

Evaluation Report #2
Computing Research Association -
Distributed Mentor Project
(CRA-DMP)

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prepared
for

Professor Anne Condon
University of Wisconsin-Madison

by
The LEAD Center, UW-Madison

Evaluation Research Team:
Baine B. Alexander & Debra Penberthy

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Introductory Materials

The Distributed Mentor Project (DMP) Evaluation Report #2 is the second in a series of three reports as part of a three year evaluation project (1995 - 1998) conducted by the UW-Madison's Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center.¹ The report is based on interviews with, and surveys of, the mentors and students who participated in the Computing Research Association (CRA)-DMP during 1994, 1995 and 1996.

This report represents the second phase of an ongoing evaluation of the DMP. It builds upon the findings presented in the first report and presents new findings on issues which were not fully explored during the first phase of the evaluation. In the third phase of the evaluation we will gather more data and conduct more extensive analysis in order to address these issues in more depth. In addition, we will seek to better understand which of these issues appear to apply to multiple program years and specific implementations and which appear to be context dependent or ungeneralizable. Unlike the first report, this report does not provide a separate section discussing the mentors' experiences in the DMP; instead, we use mentor data to provide further illumination on issues raised by students.

The evaluation was conducted by staff of the LEAD Center. The evaluation team consisted of Baine B. Alexander, the Associate Director of the LEAD Center, as project director, Debra Penberthy (August 1996-present), a full-time LEAD Center researcher, and Sue Daffinrud (July 1995- August 1996) and Heather A. Lewis (July 1995-August 1995), both graduate students in the UW-Madison Department of Mathematics, as project researchers.

I. Purpose

One purpose of this evaluation is to provide the CRA-DMP with formative feedback information while the DMP is being implemented. Feedback information is "formative" when it is used by decision makers to reflect on and analyze the project's goals and processes and then make any needed mid-course corrections. In this case, the "feedback" is literal in that much of the report consists of excerpts from interviews with DMP participants. These excerpts are carefully selected through an analysis process of all of the interview data. Those selected are viewed as particularly good articulations of significant themes that emerged from our analysis. A second purpose is to inform and prepare prospective mentors and student participants about the program.

¹Established in August of 1994, the LEAD Center supports individuals engaged in educational reform activities at both the baccalaureate and graduate levels. The LEAD Center focuses on student learning experiences and faculty adaptation and dissemination processes. It provides clients with both summative and "formative" evaluation (defined above).

II. Research Questions

The following are the research questions, developed with Professor Anne Condon, Principal Investigator of the CRA-DMP, that informed the evaluation's design:

- (1) Are there measurable effects, positive and/or negative, resulting from the Distributed Mentoring Project? More specifically,

Do undergraduates who participate in the DMP *enroll* in graduate school at higher rates than a matched comparison sample?

- (2) If the answer to question "#1" is "yes," what kinds of qualitative effects are experienced by the DMP students and can patterns in mentee/mentor interactions be ascertained and associated with the measurable effects of the program? More specifically,

- (a) What, if any, relationship is there between student response to the program and:

various characteristics of the mentor's research project and/or methods of involving the student in that project

the level and type of interaction the student had with graduate students at the mentoring site

the overall departmental culture she encountered during her summer research program

the level and type of interaction that the student maintained with the program after her summer research program

- (b) Did the mentee and/or mentor believe that the DMP program helped effect changes in the student's:

level of self-confidence in academic abilities

ability to formulate and solve problems typically encountered in CS&E

overall appreciation of the basic "ways of knowing" that inform the disciplines of CS&E

sense of individual accomplishment

time management skills

ability to work cooperatively in a research team

degree of identity with CS&E

level of motivation

perception of value of graduate education

understanding of national graduate programs

understanding of application requirements for graduate school

career goals
understanding of the research process

(c) Did other factors in the DMP students' experience have an effect on their decision to attend graduate school, including:

departmental climate
rejection of science careers/lifestyles
pace and coverage of curriculum
peer culture in her department: competitive or supportive?
financial situation
type of pedagogy: peer group learning vs. traditional lecture style
quality of advising
family support

(3) What, if any, special problems and/or satisfactions do faculty mentors experience as mentors in this program?

III. Guide to the Reader

The main body of this report (Tab 2) presents qualitative data on the students' and mentors' perspectives on the DMP. This section contains four sub-sections. In the first sub-section, we provide extensive contextual information regarding the DMP participants' undergraduate experiences. This provides important background information for understanding the students' expectations of, and experiences in, the DMP. In the second sub-section we provide a comprehensive discussion of the participants' perceptions of the benefits of the program. (Readers who are primarily interested in program outcomes may wish to read this section only.) In the third section, we discuss the essential elements of the program that brought about these program benefits. (Readers who are primarily interested in the function of program components, such as the research project, the female faculty mentor, and the research university setting, may wish to read only this section.) In the fourth sub-section, we address particular program implementation issues which were raised by the mentors through surveys and qualitative interviews.

In Appendix A we present the results of the survey that was conducted. The purpose of the survey was to allow us to triangulate across a range of different data sources during the analysis process.

Intended Audience

This report is intended for a varied audience that includes: former and prospective student participants of the DMP, faculty who participated as mentors in the program, faculty who are considering participating in the program, and other interested individuals.

IV. Methods

We have thus far pursued these research questions through structured, open-ended interviews and through surveys. The reader should note that qualitative and quantitative research methods differ not only with respect to data collection but with respect to analysis. Individual interviews allow the researchers to "get inside of" the experiences of these diverse participants. Data collection methods are as open-ended and subject-responsive as feasible to ensure that the experiences of the study participants, not the researchers, are reported. Likewise, analysis processes are fundamentally inductive to ensure that the participants' experiences shape the findings. In practice, this means that the researchers make every effort to at least temporarily suspend the ideas that structured their interview protocols. The analysis of interview transcripts is focused on determining what is most important to the participants. The primary analytical categories that emerge as the researchers process the transcripts are apparent in the table of contents. In contrast to survey methods, these methods do not yield precise, quantitative assessments of the proportion of participants holding pre-specified opinions. However, these methods provide extraordinarily rich information expressing the complexity of the experiences of the study participants.

Open-ended Interviews

We interviewed both mentor and student participants from the 1994, 1995 and 1996 programs. The structured open-ended interviews were conducted individually and lasted approximately one hour. The interview protocols for the students and mentors appear in Appendix B. All interviews were recorded and transcribed; an average transcription was twenty single-spaced pages.

We interviewed 10 out of the 28 total 1995 student participants in the summer of 1995. Each student participated in three interviews: one at the beginning of her program, another upon the completion of her program, and a third the summer following her participation in the program. Interviewing the students at the beginning and end of the program allowed us to observe if and how the students' experiences and attitudes towards graduate school and research in CS&E changed throughout the program. The third, or "year-out" interviews, allowed us to examine the long-term effects of the program on their career choices. We conducted one interview each with 10 out of the 25 total 1994 student participants. (One of these students participated in 1994 and 1995.) The purpose of these interviews was to develop an understanding of their experience in the DMP and also to assess the impact of the program on their career decisions. We interviewed 10 of the 21 1996 students prior to their participation in the program and 9 of these same students after the program (we were unable to contact one). We will be interviewing these same students in the Spring of 1997.

In the fall of 1995, we conducted a single interview with each of 9 out of the 25 1995 mentors and 10 out of the 24 1994 mentors. In 1996 we conducted a single interview with each of 9 of the 19 participating mentors. The purpose of these interviews was to understand the faculty's experiences and attitudes toward mentoring in the DMP and to provide a valuable perspective on the students' experience in the program.

Email Surveys

We have gathered extensive survey data from student participants and mentors. In addition, we surveyed a “matched” comparison group of students. This group was matched by gender, GPA, and class standing. The names of the comparison group students were obtained from chairpersons of departments (or other appropriate individuals) that had hosted DMP students and from applicants who met the selection criteria but who were either not accepted or declined acceptance into the program.

For the purposes of this report, the surveys were used to determine whether the findings from the qualitative interviews were representative of the experience of the mentor and student participants as a whole. So although we have not included the quantitative data in most of the main body of this report, it has informed our findings. In Appendix A, we present the survey data in raw form. We plan to conduct a full analysis of the quantitative data during the third-year of the evaluation. At this time we will fully integrate the qualitative and quantitative findings. To some extent this wait will be advantageous because the survey sample will be larger at the end of three years. This is particularly important for the matched comparison group. Below we provide necessary information on each of the surveys. See Appendix C for copies of each. All surveys were administered by email, unless otherwise noted.

Participants:

Comprehensive Student Participant Survey on Program Experience and Issues Relating to Undergraduate Experience. A survey was distributed via email to the 1994 and 1995 student and mentor participants in the fall of 1995. The survey response rate is as follows: Twenty-two of the 28 1995 student participants and 11 of the 25 1994 student participants responded to the survey. Two of the students who responded to the survey participated in 1994 and 1995, and we included their responses only in the 1995 survey results. The low response rate among the 1994 students results from the difficulty of contacting students who had graduated and did not have email addresses. In the fall of 1996 we administered a survey to the 1996 participants. Twenty out of 21 of the 1996 student participants responded.

Tracking Survey. In the summer of 1996, we attempted to track all of the 1994 and 1995 participants of the DMP to gather information on their current activities and future plans. Through email, postal mail, and phone surveys we were able to track 16 of the 25 1994 participants and 26 of the 28 1995 student participants. See Appendix A, page 6 for this information.

“Matched” Comparison Group:

Survey on Undergraduate Experience and Future Plans. In the Fall of 1995 we emailed this survey to 28 students who were matched with the 1994-95 participants; Fifteen responded. In the Fall of 1996, 27 students who were matched with the 1996 participants were emailed with a modified survey -- 13 responded. Every effort was made to increase the survey response rate.

Mentors:

Survey on DMP Experience. In the fall of 1995 the 1994 and 1995 mentors were surveyed. Twenty-one of the 38 total mentors responded to the survey. Of the 13 mentors who participated in 1994 only, 4 responded. Of the 11 mentors who participated in 1994 and 1995, 7 responded. Of the 14 mentors who participated in 1995 only, 10 responded. In the Fall of 1996 we surveyed the 1996 mentors. Fourteen out of 19 responded.

