimenters have not previously studied pre-surveys administered to either GHC's or Celebrations' attendees, nor have they compared the results of pre-surveys to post-surveys. For the first time, this paper describes pre-surveying and also post-conference, follow-up surveying at a several-months' interval after Celebrations attendance. Positive results from the follow-up surveys further extend the value of Celebrations.

Keywords—conferences; career development; student activities

I. INTRODUCTION

This paper provides current statistical information that demonstrates women's underrepresentation in computing. The paper also reviews the literature of gender issues in computing to point out research articles that list and explain rationale for the underrepresentation of women. The authors connect the research results to special localized conferences (Celebrations) and the conferences' components and describe a National (United States) Science Foundation (NSF) grant. The paper outlines a Celebrations' pre-survey and its results, and connects the pre-survey to the post-survey. The authors also describe a follow-up survey that they conducted. All survey results are compared to GHC's (a much larger and well-known global conference) surveys.

II. UNDERREPRESENTATION OF WOMEN IN COMPUTING

For more than twenty years, seminal articles by researchers [6, 18] have highlighted the underrepresentation of women in computing. Despite the attention that the statistics produced and the work of researchers to reverse the decline of women earning computing degrees, data [21] collected at the national level in the United States (US) indicate that little progress is occurring. Fig. 1 shows the current century's percents of female undergraduate degrees in computing dropping from a high of almost thirty-five percent and flattening to a final, six-year trend that places the rate at about seventeen percent, approximately half of the maximum rate in the time period 2000-2012.

III. LITERATURE REVIEW

Despite Fig. 1's trend for the past several years, researchers published articles [9, 17] containing localized successes for increasing women's representation in computing. It is important to thoroughly study any promising practices to broaden participation in computing, as the problem of underrepresentation is a persistent and challenging issue. This section of the paper highlights four promising practices for increasing women's participation in computing.

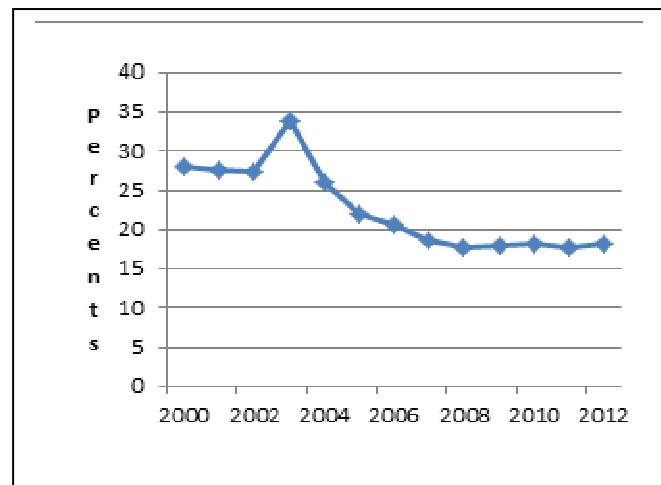


Fig. 1. Percents of computing bachelor's degrees awarded to US women

A. *Intentional Role Modeling*

Women can model positive attitudes, persistence, and empowerment to young students during vulnerable times in their academic careers. Intentionality means that role models understand or receive direct instructions to discuss all aspects of their careers, including early struggles and how the role models overcame these difficulties, without indicating that the difficulties resulted from their gender or that women are less capable than men in the computing field. Revealing the difficulties along with career information allows young protégés to identify with the role models, to emulate their behaviors, and to gain confidence that they too can succeed in a male-dominated profession [4, 16]. Closely associated with benefits from role modeling is the reduction of stereotype threat, where women perform less ably than their male counterparts, because they have internalized a message that women generally do not perform as well as men in mathematics or computer science [19, 20].

B. *Mentoring*

Mentoring directed at improving gender balance in undergraduate programs succeeds in retaining women in computing [8]. Mentoring leads to other positive effects in many settings, including undergraduate programs [7, 13, 14].

C. *Building Community*

Researchers report that women often leave the computing field as a direct result of the isolation they feel, after realizing that they are the only female or one of a few female students in their computing classrooms and in their majors [11, 25]. Social networks and organizations help to retain women in undergraduate and graduate computing programs [5, 9, 17].