V. Notes on the Use of Verbal Quantifiers

Specific verbal quantifiers are used to denote the relative size of a group of participants who presented particular perspectives or described particular experiences in interviews. It is important to note that due to the nature of qualitative interviews, the size of a group who *discussed* a particular type of experience does not indicate the size of the group who *had* this type of experience. Although the same interview protocol was used in each interview, respondents' answers often prompted discussion in a particular area that may not have emerged in other interviews.

The verbal quantifiers used in this report are:

"a few":

used when up to 30% of those interviewed presented the perspective under consideration

"many":

used when 30 to 70% of those interviewed presented the perspective under consideration

"most:"

used when 70 to 90% of those interviewed presented the perspective under consideration

“virtually all:”

used when 90 to 100% of those interviewed presented the perspective under consideration

Students' and Mentors' Perspectives on the Distributed Mentor Project

I. Context

In this section we present findings about the perspectives and the experience that the DMP participants had as undergraduate Computer Science majors prior to their participation in the program. This background data is essential as it provides a context with which to understand the nature and the scope of the impact of the program on these women.

A. Different reactions to the lack of women in the field of CS and to the culture of the discipline

Virtually all of the DMP participants whom we interviewed from the 1994, 1995, and 1996 program years, expressed an awareness of the lack of women in the field of CS and discussed the impact of this on their experience as undergraduate CS majors. All of the women interviewed were affected in some way by the lack of women in the field and/or by aspects of the dominant culture of CS that were perceived to be related to the predominance of men in the field. What differed was the way in which these women were affected and the degree. In a few cases women discussed feeling like there were ways in which the lack of women had positive outcomes for them.

1. Women CS majors viewed as a novelty by peers

Some of these women felt that they stood out as unusual as undergraduate CS majors because of the lack of women in the field. Many of them discussed that the common reaction when they told their peers that they were majoring in CS was one of surprise or shock because they, as women, did not appear to fit the image of a computer science person. In the following interview excerpts these women discussed the reaction of their peers.

I: Do you think that there's a stereotypical computer science major at all?

R: Yeah. People are still surprised when they find out I'm a computer science major.

I: Why is that?

R: I'll be like with -- my roommates or something will say, "This is [student's name]. She's a computer science major. Do you believe it?" Or, "Guess what her major is. Oh, wow." And even my other friend, this woman that I had graduated with, she said she'd go to a party or something and people would introduce her as, "So-and-so, who did this and

such with computers.” It was kind of a novelty. People are just kind of surprised that you’re doing that.

* * * * *

R: People are always shocked when I tell them what my major is. (laughs) The standard response is, “Oh really?!”

I: What do you say then?

R: I say, “Yes, I am!”

I: Is that offensive at all to you, or is it just like, “Well, whatever?”

R: No, they’re not like, “Oh my god, how could you possibly be that?,” but I guess it’s not the first thing that would come into your mind when they meet me.

* * * * *

When I tell people that I’m in computer science they kind of have to do a double take. Like you know, “Why are you in computer science?” Or I commonly get asked why did I choose it or how, or whatever and I just say, “Well, because I like it. It’s easy for me to do Math and all that’s easy for me to do.” But if a man were to say, “I’m going into computer science,” they wouldn’t think twice about it. So that’s just the real obvious example for me, just real basic thing there. Or I’ll tell people that I want to go to grad school and they’ll ask me, “Why?” You know for a man to go to grad school it’s kind of expected, “Well you need to get a better job, so you need to go to grad school to get a better job.” Well that’s not why I’m doing it, so...

2. Feeling as though they are more visible as women in CS: intimidating for some, beneficial for others

Most of the women interviewed indicated that they became acutely aware of the lack of women in the field through their experience in their CS classes. Many of them described how they were often in classroom situations in which they were the only woman in their CS courses and recounted a range of responses to this situation.

That is one thing that I liked about the program was I liked the idea that they were trying to get more people into computer science because you can really tell in computer science that it’s typically been a man’s world and especially when you go in and there are only, like several classes where there has been me and another girl in the class. So, you can really tell, you know, they are really male-oriented.

Many students felt intimidated by the lack of women in CS classes, particularly in their first few CS classes. They expressed that because they were more visible as women that their comments

and questions were more likely to be more noticed and remembered by faculty and other students. This caused them to feel self-conscious and to be more careful in asking questions and participating in class out of a concern for appearing stupid.

I: How did you feel about the small number of women [in your CS&CE classes]?

R: Well it was pretty intimidating when I took one class my first semester junior year where I was the only female in the class.

I: Oh no.

R: Yeah it was intimidating at first because I didn't really know any of the guys either 'cause they were mostly seniors who I hadn't met yet. So yeah that was intimidating. [Laughter]

I: All right, just for the reasons we talked about before?

R: Yeah, I was the only female and that I think, yeah that made me stand out a lot. So it was easy to call on me, or I stood out in the class.

I: Did the professor call on you more then?

R: Well I don't think he did, it just felt like he could -- I couldn't really hide.

* * * * *

It's somewhat intimidating because I'm more hesitant to ask questions in that environment than if it's more 50-50 [female/male]. I think I'm a little hesitant because [I wonder], "Well, am I asking a stupid question?" Or, "Am I asking something I really don't know and need to ask?" It depends on the class.

Viewing themselves as representative of all women

A related reason that many of these women felt intimidated in CS classes was that they felt that in classes with so few women that they stood out more as women than as individuals. This made some of the them feel as though they were viewed as a representative of all women in their classes. For some this felt like a burden making them hyperaware of their behavior out of concern that they might make all women appear stupid. A mentor discussed how she had observed this type of dynamic in her classes.

R: When I think about my women students there are a lot of times when there is only one woman in the class or maybe two. So when you're in a room of forty and you're the only woman you can't help but feel that way.

I: You can't just be a person because you stand out as different?

R: You're not just an individual. The guys will see you as a woman.

In the following interview excerpt a participant described the reasons behind her fear of talking in classes where she was one of the only women.

I: So if there are a lot of men in the class they tend to overpower the class?

R: Yeah, I think so. Sometimes I'm afraid to say something because it might be something stupid, and then everybody would look at me. Being, for example, the only woman in the class, I'd even feel even more stupid. Like, I will make all the women feel stupid. You see what I'm trying to say?

I: Are you saying you're kind of a representative?

R: Right. If I say something wrong, then they might think, "Yeah, she said something stupid, something wrong. All women are the same," that kind of stuff. So I usually, if I wasn't sure of something I'd try to keep quiet.

Benefits of, or lack of concern about, visibility due to being one of the only women in classes

At least one woman experienced the visibility related to the lack of women in the field as a positive thing because she was more easily noticed and remembered by faculty and students. This motivated her to push herself to do well in classes.

R: [CS is] such a male populated field, or major.

I: Do you see any down sides of being in a major like that?

R: No. In this particular, in this case, I don't know what it will be like working, but in terms of having been in the major, it was really good. I know that I was noticed by the students, and by the teacher more, which helps because otherwise I - often I tend to be very quiet, and I won't try to get the attention of the teacher. I won't go and talk to them all the time, but I was pushed into that more, and I was pushed into them being more aware of me, which made me push myself more to do well. Because I know that they see what I'm doing and that they're aware of what I'm doing. If you're in a really big class it's easy to get lost. But if they're if they're aware of me, I have a much harder time blowing anything off, it pushed me a lot more, and it gave me much better relationships with my professors, which probably wouldn't have happened otherwise...a lot of times [other people encouraged me to go see profs], but once I got there, they were going to remember me more often than a random guy who walked in one time. It's interesting that I've actually talked to male friends who sometimes are very frustrated because they won't

be remembered. They're like, "Oh, he doesn't know who I am." But I'm not going to have to worry about that!

A few women openly discussed how they were indifferent to the fact that there were very few women in their CS classes and departments.

[The lack of females in my CS&E classes] is not something like I said that I notice all the time or that I think it really intimidates me. Every once in a while I look around and go, "Hey, there aren't that many women around here." But I mean I didn't think [that all of the graduate students I interacted with at my mentor's university were male] was weird at the time. I mean it's computer science. And I think the women are more slowly coming into the field.

3. Some actively questioned why there were so few women: Do I belong in this field?

Some women described how they had actively questioned what the relative lack of women in the field of CS indicated about the field and their participation in it. They felt different, and some questioned whether they belonged. The following interview excerpt is representative of this set of respondents.

I: Do you think that your experience as an undergraduate in CS would have been different had you been male?

R: Probably. I'm not sure how, but it probably would have. Somehow I think I wouldn't have felt so different, you know. You walk into a classroom, and there's not a lot of women - maybe one more woman, and sometimes none. You just can't help but feel different. You're like, "Gee something's wrong." Or, "Why aren't more women here, what's happening?" I feel like, perhaps sometimes I don't belong.

Despite these lingering questions about whether they fit into a predominantly male field, some women indicated that grade-related success in these classes helped them to feel better and served to counterbalance some of their concerns about whether they should be in the field.

I mean, just because I walk into a room and there's no other women doesn't mean - you know, nobody's asking me to feel differently, I just feel different. I feel like perhaps sometimes I don't belong. Or it sometimes makes me wonder about the future of women in this field and things like that. But at the same time, it might seem paradoxical, but...I'm one of the top students. And then it makes me feel very good. It doesn't make me feel as bad as when I walked in the first day of class.

4. Feeling like they have to prove their ability in CS because they are women: Factors which contributed to this perception

Most of the participants discussed that they felt they had to prove themselves as a woman in CS. Many of the women who did not openly discuss issues of intimidation in classes or questions

about whether they belonged in the field of CS, did state that they felt that they had to prove themselves as women in the field. These women discussed that they worked harder in their classes to make sure that they gained the respect of the faculty members and their peers because they assumed that as a woman in a male-dominated field they would not be taken seriously until they had proven their abilities. An additional factor that may have contributed to the feeling that they needed to prove themselves, was the perception that they had different abilities and a different approach to computers than their male peers.

Some women indicated that this feeling of having to prove themselves was much stronger during their first couple years of CS classes. In the following interview excerpt a woman discussed how initially she had worked hard to prove herself, but she now felt accepted in the CS department.

[My experience in CS&CE has] been mostly similar [to another male student's experience]. Except in the first couple years, he did not have the impetus to like really try to shine in his computer classes, because he didn't feel that it was something that he really needed to make sure that he was noticed by the faculty, or that it was absolutely necessary that he get all A's in his computer classes, or really do outstanding work, either to be noticed by faculty or just to be the best in the class. Whereas I did. I'm sure it was at least partially because I wanted to sort of prove that I could be as good as any of these other people in here, even though I'm a female. Or just the fact that I just feel like I can prove that I can be as good as anyone else in here It's hard for me to think now because I think of all of us as big family, and I can't see how any male/female differences played into that. But if I really think hard about freshman year, it probably did, because I think about, like I said, there were two other freshman, or two other girls in the honors program, on my floor freshman year in the dorm who were in computer science, and we *worked*. We worked really hard, and we worked together to be the best.

She went on to say,

By the time you get to the end of your second year, when you are going to walk into a computer science class . . . you know you're going to know everyone in the room. There's only going to be 8 or 9 of you. You're going to sit down the first day and put your feet up on the desk in front of you and start talking to the person next to you, and you're never going to have worry if you miss a class. You know who you're going to get notes from, and uh, you know, if you, if you bring food you bring enough for everyone. And it's a very congenial atmosphere. I remember my first class in computer science, the first semester you only have one, and you're still a pretty spread out group. And that's very different and there was only one other female in that class. And I totally aced that class. And so that was my goal. And you know, being a freshman level class, of course, it's possible. So that was what was important to me -- was sort of to prove to myself and to other people that I was a real serious student. But by the time you get to the upper level classes it's totally relaxed. You know, everybody knows everybody else, and you've had this teacher for two or three other classes before this, so they know what to expect from you too.

Some women discussed how they had to develop strategies to be accepted by their male peers in order to be able to work with them. One student recounted how difficult it was to get accepted and connected with peers. In the following interview excerpt she discussed the strategies that she used to prove herself.

By working with the professor, that was one of the things that got me in, because people started to instantly know my work, and then they would hang around with me and they'd vouch for me --"Ok, she knows what she's doing" -- and then I started getting in groups. Then once you get in good groups, then you all feed off of that energy, and then you go...[This was] before the mentoring project. Had I got into the mentoring project like a year earlier, oh, I'd be set! Would have been totally set!...I would have gotten connected that much sooner, but it took me that long to get, you know, get into position.

There were several factors that contributed to these women feeling as though they had to prove themselves as computer science majors. Some were related to the culture of the discipline of CS, whereas others, such as reactions to affirmative action, were related to broader cultural issues.

a. Having to be on guard: Perception that they were judged more critically because they were women in a predominantly male field

Some women discussed how they felt that they were judged more harshly by their male peers. As a result they had to work hard to overcome the perception that they were not capable of doing the work and the expectation that they would not do well. In the following three excerpts women discussed having to be on their guard to keep from "slipping up" and being seen as "stupid:"

I: Do you think that influences you, in maybe, in anything you do? Just having so few females around?

R: Sometimes it makes me work a little harder because I feel like I'm trying to prove something. Like, I've had people treat me like I don't know what I'm talking about because I'm a woman, at least I think that's why they are treating me that way, and so, then it makes me just have to show 'em, that I do know what I'm doing.

I: So, when you say you work harder, what does that mean? Like, getting better grades, or --

R: Yeah, I guess I like, yeah, trying to do the best I can. I guess, yeah, in school that would mean grades, or getting the project to work, or anything like that.

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I mean I've had enough male friends who have no problem with like making you feel dumb if you say something dumb. And maybe it's the group of friends I have, you know,

you stay on your guard and it's like, survival of the fittest and the wittiest and things like that...but I definitely have felt like I want to prove myself as a woman and as a woman in the field of computers. I certainly wouldn't always be trying to impress, but at least always trying to make sure that I didn't make a silly impression on them. But as I said, no one's ever made the slightest indication that I wasn't qualified or you know motivated enough or anything. But, it's just, you know (pause) there's certainly something...

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R: You've got to learn how to work together too, and if you don't - if you're not well respected by your classmates - a lot of times they just look at women, and women ask [questions in] a certain way. Like, we don't cry out the answer in class. You've probably seen it over the years.

I: Especially if women don't know the answer perfectly.

R: Yeah, guys will go out on a limb all the time if they don't know it, but if a woman comes up with a wrong answer, she knows she's going to be criticized a lot more than a guy coming out with the wrong answer.

I: Because she's a representative?

R: Exactly. They say, "She's dumb," when in reality they're doing pretty well, but they don't work in the open forum very well. I would go to TAs and teachers after class to really talk, because then I felt more comfortable. Because if they perceived you as being stupid, well, then your dead as far as getting in a good group.

I: So you don't want to talk because you might be perceived as stupid, but if you don't talk then people don't think you know what you're doing.

R: Exactly, so you're going to have to somehow talk with them in class to demonstrate you know what's going on.

b. Perception that they may have different abilities and a different approach as women in the field of CS

Underlying the feeling that as women they had to prove themselves in the field of CS was the perception that they did not have the natural ability in CS that they attributed to males. In addition, for some their seemed to be the perception that women came to the field with a different degree of experience and possibly a different type of interest in computers. Because of the lack of women in the field it may have been that what was often categorized as the predominantly male approach was viewed as the standard approach to CS. Again for some women this perception made them question either their participation in the field and/or increased the pressure for them to prove themselves in the field.

1) Feeling like they have to prove themselves because of the perception that males have more innate ability in CS

Some women expressed that, either they believed or that others believed, that males had more innate ability in the field and that this was a major factor in the perception that they had to prove themselves as women in the field of CS. In the following interview excerpt a participant discussed this perception of superior male ability in CS and how as a result it is assumed that women will not do well in the field.

R: It seemed that the men [in my department], probably just because they were more interested understood it a lot better. It seemed more innate in them to pursue computer science.

I: Hmm, what do you mean by that?

R: Just that, it was something that came naturally to them, this interest in computer science, and so that kind of translated directly into performing well, and the women it was more like, "Well, I'm a woman in computer science. I'm a novelty." You know, there isn't this assumption that I'm going to do well, or something.

I: Oh, really?

R: Yeah, I mean, not that people were saying, "Hey, you're a woman. You're not going be able to do computer science." Just that, it's a lot, I mean you just don't expect women, I mean if you think of computer science, then you think of a man.

I: Is there any way that that gets communicated in a class, or is it just there?

R: No, it, it gets communicated by the fact that are [not] many women.

2) Perception that as women they take a different approach to CS than their male counterparts:

Task/grade orientation vs. Hackers

Related to these women's beliefs about the natural ability of males in CS was the observation by many of these women that they approached computer science in a way which differed from their male counterparts. They discussed how many male CS majors were "hackers" for whom computers were "a way of life" and for whom ability in CS came "naturally." By contrast, these women often described themselves as having to work harder because it didn't come naturally to them. Furthermore, they described themselves as more interested in computers as a tool by which they could accomplish a task. Males seemed to feel passionately about computers and felt the desire to spend a lot of time on computers. These women felt less excitement about computers in and of themselves and did not want to spend the majority of their free time working on them. It is important to note that our sample did include a few women who were self-described "hackers" and therefore did not feel that their approach to computers differed from their male counterparts.

In the following interview excerpts women who did not consider themselves "hackers" explained their conception of the stereotypic, male computer science major and his approach to the discipline. They usually discuss this male approach in contrast to their approach as women:

R: It was sort of a bias because I'm not a hacker, and for the most part I think females are less likely to be hackers than males.

I: By "hacker" you mean just plugging around with computers trying to find weird things, that kind of thing?

R: Yeah, just sort of playing with computers - you know, sitting at home playing with them all the time. I don't do that, but I'm still a good programmer. I don't have that sort of attitude that I play with this stuff all the time. I think part of it is this mentality that the hacker is a teenage male who sits in front of his computer all the time and that makes him a better programmer, which isn't necessarily true, but it also is sort of - works for the bias thing.

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I: So he would be the stereotypical "computer science major?"

R: Yeah. He kept just a real simple program just to do something with numbers and make them spit out or sort them a certain way, and our professor would have a student demonstrate it. He'd go up, and his would just sing and dance. Lights would flash, and he'd sit down and stuff. But he was almost stereotypical also because he just did all these amazing things that none of us - and we just tried to do the assignments and get through what's there, and he's just doing these incredible things, and we're like, "Oh my god!"

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R: I think that a lot of the computer scientists out there are computer scientists because

they just like computers. They think they're neat. I mean, I remember basically the men in my computer science class always talking about cool things that they did with their program, and you know, what cool output it produced. I mean they always applied these adjectives to it like "neat" or "cool" or "awesome" to their programs, or their code, and I never felt the inclination to get that excited about this code I'd written. I never felt, you know, the inspiration to do that little bit extra to make it a really cool part of my program, and they did.

I: So you're saying that they described them as "neat, cool, awesome", their program, or their code, and you felt that that was somehow alien to your experience, that you wouldn't use those adjectives.

R: Definitely.

I: What adjectives would you use?

R: I guess I'm very much a practical person, and so I wrote the computer programs as concisely as possible so that they accomplished what they were supposed to accomplish. And I kind of got a sense of fulfillment if I could write a computer code that was, you know, nice-looking and compact, straightforward, not, with all these gadgets and digits everywhere.

Focus on grades may be linked to feeling the need to prove themselves: oriented towards getting good grades rather than on acquiring hands-on experience

As was suggested in the previous sections, many of the women we interviewed expressed that they were motivated to focus primarily on getting good grades during their undergraduate classes. In contrast, they observed that the male CS majors seemed more interested in gaining hands-on experience by pursuing their own interests.