D. *Providing Accurate Career Information*

Men often have access to accurate and useful career information through their informal networks. Women rarely have the same access, especially to information about technical careers. Formal communication of that information can help women enter and advance in technical careers [12].

IV. APPLYING LITERATURE RESULTS TO THE CELEBRATIONS

The following section will apply the research results summarized above to Celebrations of Women in Computing (Celebrations). Next, the paper will describe an NSF grant that funded both the creation of twelve new Celebrations and also the grant's assessment.

In 2004, the Association of Computing Machinery's (ACM) Council on Women in Computing (ACM-W) sponsored the first Celebration, the Indiana Celebration of Women in Computing (INWIC). Within a short time, conferences followed in Ohio, Colorado, and Michigan, and these four conferences continued biennially.

By 2009, ACM-W wished to expand conferences beyond the Midwest and Rocky Mountain states and sought funding from the NSF (Broadening Participation in Computing

program) to create twelve new Celebrations. The Anita Borg Institute (ABI) and the National Center for Women & IT (NCWIT) formed an alliance with ACM-W and contributed speakers for program events at the new conferences. Students (poster winners) and faculty conference organizers from the Celebrations also attended ABI's and NCWIT's premier events, (respectively) Grace Hopper Celebration of Women in Computing (GHC) [2] and the Annual Summit [22].

Although Celebrations now span more than a decade's time, the conferences (including the twelve Celebrations made possible by the NSF grant) follow a fairly standard format that the following sections of the paper describe.

A. *Basics*

- Celebrations generally last from Friday late afternoon, after weekly classes end, through Saturday lunch, concluding with a Career Fair mid-afternoon on Saturday.
- Attendance at Celebrations averages around 130-140 people.
- Celebrations include at least two tracks, reflecting attendee interests in research, graduate school, undergraduate school, and industry. Additional tracks include the concerns of faculty members and industry representatives.
- Examples of program events: an Imposter Panel and practical advice about interviewing, resume construction, and networking.
- The program contains at least one keynote address.
- Students participate in at least one poster session. Most conferences hold a poster session for research posters and a separate conference for informational posters and posters concerning social, ethical, and curricular issues.
- A lightning talk event (five-minute presentations) also provides developmental and confidence-building opportunities for students. Frequently, as in the case of poster sessions, two separate lightning talk events occur, divided in the same way that posters are separated.
- There is a designated time for informal networking and entertainment, frequently occurring late Friday evening.
- Industry sponsors host the Career Fair to interview students for internships and jobs.

The following sub-sections tie the conference components to Section III's research results.

B. *Intentional Role Modeling*

Adhering to research conclusions contained in section III.A, conference coordinators carefully choose keynote speakers, asking them to speak about their career paths, their research, and struggles they have overcome. Students meet

additional role models at the Career Fair and during meals or the Friday entertainment event.

C. Mentors

Paradoxically, away from the busyness of their respective campuses, students find mentors among fellow students and faculty members, along with mentors in the same populations at other institutions. Faculty members attend recruitment and retention sessions presented by NCWIT representatives, where the professors learn about mentoring and its benefits.

D. Building Community

The Celebration experience in its entirety builds community among its attendees, as they all reside within driving distance of each other, allowing students to easily commute to see each other again. Events, such as "Creating an ACM-W Chapter", [3] encourage women to sustain the Celebrations community, when they return to their home institutions.

E. Accurate Career Information

The keynote speakers and other academics who participate in the program provide information about their research at large universities, national laboratories, or industry locations. Industry representatives who staff the Career Fair also provide important contributions to the program by conducting panels such as "A Day in the Life of,," (describing typical days in their work lives).

F. A Grant from the NSF to Expand Celebrations

Funding from the NSF expanded the number of Celebrations from four to sixteen in the United States, as new conferences spread to India, United Arab Emirates, Europe, Canada, Australia, New Zealand, Puerto Rico, and Cuba [3]. The NSF award also provided comprehensive assessment services from Rockman et al [24], a research and evaluation company headquartered in San Francisco. Rockman administered post-surveys for all twelve of the grant's new Celebrations (along with the four original Celebrations) and interviewed coordinators of the conferences.

The post-surveys carefully incorporated survey items from the GHC's post-survey, in order to compare the resulting statistics for both kinds of Celebrations. There are numerous articles in the literature about recruitment and retention benefits associated with attending GHC, including two 2014 articles published in the *Commun. ACM* [1, 23], so it is important to determine if the less-expensive, easily-organized, local-area conferences have similar benefits. The ACM Press recently published a paper [26] that compares (for the first time) post-surveys from the grant's Celebrations with GHC

post-surveys. The paper includes statistics, indicating that positive responses to Celebrations' survey items meet or exceed positive response rates for identical GHC items [15] in almost all categories.

Before this paper, neither GHC nor Celebrations compared attendees' pre-conference survey results to post-conference survey results. This paper provides the initial analysis of pre- and post-conference survey results for any Celebration of Women in Computing. Likewise, it presents the first follow-up surveying at an interval sufficient to determine if the effects of Celebrations are lasting. The paper discusses the pre- to post-survey comparisons first in Section V and then moves to the follow-up surveys in Section VI.

V. PRE-CELEBRATION SURVEY

Celebration registrants (year three of the grant period) were invited to complete a brief, anonymous survey before attending a Celebration. The survey was designed to measure baseline levels in three categories of outcomes promoted by Celebrations—*Community/Connection* with women in technology, *Interest/Motivation* in a technology career, and *Skills/Advancement* in those careers. Table I lists the conferences that were invited to complete surveys. In calculating how representative the survey is, the authors combined all affiliation categories into a total N. Table II gives response rates (compared to a 40% post-survey response rate for the larger 2011 international GHC post-celebration population [15]). Based on these figures, the authors believe that the pre- and post-conference survey respondent sample is a good representation of the participants, though the report refers to "respondents" rather than "participants", and report by affiliation where possible—and note any differences by group—to avoid response bias.

TABLE I. Pre- and Post-Survey Celebrations

Location	Acronym
Indiana Celebration of Women in Computing	INWIC
Carolinas Women in Computing	CWIC
Midwest/Minnesota Celebration of Women in Computing	MINNEWIC
Kentucky Celebration of Women in Computing	KYWIC
Capital Celebration of Women in Computing (Virginia)	CAPWIC
Northwest Regional Celebration of Women in Computing	NWRWIC
Celebration of Women in Computing in Southern California	CWIC-SoCal
Missouri-Iowa-Nebraska-Kansas Celebration of Women in Computing	MINKWIC
Tennessee Celebration of Women in Computing	TNWIC
Louisville and Cincinnati Celebration of Women in Computing	TRIWIC

TABLE II. Celebrations Participants and Survey Respondents

Total Year 3 Participants or Potential Respondents	Pre-Survey		Post-Survey		Follow-Up Survey	
	Number of respondents	Response Rate	Number of respondents	Response Rate	Number of respondents	Response Rate
N=850	379	46%	542	64%	66	<10%

A. Over-All Expectations

When asked, on the pre-survey, about their expectations for the upcoming conference, approximately three-fourths of the student respondents (N=379) cited networking (77%), celebrating and having fun (74%), gathering with a larger community of technical women (70%) – and being inspired (69%). (Percentages exceed 100 because respondents could check more than one activity.) Generally, those activities led faculty (N=80) and industry (N=67) lists as well, though students expressed slightly more excitement.

Just over half of the students reported that they expected to present at or attend technical sessions (56%), learn about cutting-edge technical research (57%), and find job opportunities (50%). Fewer, but still one-fourth or more expected to present at or attend professional development sessions (43%), represent their organizations (25%), and mentor others or find mentors (24%) – the latter a notable intention among students. Not surprisingly, industry respondents had higher expectations than students for representing their organizations, as did faculty, some of whom also looked forward to mentoring opportunities.

B. Expectations among Students

Although their confidence may have been boosted by the upcoming Celebration, students expressed high levels of confidence and a sense of support even in the pre-conference survey: 70 percent, for example, "Agreed" or "Strongly Agreed" that they felt energized and confident about their career in technology, and two-thirds said they had the tools to be successful as a technologist. Fewer, but still close to half of student respondents (48%), "Agreed" or "Strongly Agreed" that they have a mentor or mentor others.