I: Think of some male friend or acquaintance in computer science and engineering. How has his experience as an undergraduate been similar or different from yours? Do you see a difference?

R: Yeah, I do. I can take one - one of the guys that I was good friends with, he didn't do as well as I did in a lot of classes. He was also in a different - he was working. He was trying to work 40 hours a week, so he learned more about computers hands on. He could go through and install more hardware than I could. I pretty much stuck within the department, and he moved out into the industry a lot sooner than I did and worked in the department a lot more. His experience was a lot different. I mean, I did better in the classes than he did, but he did better in the working. He was able to find more jobs. I don't know if that's because he was a man or anything, he just went to a different area 'cause he wanted to work and make money at it, and I just wanted to get good grades and do real well in the department I don't know if that's just the way we were raised. It

was just more important to me to get good grades and do well in school.

Task-orientation may be related to wanting their work to have relevance to the real world, not just wanting to play around on the computer

Some women expressed that their interests in CS were more directed toward “meaningful” applications in the real world, and that this approach differed from that of their male peers.

R: When I think of people in computer science, I think of people in MIT. You know, the ones who don’t really have a social life, and whose social life revolves around the computer, and hacks all the time, and, I mean, really likes the computer itself, I mean, the physical aspects of the computer, and seeing what he or she can do with the computer. ...Just because a lot of what’s done on a computer...There’s no real physical results. I mean, of course there are in robotics and everything, but, that doesn’t really interest me, either.

I: Ok, so, what is their relationship to the computer?

R: Oh, just that, that they enjoy working with the computer for the sake of working with the computer, and I like to work with things that have a sense of accomplishing, just something tangible. I can see the effect of it, in a tangible way, you know, it’s meaningful.

Drawbacks of not being hackers--having less hands-on experience and feeling less qualified when entering the job market

Several women discussed that while they were in school their focus was on getting good grades, but now that they were about to graduate, or had graduated and were seeking jobs, they felt that the fact that they were not hackers would possibly put them at a disadvantage because they had less hands-on experience.

[Sometimes at my home institution people would be talking about their programs,] and you’re just like you know “Shut-up, who cares, it works.” And, and then I sort of, I’m starting to think like, “Well, you know that’s a valuable thing in the work force,” to be, you know write efficient code and do it with the least amount of overhead and things like that, that in academics if your program works that’s all that matters. And I think I could have learned a thing or two if I had bothered to--well not that I was the most inefficient programmer -- but there were priorities and you know, getting it to work was first priority.

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I: You mentioned that in a lot of your classes the people have been doing computers since they were ten years old, and you know, have been basically hackers and that you hadn’t done a lot of that...How has that been for you?

R: Well, its just been a drawback for me, but it is my own fault, um, I don't, I mean, I guess it just, I'm not as in to it I guess as some people that I see who are just, you know, just talking in numbers, oh, well this uh 14.4 baud whatever, {laugh} and I'm just like, "I don't care." But I don't know how, it doesn't seem that important to me to care about all sorts of little hardware things but it would have made, I guess some of my classes, it would have made me put a, sort of put a big picture together I guess. Like if I had sort of been playing with computers for a while, and then I'm taking a class on, "Well this works because of this," that I would have sort of, "Oh this all makes sense now!" You know, that type of thing. Where as here I'm just sort of learning about things, so it's hard to put them all together.

c. Pathways to CS: -- 40% of DMP participants did not enter college considering CS as a possible major

Another factor which was linked to some participants' expressed need to prove themselves was that many of them (40% of survey respondents) planned on majoring in a non-CS&E field when they entered college, and were not even considering CS&E as a possible major. They ended up choosing CS&E because of encouragement of parents/faculty or as a result of taking an introductory computer programming class as a requirement for other majors and deciding that they were interested in it. The participants who came into CS&E through these types of avenues tended to express that they felt relatively inexperienced with computers when compared to the majority of the students in their departments, and that this contributed to their feeling that they needed to prove their abilities to themselves and others.

d. Feeling as though they have to prove themselves because males are "cocky" though they actually do not always perform as well as the women

A few women expressed that some of the men in their departments were quite cocky and acted as though they knew more than other people, but they noted that these same men would often perform at a lower level in classes than other students.

I: You mentioned earlier that sometimes you felt uncomfortable asking questions in class. This was before the program. Do you generally now ask questions whenever you feel like it or offer suggestions?

R: Yeah, pretty much. There's a few guys here in the CS department that are real [into it]. I'm not that kind of a person. I'm a good student, I get good grades, but sometimes they start talking about stuff that I don't even understand. It's like, "Gee, I don't want to ask any questions because they'll think I'm stupid or something, but maybe not." Then those guys end up getting really low grades. I'm not sure how they do it, so I'm not sure where I stand as far as comparing myself to all those guys that are supposed to be real good. They get lower grades, I get high grades, but then when they speak they seem to know everything, so I don't know. Perhaps they don't work as hard as I do.

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I: [During your first interview] you said that -- you sort of described a real sort of collegial setting with your classmates and you said that being in a lab is kind of like being with a group of your big brothers, and you're all kind of in there together. And I was just wondering why it feels like they're your *big* brothers?

R: {Laughter} Oh, that's a good question. Well, most of them are older than me. I guess that might have been why I said big. Hmmm. That is a good question. {Laughter} 'Cause not all of them are older than me ... I guess because most of them, like I said are the type of people that have been playing with computers for a while, so I feel like they know a lot more. But sometimes they really don't. They just sort of talk about it more, and make it seem like they know more, which is just annoying. So I guess maybe that's why I sort of look up to them, is because they think that they know a lot, but that may or may not be true.

e. Ambivalence about affirmative action for women in the field of CS: Benefits with a price

Both mentors and students discussed affirmative action as a compounding issue in relation to having to prove themselves as women in a male dominated field. The participants discussed the fact that as women in a predominantly male field, they would possibly receive preference when applying for jobs. However, they were ambivalent because they preferred being rewarded for their capabilities and for the quality of their work. A participant discussed this issue in relation to her experience in applying for a summer internship.

R: When I was at [a company for] my onsite interview, I was the only female in a group of about 10 who were standing around waiting to go in.

I: Oh, really. For your interview.

R: Yeah, that was pretty bizarre. I hadn't noticed it, and then I looked around, and I was like, "Wait a minute."

I: And what thoughts go through your mind when you say, "Wait a minute"?

R: First I think this is interesting, and then I get a little bit hopeful 'cause I think, "Hey, maybe they'll give me a better chance or they're going to have themselves a lawsuit."

I: So, it can be to your benefit? So, it, but it doesn't make you in any way say, "Wait a minute. Why am I the only one?"

R: No, it just makes me wish that there were more people [more women] there.

She went on to discuss her ambivalence about receiving preferential treatment because she is a

woman.

R: I hate to say this because it sounds -- I'm not real big on women's issues, but I don't like using it as affirmative action and things. I want to be accepted because I'm smart, I'm intelligent, I'm going to do a good job, but I think it will actually, the fact that I am a woman, get me into some jobs.

I: Ok. How have you heard this?

R: Maybe just because they need women in that area. It is kind of a novelty thing sometimes. I think it might help me a little bit 'cause they're kind of surprised, and it will be - I may be remembered more.

I: 'Cause you'll stand out a little bit?

R: Yeah.

A mentor discussed the issue of preferential programs for women in terms of the DMP, highlighting the issue of the potentially negative impact on women's confidence.

I: So why, if at all, do you think it's important that the DMP was open to female undergraduates only?

R: I've thought about this! Because it's certainly a question that people have asked me. I think that if we really want to raise the proportion, then we have to do things that are targeted at women. I think that whenever we open something up to both men and women, the men end up swamping out the program, and we don't get the targeted effect that we were hoping for. But I have a lot of mixed feelings on this.

I: Well, tell me more about that.

R: Well, I mean I guess I have certainly had situations where people have told me that I just got xyz accomplishment because I'm a woman. So I've always had mixed feelings about whether or not affirmative action really helps the people it's intended to help, independent of whether it hurts other people.

I: Right.

R: To me there's a question of whether the confidence issues, of sitting around wondering whether you got this fellowship, or this job, because you're a woman, are better or worse than the fact that you actually get the fellowship or the job.

Many of the women discussed how their male peers had reacted to both their participation in programs that were targeted for women, and to the possibility that they would receive preferential

treatment for admission to graduate school. At times, their reactions made these women question their abilities and performance in the field, potentially undermining their success through the suggestion that they did not earn their way in this field, but that they had to be let in through the back door, so to speak. In the following interview excerpts participants discussed how they reacted to these sorts of comments by male peers.

R: Some of the men, I've actually had some of the guys say things about this, like, "Well, you know, they couldn't even apply for this [the DMP]." You know what I mean? But it's not like they went and applied to all the ones they could! The big jerks. It's like, "Oh, you're in this thing only for women." I'm like, "You know what? There's like ten million of them, that everybody can apply to. Did you apply to that? I don't think so."

I: Yeah, how do you feel when people say that?

R: It hurts my feelings. And it does make me feel like, you know, it does exactly what they're trying to make it do. Which is, to put me down. I mean, it does. It makes me think like, "Well, yeah, I guess it was only for women."

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I: So, how did that make you feel? I mean, how do you feel about that, that there's so few women?

R: All the guys in my class have always been supportive and nice but I mean, but there's still remarks and stuff just because the program that I was in, the Distributed Mentor Project. They were just a little like, "Oh you only got it because..." I mean they couldn't apply, it was only for women, and they made some remarks. And the same with like going to graduate school, they kind of sometimes make me feel like you know just because I'm a woman I could get into these kinds of programs but I think that after four years I've proven myself to them. But I don't know, it seems like they don't have to prove themselves to anybody.

I: Does that worry you?

R: No, I mean it just, I think it just goes with the major.