It is worth noting that – especially in comparison to higher rates in post-conference responses – percentages fell somewhat when students were asked about their sense of

community and a network of technical women. Less than half "Agreed" or "Strongly Agreed" that they interact with a network of technical women (44%) and are knowledgeable about academic career opportunities for technical women (42%). Under half (44%) said they felt they were part of a larger community of women in technology. Only a fifth, however, reported that they feel isolated as a woman in technology.

Fig. 2 summarizes the data described in the pre-survey section above – data from all three respondent groups who "Agreed" or "Strongly Agreed" with statements about confidence, skills, and community.

VI. IMPACT OF CELEBRATIONS ON STUDENTS: POST-SURVEY RESULTS

Although expectations were high, overall, students felt they were well met by the Celebrations, when post-survey results were examined. Approximately 70 percent of post-survey student respondents said their expectations were met "Very" or "Extremely" well; an additional 15 percent reported they were met "Moderately" well. Responses to questions related to commitment, skills and tools, and sense of community all supported the overall ratings and indications that students profited from participation. Pre-survey replies (in italics) pair with the following post-survey categories and respondent replies, allowing ease of comparison between pre- and post-survey responses.

A. Commitment to Careers

High percentages of students also indicated that the Celebration had had a positive effect on their commitment to degrees and careers:

1) Over 70 percent "Agreed" or "Strongly Agreed" that attending the Celebration increased their commitment to complete their degree program, increased their commitment to

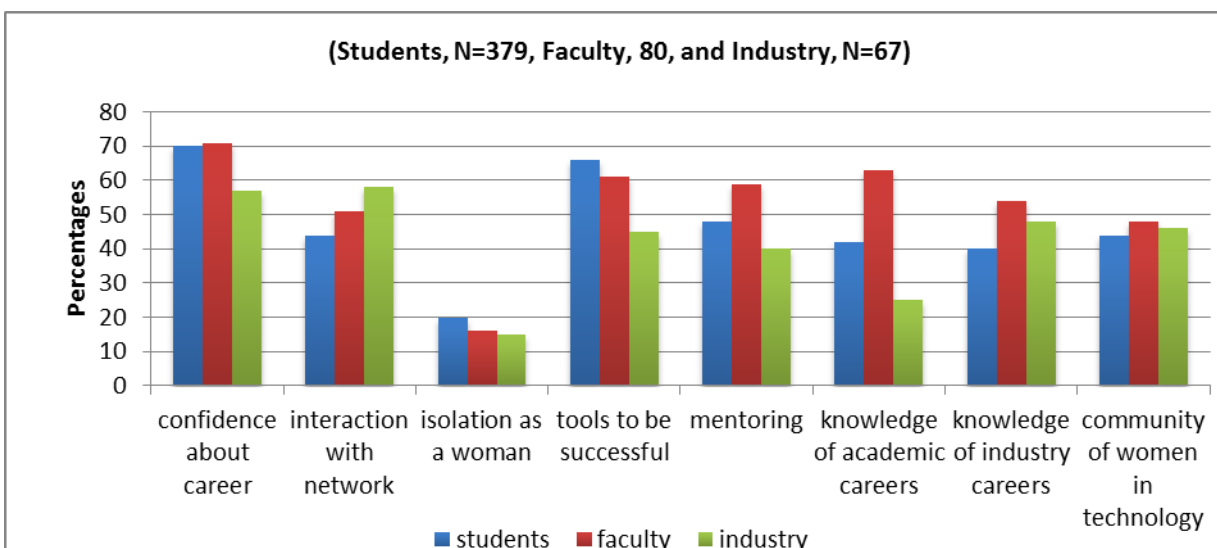


Fig. 2. Pre-Conference Reports of Confidence, Skills, and Community

their technology career, and increased their intention to find a mentor or to mentor women in the field. (*Pre-survey: 48% "Agreed" or "Strongly Agreed" that they have a mentor or mentor others.*)

2) Over 80 percent "Agreed" or "Strongly Agreed" that attending increased their confidence in their ability to pursue a technology career; two-thirds reported that they had also learned about career opportunities at sponsor companies as a result of attendance. (*Pre-survey: 42% "Agreed" or "Strongly Agreed" that they are knowledgeable about academic career opportunities for technical women.*)

3) Over half of the student respondents reported that attending increased their intention to pursue an undergraduate or graduate degree in a technology field and had a positive impact on their professional development. (*Pre-survey: 70% "agreed" or "strongly Agreed" that they felt confident about their career in technology.*)

4) And over half of student respondents also reported that attending helped them obtain tools to be successful in their career as a technologist, gain valuable opportunities to be mentored or to mentor others, and learn about academic programs from the university sponsors. (*Pre-survey: 67% said that they had the tools to be successful as a technologist.*)

B. Isolation and Sense of Community

In sharper contrast to pre-conference responses related to a sense of community, following the Celebrations:

1) About two-thirds of the students "Agreed" or "Strongly Agreed" that they felt less isolated as a woman in technology and that the Celebration had significantly increased their network of technical women. (*Pre-survey: 20% "Agreed" or "Strongly Agreed" that they felt isolated as a woman in technology.*)

2) Approximately 75 percent "Agreed" or "Strongly Agreed" that they feel part of a larger community of women in technology as a part of attendance. (*Pre-survey: 44% "Agreed" or "Strongly Agreed" that they interact with a network of technical women.*)

3) Over 85 percent "Agreed" or "Strongly Agreed" that they feel inspired by the role models they saw at the conference.

4) Over half intend to stay in touch with people they met at the conference.

C. Conclusions from the Pre-Survey to Post-Survey Comparisons

This section ties survey results back to research (Section III) and Celebrations' design (Section IV), reflecting four issues. The first issue is role models, but there was no appropriate counterpart pre-survey item for the post-survey query, asking if students felt inspired by the conferences' role models. The preceding section indicates that 85% of students responded positively (on the post-survey) to feeling inspired by the Celebrations' role models.

The second research issue is lack of mentors. Before attending the Celebrations, 48% of respondents positively agreed that they had mentors or mentored others; the post-survey percent of more than 70% of students saying that they were increasing their intentions to seek mentors or to mentor others implies that some students are seeking either their first or additional mentors or protégés.

Although the assessment evidence indicates that Celebrations met the goal of expanding mentoring for students, the evidence for attainment of the third goal of building community is even stronger. Before the conferences, 20% strongly agreed that they felt isolated; but, after the conferences, 67% said that they felt less isolated. Likewise, before the conferences 44% strongly agreed that they felt part of a community of technical women; after, 75%.

Finally, the goal to increase career information and tools through Celebrations appears well met, because over half of the respondents indicated that the conferences provided tools to be successful in their careers as technologists. The pre- and post-survey comparison suggests significant assessment of goals, but the question emerges: Are the results maintained over time? To answer the question, Rockman et al performed a follow-up survey, described in the next section of this paper.

VII. THE FOLLOW-UP SURVEY

In an effort to track longer-term impact of Celebrations, in the last year of the NSF grant, the evaluator initiated a follow-up survey sent to all former survey respondents in each of the three years of the grant period, also modeled after a GHC survey [15], to track further changes in community-building, academic or career progression, and other changes, as Celebration participants advanced through the pipeline. With the intention of comparing results to responses from a national pool, the survey also included items from CRA-W's [10] Data Buddies project, more specifically items related to respondents' sense of isolation, support, or community within their institutions. A low response rate (N=66, <10%) was not unexpected, given that some former Celebration respondents had graduated and likely changed email addresses, but, due to the small numbers, especially by individual group or cell (faculty, student, industry), the authors have not compared results to the broader pool and report aggregate results here.

The conclusions that can be drawn from the small number of follow-up survey respondents (N=66) are limited, but respondents do represent a fairly wide sample of Celebrations: They came from 13 of the 16 different regional organizations, including conferences held in Oregon, Chicago, and Tennessee (not shown in Table I). There was also a representative spread across respondent groups: just under a third (30%) were undergraduates; a fourth (25%), graduates; and a fifth (21%), faculty. The remaining respondents came from industry (13%), government or the public sector (2%), or administrative and planning teams; the remaining respondents did not identify their constituent group.