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I don't mind being one of the only females or whatever, it doesn't really make any difference to me. But what I hate is when I would be talking to my boyfriend about getting into grad school or something he'll go, "Oh, you'll have no problem, you're a girl in computer science." It's like, "I really hate it when you say that because I know I'm damn good enough. It doesn't matter whether I'm female or not. I don't need that gender thing, and I don't like you saying that I do." It's like, "I don't like you saying that

I can go further in jobs easier than you because I'm a female. Besides all that, I'm going to make 75% of what you make. Don't give me any of that. I don't want to hear it." That's the thing that irritates me, is that the fact that there are few women makes a lot of the men go, "Oh, well, you can get such and so because you're female," and I hate that. I really hate that because I know that I can perform at a level that anybody sets for me.

One participant discussed how she used the strategy of hiding the fact that the DMP was only for women from her male peers. This way she could earn their respect without fueling their judgment and potential resentment.

R: If I told people, "Oh, I've got this summer project," I would just say, "I got a grant." I wouldn't necessarily say that it was because it was mentoring women. I would leave that part out. I would just be very brief, 'cause it's tough enough when, some guys don't think you belong.

I: And then for you to get a grant because you're a woman?

R: Yeah...I think there might have been some jealousy on the part of other guys that wanted to maybe work with professors over the summer, and how did I get into it. I think they felt, "Oh, you got into it? Wow!" So then I got a measure of respect which might have been eroded had they found out why I did and they would have made their own conclusion.

5. Concerned about the lack of women in the field when deciding whether or not to pursue a career in CS

A few women responded to the lack of women in the field by openly expressing doubt or concern about going on to grad school in CS. The following interview excerpts highlight the nature of their concerns.

I: Do you have any concerns about graduate school?

R: Yeah, I mean the whole ratio kind of women and men kind of thing is a little- just being at [my home institution] I mean there's definitely a lot more men than women. I mean there's only, there's two of us graduating -- two women graduating as [computer science majors], two or three.

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I: Do you have any concerns about going into computer science, especially going for a Ph.D.?

R: Well yeah, I'm worried I won't make it that far and that I won't have whatever intelligence or capabilities it takes to think up the thesis idea and write it and do it. I'm

certainly not looking forward to listening to football talk for the rest of my life.

I: How does that fit in?

R: Well, if women are only 5% of academic faculty in engineering, or whatever, that means there are a lot of men, and men do football, baseball talk, which puts me to sleep.

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I: Does it worry you that there are so few women getting Ph.D.'s? Is that the concern that you have about *your* entering into graduate school?

R: It worries me in that my best friends have always been women, and stuff and I'm like, "Geez, the pool is shrinking here." I mean, I've always done what people say girls shouldn't, or not the stereotypical female things. I mean, I know the stereotypes are being broken right and left here, and I'm not sure I could do this if it were 20 years ago. But, I mean, I went into sciences, ...and I hate pink. So that doesn't bother me. I'm sort of proud of myself for doing it. Why stick with the mold?

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R: [I was talking to] one of the guys at work who's 50 years old, and I said, "I'm going to grad school. I'm kind of worried 'cause I am female and they're kind of rare." He's like, "Yeah, the good old boys club is alive and well. Don't let them tell you different." In industry at least, the good old boys club is there, so it's a valid concern to be worried about it.

I: Just to make sure, by "good old boys" you mean the men in power want to keep men in power?

R: Yeah, and the sort of thing where the networks - the power of -- the people who have the power and stuff are male and they meet for golf, or whatever, they don't have a little tea party where it would be equally fine for -- it's the golfing buddies, or whatever. The networks that lead to -- they talk about networking on the job and stuff to lead to promotions and better jobs, or whatever. You find out about those jobs through the network of friends and acquaintances and business associates, and if the network where the good jobs are heard about is the good old boys' network, you're not going to hear about it if you're a good young girl.

II. Impact of the DMP -- The Participants' Perspectives

In this section, we discuss the impact of the DMP on the participants. A primary focus of the post-program and “one-year-out” interviews was on the effect of the DMP on the participants, and how the program had influenced their decisions regarding future career and educational plans. In, “Section III. Essential Program Elements” we discuss the role of particular program features (the research project, the female faculty mentor and the university setting) in bringing about these outcomes.

A. Increased confidence in their ability in CS

For many of the participants whom we interviewed, the most important and far-reaching impact of the DMP was its positive effect on their confidence in their abilities in CS. There were several different ways in which their confidence was increased. In this section we discuss these. (See “Section III. B. Essential element #2: Research Project” for a discussion of the important role of research project in fostering increased confidence.)

Increased confidence in their ability to “get the job done”: ability to apply their knowledge from CS and work independently

Many participants discussed that prior to the DMP, although they had done well academically as undergraduates in CS, they had often questioned whether they would be able to perform well in a CS job. As we discussed in Section I, many of these women considered themselves to be grade-oriented, and more interested in doing well on their assignments than “hacking”. Thus, they felt that they had less “hands-on” experience than the typical CS major, and worried that when it came time for them to test their skills on the job, they would not do well. As a result of having a successful research experience in the DMP, however, many had become more confident in their ability to apply their knowledge of CS

Although students tended to talk about their increased confidence in terms of knowing that they could “get the job done,” their comments make it clear that what they meant by this was that they had come to realize that they could apply their knowledge to new problems and that they could be successful at completing an independent project on which they had little guidance. Their classroom settings had afforded them little or no opportunity to test these abilities, and through their success in the DMP, they became more confident in these abilities. The following student quotes illustrate this point.

I: Did you see the mentoring program as being helpful in getting your job or in your job right now?

R: Probably. You know, you put that on your resume, and that looks good, first of all. Second, as I said before, just getting the work, or to participate in the mentoring program,

and actually doing something gives you a self-esteem boost and more confidence. Yeah, it's helped definitely.

I: More confidence, and you're saying that influences you how?

R: I was always very unsure. Even though I got good grades and everything was good in school, I was always unsure that I could perform a job for some reason, I don't know. But then getting this, you know, participating in the mentoring program and being able to finish the project I was told to research and stuff, that made me feel more confident, so now I go and I can apply to jobs knowing that I will be able to perform well. It helped me definitely, the mentoring program, it did, with jobs and things like that, because now I go with more confidence.

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I [had] just finished with my sophomore year and I didn't have much experience and I was really, really nervous going to a university where I'm like, "Well everyone's gonna expect me to be able to do something." [Laughter] I mean I got into this program but all I did was -- well, someone had already started this program that translated one assembly language to another and basically there was maybe half the work left to do and I finished it and I had to test it and write documentation for it and stuff. But it I mean I accomplished it. I did what I was supposed to do and I think it gave me a lot more confidence in my ability to do something that wasn't an assignment in classes and it seemed like it was supposed to be harder and I did it. And I think it really boosted my confidence that summer.

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R: Maybe the [the mentoring program] makes me a little bit, either more confident, or it makes [me] want to do challenging, different kinds of work because I'd never done anything like this research grant thing, and it worked out well, and so, for example, during the month of January, I applied to all these economic-related jobs, yeah, and so, I actually do think that it, it did build some kind of confidence in me that I could, you know, accomplish something that I'd never done before. I've never been in any kind of situation where I've had to do research by myself, and I'd never been in any kind of situation where I've had to have a job. You know, it was never something to think, so I think in that it did help me.

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I: What stands out about your mentoring program experience?

R: What stands out about it? I think the confidence that it gave me in myself and my abilities.

I: How has that been recognized? Do you see it as influencing things you do now?

R: I think it makes me more confident in my job that I have now. I don't second guess myself like I may have a little more often before.

I: Ok, how did it do that?

R: How did it do that? Well, it gave me just a sense a confidence in myself and my judgment and my abilities...I went into [the DMP] not really being sure of myself and not really being sure I could do it, and I did it. So therefore, you know, it gave me that confidence in myself that I can do the job.

In the following interview excerpt, a student discussed that prior to the DMP she lacked confidence in her ability to be "creative" and thus, she was unsure if she could do research. Through the DMP research experience she came to see that she could be creative by coming up with problems and solutions. It is important to note that unlike many of her cohorts, this student was given the opportunity to pick the research project which she worked on during the DMP. This unique aspect of her experience may be related to this particular type of impact.

I: So, what did it mean for you to have your own project?

R: Well it just, I mean I'm probably a control freak, which is probably why I'm most comfortable being given assignments because, you know I can get my head around it, you know, do a plan of attack and get it done. So, for one it gave me an idea that it's possible to come up with a project assignment. You know, my peers at [my school] had thought of projects that they were going to ask professors if they could do, and I never really cared about that. I was really, you know, a book worm, like into the academics and passing the tests and doing well academically. But all of these projects on the side didn't really interest me, basically because I don't feel very creative and I just never really thought that was something that I would be motivated to do. Because it really scared me. It was easier to do a good job at what I was told to do. So, I mean it just, it made me realize that, you know, you can come up with projects, and people were throwing them at me left and right. And I guess you become very good at thinking of, you know, looking at things in a certain light and figuring out how you can create a project from it, or what needs to be done and how it can be advanced. It also gave me a lot of respect for not having a nice little clean problem.

Increased confidence that they would be accepted to, and/or could succeed in, graduate school

Some DMP participants indicated that the DMP gave them the confidence that they could be accepted into and succeed in graduate school. In the following interview excerpt, a participant discussed that prior to the DMP she did not have confidence that she was a highly competitive candidate for graduate school admission. Through the DMP she changed her view of herself and

raised her aspirations.

I: Did the mentoring program influence your perceptions of what you can accomplish, we'll say in your career or anything?

R: Oh, definitely. I never would have thought of myself as becoming a researcher at a top school, or even being able to apply to and then attend, or be accepted to such top schools as I was. I had always had this opinion, "Well, I came from this really small town." My parents always said to me, "Hey, you may be the best student here, but you have to realize the best students aren't here; they're other places. So, you have to understand that what you see of as the world here, isn't the whole world, and there are people who are better than you." And I still felt the same way at [my undergraduate institution], not quite as much, but, still, I'm like, "The best undergrads don't go to the [my undergraduate institution]." If there's really good people, maybe they're going to Stanford, or maybe they're going to MIT, and these are the people I have to compete with." But, by the end of my four years of undergrad, I thought that I had done as well as I could in the environment I was in, and that there were other factors in my education that still made me a better student and a better researcher than those people coming out of maybe more rigorous undergraduate degree programs.