Responses from this group cannot be generalized, but they do provide some insights into the ways the communities have or can be sustained.

A. Retention and Recruitment

Items on the pre- and post-celebration surveys asked respondents about the extent to which they engaged in recruitment-related activities. Items on the follow-up survey inquired, first, if the attended Celebration inspired respondents to engage in such activities, and if they had, in fact, engaged in them – with rates that range from 16 to almost 40 percent. The rates of engagement (**bold**) match or exceed intentions (*italics*) in the cases of:

- participate in an existing network (*21%* and **31%**)
- mentoring others (*30%* and **30%**)

Two categories indicate that respondents essentially accomplished what they set out to do:

- reaching out to high schools and other groups (*38%* and **36%**)
- starting a women’s network (*16%* and **13%**)

For some other categories, actions fell short of intentions:

- seek mentors (*30%* and **15%**)
- investigate issues facing technical women in your organization (*30%* and **16%**)
- investigate issues facing technical women on a broader scale (*33%* and **18%**)

B. Change in Interests or Commitment to Technical Careers

With the caveat that the sample is small, other results point to the lasting impact of the regional Celebrations:

- 69% of the respondents report that, compared to a year ago, their interest in doing technical work is "stronger" or "much stronger"; 61% say the same for their interest

in a technical career. Eighty-one percent have neither left nor made plans to leave technical work. (A few (4%) have, and another 15% say they are unsure about leaving or staying.)

- 84% said that the information about career and professional development was "very" or "extremely" important, as was, according to 55%, the coverage and discussion of technical content.
- 61% said the Celebration had a positive impact on their current degree program, and 62% said it had a positive impact on their intention to pursue a graduate degree in a technical field.
- Almost three-fourths (73%) said the Celebration had a positive impact on their commitment to a technical career; the same percentage said that Celebrations provided resources to help them do so.
- 91% cited a positive impact on their overall professional development.

C. Sense of Community

In response to a series of questions about their sense of belonging in a graduate or undergraduate program, follow-up survey respondents indicated that communities are welcoming, supportive, and fair:

- 73% said they feel "very welcome." Only 1 respondent checked "somewhat welcome", and no one checked "somewhat unwelcome" or "very unwelcome."
- 100% said that faculty members "care about me as a person", and 90% say that someone other than their major advisor takes an interest in them.
- 86% say their sense of belonging to a community of technical women is much stronger than it was a year ago;
- 78% found the networking opportunities at the conference to be "very" or "extremely" important.

TABLE III. Comparisons of Common Survey Items across Celebrations and Time

<i>% who agree/strongly agree that...</i>	Year 1 Celebrations	Year 2 Celebrations	Year 3 Celebrations	Celebrations Follow-up	2011 GHC [15]
the conference increased their commitment to a technology career	73%	62%	82%	72%	82%
attending the celebration made them to feel part of a community of technical women	73%	69%	88%	82%	77%
they feel less isolated as a technical woman as a result of attending the celebration	63%	56%	74%	56%	75%
attending the celebration made them feel more confident and energetic about their technology career	77%	68%	86%	72%	NA
they felt inspired by the role models they saw at the celebration	83%	73%	92%	60%	92%
they expanded their network of technical women	58%	55%	70%	76%	66%

Similarly, graduate students indicated that they feel they fit in well or belong "somewhat" or "quite a bit", to their:

- research group (27%, "somewhat"; 64%, "quite a bit")
- department (23%, 69%)
- research or professional community in their specialty area (33%, 58%)
- computing field as a whole (61%, 39%)

Although the numbers are small, responses to a series of survey items included in post-conference surveys for all three years of the NSF grant also suggest that the confidence and sense of belonging respondents felt at the conclusions of the conferences have stayed with them. (See Table III.)

D. Conclusions from the Follow-up Surveys

- The response rates concerning mentoring point to the importance of the role of the mentor, suggesting that those who intended to mentor at the time of the conference carried through with their plans, but it was more difficult for respondents who intended to seek a mentor to do so. Having ACM-W Chapters (an ACM-W project that involves almost 150 world-wide student organizations which recruit, retain, and celebrate women in computing [3]) organize formal mentoring projects will remove women's hesitancy to approach a potential mentor or their simple failure to adhere to prior plans.
- Every single student said that faculty members "care about me as a person," and 90% say that someone other than their major advisor takes an interest in them. One of the ways that faculty members demonstrate caring is by organizing the Celebration trips and participating in all activities alongside their students for twenty-four hours or more. Likewise, sponsoring an ACM-W Chapter supports women throughout the school year.
- The drop (92% to 60% in Table III) in feeling inspired by Celebration role models is expected. Again, it falls to ACM-W Chapters and other women's organizations to supply events with role modeling. Another solution to the issue lies with holding the Celebration every year instead of biennially, a plan adopted in Indiana and Minnesota. Finally, examining departmental speaker lists to ensure that there is gender balance in invited talks is critical, as is choosing female student speakers, as often as possible, because more mature students role model effectively for younger students.
- Another large decline (74% to 56% in Table III) concerns feeling less isolated as a woman in technology. The survey item, as all items in Table III, corresponds to national-level queries contained in CRA-W Data Buddies projects and GHC annual surveys. The authors assume that respondents consider isolation at the personal level. If so, it behooves local organizations (clubs, chapters, departments, groups of concerned individuals) along with individuals who will accept the challenge to "make a difference" to reduce

isolation by adopting mechanisms suggested in these bullet points: Organize students to attend the closest Celebrations every year (including GHC), sponsor an ACM-W Chapter, ensure role models for students, launch a mentoring program. See the ACM-W and NCWIT websites for additional ideas [3, 22].

- One item from Table III, "expanded their network of technical women," provides a last look at a Celebrations' goal, "expand community". Women seem to differentiate between the professional networking they gain by attending Celebrations, networks that they retain for years to come, from the sense of personal isolation that is first alleviated by conference attendance but later returns, as indicated in the preceding bullet point. At the conclusion of the grant's third year, 70% of respondents felt that they had expanded their technical network; months later, 76%, where both rates outstrip 2011 GHC's post-survey rate of 66%.

VIII. Future Work

Post-surveys and follow-up surveys highlight Celebrations' remarkably-successful results in creating a network or community of technical women. Because the majority of Celebrations follows a biennial pattern, the long-term benefits of role models and mentors depend on supplementary programs outlined in the bullet points above: Organize Celebrations every year, expand ACM-W Chapters to every Celebration school, carefully recruit female role models as school speakers, create well-designed mentoring programs, and organize additional retention projects.

ACKNOWLEDGMENT

GCT thanks the NSF grant's co-PIs: Telle Whitney, Lucy Sanders, and Deanna Kosaraju. She remembers co-PI, Joanne McGrath Cohoon, fondly. GCT also thanks ACM-W and its current chair, Valerie Barr, for oversight and management of Celebrations and invites anyone interested in organizing a Celebration to contact ACM-W's Celebrations Chair, Wendy Powley (wendy@cs.queensu.ca). She appreciates Tracy Camp for first recognizing the potential of Celebrations and Elaine Weyuker for funding the inaugural INWIC and many of its successors, which helped to bring a dream to reality.

REFERENCES

- [1] C. Alvarado and E. Judson, "Using targeted conferences to recruit women into computer science," *Commun. ACM* vol. 57, no. 3, pp. 70-77, Mar. 2014.
- [2] Anita Borg Institute's Grace Hopper Celebration of Women in Computing website. [Online]. Available: <http://gracehopper.org/>
- [3] ACM-W website. [Online]. Available: <http://women.acm.org>