Feeling less "intimidated" by the predominantly male environment of CS

A few women indicated that through their experience in the DMP, they had become less intimidated and therefore had begun to speak up more in class without fear that they would look "stupid." As students began to gain confidence in their abilities they began to feel less intimidated by others' abilities.

I: Do you see that as influencing how you approach things in terms of school or in terms of research or your career?

R: Yeah, I feel less intimidated. Before like, if I wasn't sure of something I'd kind of sit back, and a lot of the men in the classes took over discussion and things and asked more questions. I said, "Hey, this has to stop. I have to speak up." So it definitely helped me. . . . Because I was exposed to this mentoring program with [my mentor] I kind of learned how to probably be more outspoken and not be afraid of speaking more.

I: Do you attribute this to just interacting with [your mentor] or with doing research as well?

R: Probably both. Yeah, doing research, it kind of lifted my self esteem a little bit and my confidence.

Feeling less intimidated by faculty members: gaining comfort in interacting with them

A related program outcome of having increased confidence and feeling less intimidated was that some students became more comfortable interacting with faculty members at their home institutions. In the following quotes, the students discussed how prior to the program they viewed faculty members as inaccessible authority figures, and that they had come to see them as “real people” that they could approach.

I: Did the mentoring program influence how you interacted at all with other faculty?

R: A little bit. When I first came as an undergraduate I didn't realize that you could be friends with a professor necessarily, that you could actually go into their office and get help. I always thought, “Oh, they're too good for that.” They're these people on this pedestal. But it's ok to go in and ask them questions. I still, even after I figured this out, I ran into people who didn't understand that, that thought, “Well, they have too much to do, they don't want to hear my problems and such-and-such,” but it's ok to do that. That was something I definitely figured out after a while.

* * * * *

I: Has the mentoring program been an influence on how you interact with faculty?

R: That's a tough one. I think maybe in that I had never really interacted that closely with somebody in, what do I want to say, academia -- a professor. I think it sort of put a human face on it, made me realize that, you know, they're people, too. Just the idea of working that closely with my mentor.

Evaluator's Viewpoint : Increased confidence in abilities may lead to greater commitment to the field

For some women this increased confidence that they could apply classroom knowledge and succeed in working on a research problem, made them feel more sure that CS was the right field for them to pursue. As discussed in the Section I, when some of the participants came into the DMP, they were unsure about whether or not CS was the right field for them. They stated that they had applied for the program in order to obtain more hands-on experience in the field, so that they could make more informed decisions. In part, they questioned whether or not the field was right for them, because they were not entirely confident of their hands-on abilities. During the DMP research experience, many students found that they were quite successful working independently on an applied, open-ended problem, and thus, their confidence in their abilities was increased. By addressing this concern and removing, to some degree, the fear of failure as a barrier to persisting in CS, the DMP made some women feel more committed to the field. In the following quote, a student explicitly discussed this dynamic.

I: Did the mentoring program influence your commitment to studying CS? I realize you had one year left.

R: Yeah, I guess. I enjoyed the program, so it kind of reinforced the idea that this was the right field for me, the right career for me.

I: Was that something you were unsure about before?

R: Not overly, but every positive experience still helps.

I: And how did it reinforce that?

R: I guess because I enjoyed my research, or whatever. I don't know, I felt like it was successful, so I guess it just gave me more confidence that I was going to be able to be successful.

See "Section III. B. Essential element #2: Research Project" for more on the relationship between the research project and increased confidence.

B. Enhanced their ability to go further in CS

Students indicated that they had experienced a broad range of outcomes which were related to an improved ability to go further in the field of CS. These impacts are discussed below.

1. Gained valuable research skills

Through their experience in the DMP, most students gained valuable research skills. Upon entering the DMP, many students had little experience with research and most indicated that one of the primary reasons they had applied to the DMP was to gain research skills.

By being part of the research process, they came to understand a great deal about how problems were designed and solved. For example, some students indicated that through the DMP they became aware of the importance of reading the existing literature on the research area of interest in order to define a research question which would contribute to current academic discussions. Many students discussed that through the DMP they had come to understand that research involved trial and error and often took surprising twists and turns.

In addition to more general research skills, some students discussed that through the program they had strengthened their oral presentation skills and/or their writing skills. Others learned new programming languages, and for some, these new programming skills helped in subsequent undergraduate courses or in their post-graduation jobs.

During the program, a few students learned about the process of publishing research papers. In the following quote, a student discussed what she learned about this process.

R: ...[My mentor is] going to continue to help me, and she's going to teach me how to

submit for publication, in terms of how to write for submission, and also how to choose who you submit it to.

I: She's going to do that just in general for you?

R: Yeah, because she said that submitting it to the right source is critical in getting published. And one of the things that she did tell me -- this is some of the stuff that we got into at the end, that was really helpful to me. She said that the people that you had cited in your own research, what you do is you look and see if they tend to all be published in the same journal. Because they will tend -- you know, if they have published the material you have cited, then they will tend to look at your submission a little bit more.

I: Right, because it becomes part of their dialogue in their journal.

R: Yeah, 'cause it's like an ongoing development of the technology that they're putting forth. So I mean that was really interesting, 'cause I wouldn't know. I wouldn't have any idea how to do that stuff. So I mean, I think she's willing to stay involved in my doing research, and helping me in the future.

See Section III.B for a full discussion of the way in which the research experience fostered the participants' development.

2. Provided preparation for graduate school: Knowledge and necessary skills

In their interviews, participants discussed multiple ways in which the DMP provided them with preparation for graduate school in terms of both knowledge about "what to expect" and the necessary skills to succeed in graduate school. Most participants indicated that prior to the DMP they had little conception of what graduate school entailed. As the following quote demonstrates, most participants came away from the program with a greater understanding of graduate school life.

R. I learned a lot, getting to work with a lot of the different students, and just learning about the atmosphere about different graduate programs, 'cause I didn't understand exactly even what a graduate program was. It was just like extra education. I didn't know how it worked. I didn't understand the masters was two years and the classes and the Ph.D. was the research and the studying kind of aspect and the different things to look for when I do look for a graduate school when I did look for graduate school and how they influence my decision. Basically, it's all really -- everything I learned from it is what helped me find a graduate school now basically. . . . I keep comparing the graduate schools that I looked at for next year to the one that I went to.

In this section we present the different types of knowledge and experience related to graduate school preparation that the participants gained.

a. Gaining knowledge about what to expect

Virtually all of the participants who had worked with graduate students in the DMP indicated that after the DMP, they felt better prepared for graduate school because they knew what to expect. Not only had they participated in research which was similar to graduate research, but they had interacted with, and observed graduate students; through this they gained valuable knowledge about what graduate school entailed. For many this made them more comfortable and confident about going to graduate school.

In the following interview excerpt, a student listed many of the things she learned about graduate school during the DMP.

I: So did you talk with the graduate students at all about their experiences in graduate school?

R: Sometimes I did. Like after the graduate seminars, they would have pizza. So we would usually talk to them then...I learned a little bit about grad school...I learned that you don't really have to pick a topic for, like, your first year, maybe two. Which is kind of cool. You can pick an area but you don't necessarily have to pick a topic! And for the first two years you mainly take classes. You don't really start your research until the third one...And your dissertation isn't as important as everyone claims it is. And, I learned a lot about, actually, the final exam. The final, oral, the oral defense. I learned a lot about that. Because there was a couple of grad students doing that, they were doing the oral defense, and if you're going to get your Ph.D. and you've done all the work -- you've done the work for your thesis and you did all the research and you take the classes and you pass them or whatever, then unless your thesis makes absolutely no sense, you're probably going to pass your defense. Probably, you know? There's a slim chance that you're not. But if you've done good work, you're probably going to pass your defense. So I've learned that. All these little hints!

I: So all of this that you learned, how different was that from your impressions of graduate school?

R: I didn't realize that . . . -- I didn't know how long you had to take classes for. Like I guess a few of the grad students I had met before were on different tracks, and they would take maybe a class a term, and then they'd be working on their research, all the other time. Like the rest of the time. So, I didn't realize [these things]. It's good...It made me feel better about it.

Another student made similar comments.

It helps that I've got a better ideas of what grad school is about from last summer, 'cause before it was just sort of, "Well, you know, where do you go after undergrad school?" And now I've got an idea of how people spend their time and what they're doing there,

and that's really helpful. It also gave me an idea what academia is like.

Below we provide examples from interviews with students who had already been accepted into graduate school at the time of their last interview. These students discussed that their experience in the mentoring program provided them with a head start on graduate school.

We were essentially graduate students for a summer and being put in that environment so I knew what I was getting into. So now, since I am going on to graduate school, I know what to expect. I'm not like a scared little freshman as I was when I went into undergrad, I know what to expect. And making the contacts was also very helpful, getting other opinions on what graduate schools are good to go to, getting extra recommendations from other people that are in another school I'm sure really helped me a lot.

* * * * *

I: How do you feel about making the shift [from undergrad to grad school]?

R: Oh, I feel a lot more comfortable with it now, because I kind of feel like I know what's expected and if it's not the way that [my mentor's institution was] then great, but if it is it won't be a big shock to me or anything, I'll kind of understand it and even expect it to be that way. so,

I: Ok, good. So this might have provided you a transition.

R: Yeah, yeah, it's definitely prepared me for it, that's great.

b. Gaining necessary skills

As reported above, most participants gained research skills through the DMP. Many of them felt that these skills would assist them in graduate school. The following student quote illustrates this point.

I: So do you feel you can succeed in graduate school?

R: Oh, yeah. Yeah. I think this program is really beneficial, because I think learning what I learned this summer will save me time to learn it in grad school. When I go in to do research, I can spend the first amount of time doing everything that I learned this summer, the same way, and now I already know how to start.

I: Ok, so you just sort of have a jump start.

R: Yeah.

c. Gaining "insider knowledge" about selecting, applying, and succeeding in graduate school

By playing the role of “honorary graduate students” during the DMP, most participants gained knowledge about selecting, applying and succeeding in graduate school. They were able to access information which can be considered “insider-information,” as it came from being inside some of the top ranked CS departments in the country.

Learning about the application and selection process for grad school

Many students discussed that prior to the program they had had little or no knowledge about how to sort through the maze of picking graduate schools and applying. Through the DMP they became more sophisticated in their approach to selecting and applying to graduate schools. Some students discussed that they had come to realize more about “what really matters” in selecting a graduate school. They indicated that they had realized the importance of selecting a graduate school on the basis of a comfortable environment. These students described that they wanted an environment that was friendly or “warm” and where they would “fit in”.

Learning about importance of good advisor

A few students discussed that the program had helped them realize the importance of having a good advisor in graduate school. They had learned this either through their interactions with their mentor or through observing graduate students who were engaged in both positive and negative experiences with their advisors.

Learning about how to deal with departmental politics

Through discussions with their mentors or with graduate students, a few students had learned the importance of paying attention to departmental politics and the “rules of the game.” They felt this awareness would positively affect their chances for success in graduate school.

R: I’m glad I went...more because of what I learned. As far as the world goes. Not really for that [research] project.

I: Ok. So what did you learn?

R: Well, I learned that there’s a lot of weird stuff that goes on, and feet not to step on, and just like, everybody’s just trying to get away with everything and trying to come out smelling like roses. And just like, how the politics of academia is. And like, whoever has the power is the person you’ve got to tiptoe around. And it really seems like that’s stuff that nobody tells you.

Evaluator’s Conclusion: Broader impact of greater likelihood of success for DMP participants in graduate school

Although the stated goal of the DMP is to increase the number of women who attend graduate

school in CS, the program may have the broader impact of increasing the likelihood that those participants who choose to attend graduate school will be more successful. Through preparing students for graduate school in multiple ways, the program will ease the transition to graduate school and provide women with a foundation in the necessary skills for success in graduate school.

3. Participation in the DMP provided greater access to opportunities: letters of recommendation

A few of the students who had participated in the program in 1994 or 1995 indicated that as a result of their participation in the DMP and receiving a strong letter or recommendation from their mentor, they had been assisted in getting into graduate school or getting a job in CS.

Getting good jobs in CS

As illustrated in the quotes below, some students felt that the DMP provided them with a “leg up” in their job searches.

I: Do you see the mentoring program as being influential in getting a job? Where you’ve applied?

R: {pause} I think, hmm, I’m not really sure, how, where, the particular place where I work now I’m not doing anything dealing directly with simulation, which is what I did at my mentoring project, that’s it. Now, it did help me as far as building my resume, because I was able to put that on there and it showed that I had, you know, a broad range of experience, and they were interested in it too. You know, it was an interesting project, and it gave me something, it gave me a good story to tell in the interview. So, in that way I think it helped me.

* * * * *

R: Well, it was just something that everyone that I interviewed with asked me about and seemed very interested in and seemed impressed, I would say.

I: Did you put it on your resume, or how did they know?

R: Yeah, I had it on my resume, so I feel like it was something that my experience helped me get the job.

Getting into graduate school

Many students commented that their experience in the DMP coupled with a letter of recommendation by their mentor was extremely useful in getting them recognized by other departments and in getting into graduate schools.

Yes, [my mentor] did [write a recommendation for me]. In fact, [one graduate school] was really impressed -- when I went in to talk with them, the one professor I met with, he couldn't remember my file, so he was just kind of pulling stuff up, and we were just talking. And I told him that I had been at [my mentor's institution] and worked with [my mentor] and oooh, all of a sudden he remembered. "Yes, you had a wonderful recommendation. We were very impressed with your file, and we want to offer you some sort or scholarship, but you weren't going for the Ph.D. program, so we couldn't." I was really flattered.

* * * * *

I: And do you think the mentoring program influenced the kinds of schools you could get into?

R: Oh, I know it did. I really know it did. Because I was, one of my best friends and I made, last summer, a graduate student, she was pretty cautious with me of saying, "Listen. You're coming from a real no name place here, and you're not going to have, recommendations from researchers like people coming from big name schools are going to have 'cause no one at your school does research. And so you really need to, you never know what's going to happen, and you need to go to the best school you can get into, but you need to apply to a big range of schools, just in case." You know, she said, "You may not even get in here. You know, it all depends." And she said recently, she was like, "I did not realize how much that program and that experience was going to affect your application." And all I can say is that [my mentor] must have written me this letter that was like, woah, incredible, said incredible stuff, because otherwise I don't know how it happened. It must have, it must have made a huge impact because really that was the only real strength on my application.

4. Provided access to an expanded network of academic computer scientists

Through the DMP, many participants gained contacts that they felt would assist them in their decisions about career avenues and would give them greater access to opportunities in the field.

DMP Mentors as post-program resources

Most students who were interviewed indicated that they felt they could rely on their mentors for advice and for some help in obtaining new opportunities, such as getting into graduate school, finding new research projects, and getting CS jobs. Many students had contacted their mentor since their participation in the mentoring program. In the following quote, a student discussed the way in which her mentor would continue to be a resource even after the program.

So I mean, I think [my mentor is] willing to stay involved in my doing research, and helping me in the future. ...I feel like I could contact her at any time. I feel like I know that she's willing to write letters of recommendation for me. And stuff like that. And I

think as I get more advanced in what I'm doing and can understand what she does better, then that will give us an opportunity to get a little bit more in depth.

A few mentors and students kept in contact to organize for a presentation of a paper at a conference and/or to continue work on a research project.

Students who had been in contact with their mentors after the program indicated that their communications were not just focused on professional concerns, but that they had a social dimension of just "keeping up" with each others' lives.

Graduate students as post-program resources

Through the DMP, some students developed collegial relationships with graduate students that continued after the program. In essence, the graduate students became part of a network of resources upon which these women could draw in making decisions and attempting to go further in CS. For example, some students contacted these graduate students to discuss various issues regarding applying to graduate school or to request guidance on an industry job search:

Yeah, [my interaction with this graduate student is] both. It's mostly social, just as a friend, but I can say, "Ok, what do you think? Where should I be going?" I look to him just to give me ideas of what's out there. I think one of my biggest frustrations to an extent is that I don't know what's open or what's out there for me to do because I know there's so much, and that's why I keep hoping, to some extent, there's going to be a way to mix my various interests. And I know there will be, but I don't know it yet, so I just look to all the people that I met that summer, especially that I worked with a lot, to sort of question -- "Ok, where I'm at, what do you think I should do?" And just look for ideas.

Finding female peers in CS

A few students indicated that through the DMP they had linked up with a female peer in CS. This was very valuable to these women, because there were so few women in the undergraduate departments. In some cases participants found their first female peer in CS.

R: I had a lot of fun with the girl who was working with me [who was also in the DMP], because there aren't a lot of girls around, in my department. So it was nice to have somebody else around to talk to ... We had our own projects. They were separate...[And] we had a lot in common.

I: Ok. So was that your first friendship with a woman in computer science?

R: Ah, yeah, really.

I: So what was that like for you?

R: We were talking about it towards the end of the semester -- or, not semester, summer. But it was just, it was really nice to be able to talk about the stuff you can't talk about to the guys, you know. Just, when you're upset about something, or having a mood swing {laugh} and I don't know. We went to lunch together all the time, and complained to each other. So, yeah, it was nice.

I: Ok. So how do you feel around the men in your department in terms of those things?

R: In terms of *those* things? {pause} Well, they don't understand, of course. And you know, not that I blame them for that. But -- and I get along with them fine, and I have a lot of good friends there, but, um, I don't know, it's just nice. The only really close female friends I have is my Mom, and my best friend, but she lives 70 miles away. So it was just nice to have another woman to talk to.

Participants became more committed to expanding the number of women in CS

After the DMP, some students became more involved in trying to expand the number of women in computer science. Some discussed that they had tried to encourage other women to apply for the DMP. The comments on this issue suggested that these women were interested in increasing the number of women in CS, because they wanted a more supportive network of peers.

C. Increased participants' understanding of CS careers and what was right for them

Because the DMP was an immersive experience which allowed students to see the world of academic CS from the inside and to experience, at least for a short time, what it might be like to be a part of it, most students felt that they came away with more of a sense of what direction they might want to take after graduation. They felt that they were better able to make informed decisions about the best career choices for them. In this section we will discuss their perspectives on how the program has or may influence their career decisions.

Most of the women we interviewed indicated that the program had provided them with more information about possible career options and how to go about pursuing these options. As indicated in the Section I, many participants were unsure about what direction to take. They entered the DMP with the expectation that it would provide them with information on career options. Most felt that the program did provide useful information on this issue. The following quote is representative of what most participants felt about the DMP experience.

I: And do you think this program had affected your future career plans?

R: Yeah. Yeah, I think it has. Partly in just the experience it's given me, I think it's been really valuable, and partly in making some decisions. And having the knowledge to be able to make the decisions.

I: Ok, what sort of decisions are you making. Something beyond graduate school, or?

R: Yeah, whether to go to graduate school, career wise -- not that I've made career decisions by any means, but I think I've got a lot more under my belt now. Down the road as I need to make decisions, I think it's been valuable.

One student used her experience in the mentoring program to come to an understanding of an academic research career and took a summer job in industry to learn about industry careers.

R: I took a job like this summer because last summer I did research, so this summer I wanted to do something out in the industry, and see what the differences were.

I: Oh, that's very interesting. Ok, so you're kind of comparing for yourself. And is that, I take it that's with regard to career interests, so you're kind of seeing what, how you feel, or what

R: Yeah, I'm trying to make up my mind on what I'm doing with myself...

I: Are you using that experience -- you said you're trying to make a decision about research versus industry -- as the representation of research?

R: No, I don't think so. I'm using that as part of the representation. I mean, that's just part of it, but I know that I'm going to try to do an honors project next year.