- [4] L. Barker and J. M. Cohoon. (2006). Promising practices: intentional role modeling. NCWIT, CO. [Online]. Available: https://www.ncwit.org/sites/default/files/resources/regionalcelebrationswomencomputing-cwic_exampleintentionalrolemodeling.pdf
- [5] L. Blum and C. Frieze, "The evolving culture of computing: similarity is the difference," *Frontiers*, vol. 26, no. 1, pp. 110-125, May, 2005.
- [6] T. Camp, "The incredible shrinking pipeline," *Commun. ACM*, vol. 40, no. 10, pp. 103-110, Oct. 1997.
- [7] T. A. Campbell and D. E. Campbell, "Faculty/Student mentor program: effects on academic performance and retention," *Research Higher Educ.*, vol. 38, no. 6, pp. 727-742, Dec., 1997.
- [8] J. M. Cohoon, M. Gonsoulin, and J. Layman, "Mentoring CS undergraduates," in *Human Perspectives in the Internet Society: Culture, Psychology, and Gender*, K. Morgan, J. Sanchez, C. A. Brebbia, A. Voiskounsky, Eds., WIT Press, Cadiz, Spain, 2004, pp. 199-208.
- [9] J. M. Cohoon. "Retaining women in undergraduate computing," in *Women and Information Technology: Research on Under-Representation*, J. M. Cohoon and W. Aspray, Eds., MIT Press, Cambridge, MA, 2006, pp. 205-237.
- [10] CRA-W website. [Online]. Available: <http://cra-w.org/>
- [11] T. DeClue, "Why capable females leave CS1: a qualitative study investigating the causes of attrition," *Jour. of Computing Sciences in Colleges*, vol. 12, no. 4, pp. 290-296, March, 1997.
- [12] M. F. Fox, "Women, science, and academia: graduate education and careers," *Gender and Society*, vol. 15, no. 5, pp. 654-666, Oct., 2001.
- [13] S. Katz, D. Allbritton, J. Aronis, C. Wilson, and M. L. Soffa, "Gender, achievement, and persistence in an undergraduate computer science program," *SIGMIS Database*, vol. 37, no. 4, pp. 42-57, fall, 2006.
- [14] M. Klawe, T. Whitney, and C. Simard, "Women in computing: Take 2," *Commun. ACM*, vol. 48, no. 11, pp. 68-76, Feb., 2009.
- [15] Ku, M. C. and Gilmartin, S. Grace Hooper Celebration of Women in Computing 2011 evaluation and impact report, Anita Borg Institute for Women and Technology. http://anitaborginstitute.org/files/GHC_2011_REPORT.pdf. Data downloaded 4/10/2014.
- [16] P. Lockwood, "Someone like me can be successful: do college students need same-gender role models?" *Psychology of Women Quarterly*, Feb., 2006.
- [17] H. Lord, Ph. D. dissertation, Univ. of Virginia. Charlottesville, VA, 2008, unpublished.
- [18] J. Margolis and A. Fisher, *Unlocking the clubhouse: Women in computing*, Cambridge, MA: Wordsworth, 2002.
- [19] D. M. Marx and J. S. Roman, "Female role models: protecting women's math test performance," *Personality and Social Psychology Bulletin*, vol. 28, no. 9, pp. 1183-1193, Sept., 2002.
- [20] R. B. McIntyre, C. G. Lord, D. M. Gretzky, L. L. Ten Eyck, G. D. J. Frye, and C. F. Bond, "A social impact trend in the effects of role models on alleviating women's mathematics stereotype threat," *Current Research in Social Psychology*, vol. 10, no. 9, pp. 116-136, Feb., 2005.
- [21] National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics. (2012). Integrated Science and Engineering Resources Data System (WebCASPAR), [Online]. Available: <http://webcaspar.nsf.gov>.
- [22] National Center for Women & IT's website. [Online]. Available: www.ncwit.org
- [23] B. Nelson. "The data on diversity," *Commun. ACM*, vol. 57, no. 11, pp. 86-95, Nov., 2014.
- [24] Rockman et al website. [Online]. Available: <http://www.rockman.com/>
- [25] E. Seymour and N. Hewitt, *Talking about leaving: Why undergraduates leave the sciences*, Boulder, CO: Westview Press, 1997.
- [26] Townsend, G.C. and Harriger, A. Retaining women in technology: the Indiana Celebration of Women in Computing (InWIC). *Proceedings of the Hawaii International Conference on Education*, Jan. 2015, 2285-2291.
- [27] G. C. Townsend and K. Sloan, "An effective alternative to the Grace Hopper Celebration," *Proc. of the 46th SIGCSE Tech. Symp. Computer Science Educ.*, Kansas City, KS, 2015, pp. 197-202.