As this is only the second year of the evaluation, and the comparison group has yet to be fully tracked in terms of rates of graduate school attendance, it is difficult to determine how much of an effect the program has had on rates of attendance to graduate school and persistence in the field of CS&CE. During the third year of the evaluation we will explore this issue more fully. See Appendix A, p. 6 for a table tracking data of DMP participants from all three program years.

1. Making informed decisions about grad school

Most of the students indicated that the program enabled them to make decisions about whether or not to attend graduate school in CS&E. As discussed above, many of the students had little conception of what graduate school entailed before entering the program. Thus, they were hesitant to commit to attending graduate school. The DMP allowed them to have an immersion experience in graduate school and helped them to "try it on for size." For many students this resulted in making them feel more or less committed to attending graduate school. Student survey data confirms this finding.

a. Finding grad school was right for me

According to survey data and interview responses, many participants came to feel more committed to attending graduate school through the DMP. As in the following quotes, some

students indicated that through the DMP they came to feel that graduate school was “right for them.”

R: [This program] greatly helped me decide what I was going to do with my life...

I: Were you considering graduate school before you started the program?

R: Yeah, I was considering it but I wasn't sure if it was for me or not. And then after I finished I decided that I definitely wanted to go...

I: Right, what made you change your mind?

R: Well it wasn't really that I changed my mind I just, I wasn't really sure what graduate school was all about or what it involved and this showed me what it was about and it showed me that it was something for me.

* * * * *

I: How has participating in the program changed your view of grad school?

R: I guess it's really made me sure that I want to get my master's because I was still kind of unsure.

I: How did it affect that?

R: I guess I was just kind of scared, like I didn't know what to expect. But just meeting some of the master students, that they seemed like people I could see myself being in a couple of years or next year.

Realizing they could do the work

For many of these women, the DMP helped them realize that they were capable of doing graduate level work. This increased their confidence in their ability to succeed in graduate school and therefore increased their commitment to applying to graduate school. The following student quote is representative of this viewpoint.

Seeing the way people lived and sort of conducted their graduate experience gave me insight to realize that it's something that I definitely could do...I was very scared of it and being in that environment showed me that it was nothing to be scared of...I could handle the work...It was no longer this like, this degree that I wasn't smart enough to get or wasn't motivated enough to get or that you know, definitely meant that I was going to being a professor, um, it seemed like, you know, even if I went out into the work force after getting a Ph.D. it was just an experience that I think that I want from life. And it never would have been something that I would have considered before, it was just, it seemed like academia was something that I had had enough of.

[During the program] I saw someone do his [qualifiers or pre-lims]...and so I was really nervous, but I sat in on that and it was, it was nothing to be afraid of. It was the kind of thing where, if I had prepared the way that I normally prepare for things, there was no way that I wasn't going to pass. It may have been very stressful and it may have taken a long time to prepare, but it certainly was something that I could accomplish or that wouldn't keep me from getting, you know, a Ph.D. And that was, that was very useful to sit through and to see and to be able to take that information and, you know apply it to myself in what, you know, how I would be able to deal with that situation.

DMP provided "the push" to go to graduate school for some

In the excerpt below, one woman discussed that the DMP gave her a strong desire to go to graduate school and made her focus on the application process during her senior year.

[The mentoring program] sort of gave me this thing of like, "Forget classes this last semester. I have got to apply to grad school. That's my most important goal, and fellowships, and these stupid Essays that I have to write are more important than any of my classes." But my faculty members at my undergrad school also thought that, so in a way, and in a way it sort of gave me this, I was so interested in the exact topic I did that I worked on and basically felt like I knew exactly what I wanted to study, and partially because NSF decided that you have to tell them, like, practically what your thesis topic is, so you had to sort of pick something. But I felt so confident and interested in it that I couldn't wait to get started. And that was hard for the first month back or so. It was like, "I don't care. I know what I want to do. Let me out of here." And I, I didn't have many computer science classes left to take. I was trying to get some of my general elective stuff done, so that was hard.

Another student indicated that the DMP had given her the "push" to go to graduate school.

I: So do you see the mentoring program as influencing your commitment to your studies in CS?

R: Yeah, probably. This one I cannot say really that was the definite thing that made me go to grad school. I always had this thing of bettering myself and learn more and all that stuff, but maybe this, the mentoring program, was what gave me the push, let's say, what made me decide. But I guess the will and the desire of going to grad school was always there inside me I suppose, so yeah.

I: Did it influence your commitment to your studies in CS?

R: Yes, it definitely influenced me.

Some students are still in the process of deciding whether or not to attend graduate school

For some students the DMP increased their commitment to graduate school, but did not cause them to make a firm decision about whether or not to go to graduate school. This was partially a function of age, as some of the participants were entering their junior year and were not ready to make a firm decision about post-graduation plans.

I: So having this experience this summer, did that influence your thoughts about how graduate school would be, in terms of how much interaction with other people, or what do you think?

R: It was really weird, because I never thought too much about, like socially, how graduate school would be. And the people who were mostly around this summer were graduate students, 'cause the undergrads of course were gone, or only around for their classes. I guess I had my concerns about how graduate school would be. You know, if I could handle the research that I would have to do for a thesis or whatever. And I think this calmed some of those fears -- that it would be Ok. You know, if that's what I chose to do. I don't think it *convinced* me that that's what I want to do!

b. Deciding they were not ready to commit or graduate school was not right for them

Through the DMP experience, most participants came to a deeper understanding of their own career interests and the steps that would necessary to achieve their goals. For a few students, the DMP experience led them to realize that they were not interested in attending graduate school in CS in the foreseeable future. In their interviews, students gave various reasons for this.

Career goals were not well enough defined to justify going to graduate school yet.

A few women who decided not to pursue graduate school immediately after college indicated that they did not want to go to graduate school until they were certain about what they want to learn.

I: What is your attitude now toward graduate school?

R: My attitude right now is, I'm not ready for it, mostly because if I were to go right now I would go into CS because that's what I've *been* studying, and since I don't have a focus..., you know, I haven't figured out what about CS I really would want, I feel like I would just be going back and taking classes like I did in my undergraduate experience. That, for me, although I really enjoyed it and I did learn a lot, to an extent, I took the classes to get done with the classes, and I finished it, and if I were to do that I would still be just taking more classes for no reason. I know that if I go I need a very specific focus for, like, "This is why I'm here, and this is what I want to get out of it," so I can look for what I need from it. I think it's definitely a possibility. I'm not sure what I would go in, but at some point if something strikes me and that's the way I need to get to it, then I'll go, but at this point I definitely need a break.

Career goals did not necessitate going to grad school

Some students commented that attending graduate school was not necessary for them to achieve their career goals. For at least one student, it was not likely that she would attend graduate school because she did not want to become a professor, and even after the DMP, she had the impression that the sole purpose of getting a doctoral degree was to pursue becoming a professor.

I: What kind of factors are going into your decision of getting a job?

R: Well, for one thing, I don't see any benefit in going on. The only aspect -- the only job I think it would help out for is if I was wanting to be a teacher or professor. Then a Ph.D. would be necessary, but I think just to be a programmer I think a BS is sufficient. Also, I'm really tired of school. Four years is plenty, and I'm ready to make some money and not have to spend all day every day doing homework.

Finding they are not as interested in CS as they had thought

One student realized through the DMP that she didn't necessarily enjoy working on computers outside of the classroom. Thus, she is not planning on going to graduate school or pursuing a career in research.

I wanted to find out what research was, and I wanted to find out if I really -- 'cause I was having, kind of, doubts about computer science before I did this program, so I wanted to see if I really liked working with computers enough to do this for my career. I don't know if I'd actually thought about it as doing it outside of the context of the classroom, but I guess I found out that I don't have as much motivation now that I'm not in a classroom.

Evaluator's viewpoint: Benefit of allowing women to experience the field of CS from the inside

Although the goal of the DMP is to increase the number of women attending graduate school in CS, we suggest that the program serves an important function for those participants who find that they are not interested in pursuing graduate degrees in CS. It allows them to see and experience academic CS from the "inside" and to determine if it is right for them. It is possible that had they not had the DMP experience, these women might have gone further in the field, investing time and money into an avenue that they might later find would not fulfill their career needs.

2. Gaining information about academic research careers and defining their own interests in relation to this new information

Through being immersed in an academic research environment by participating in a research project, the participants came to understand more about the nature of academic research careers. As they began to learn more about the daily life of a CS academic, they were able to begin to grapple with whether or not this type of career would be right for them.

As in the following quote, the DMP allowed these women to experience the field from the inside and this allowed them to come closer to defining what type of career would make them “happy” or “fulfilled.”

I: Do you see yourself approaching anything differently because of your experience in the program?

R: I think approaching my life differently. Yeah. It made me much more aware of what exactly do I want to be doing or what’s going to make me happy, or what’s going to satisfy me.

Through this process, most students either became more committed to pursuing a career in academic research or less committed.

In their interviews, the participants discussed several issues relating to what they had learned about CS academia and how these issues were likely to impact their future decisions about career paths. The issues discussed below were the ones which were most commonly raised in the interviews.

It is important to note that although there was substantial agreement on the important factors to consider in deciding whether or not to pursue a career in CS academia, the participants’ conclusions about how each of these issues might affect their decisions varied greatly. We present these issues not only to show the impact of the program, but because we feel it is important for the mentors and the Program Director to have information about concerns which participants raised with regard to the unique issues that they believe are associated with academic research careers.

a. Trying to determine whether or not research is “useful” to the “real world”

Many of the participants indicated that it was important to them to pursue careers which they felt were going to be “meaningful” in terms of having an impact on the “real world.” Through the DMP, the participants were able to gain more knowledge about whether or not a career in academic research would meet this need.

Finding that CS research was more “useful” than they had thought: increased interest in academic career

Some students came to the conclusion that CS research was indeed relevant and useful. In the following interview excerpt, a student discussed that prior to the DMP she had not considered research “serious” or “meaningful” work, but that now she felt that academic research in CS was much more tied to the real world.

I: Ok. So how would you say [the program’s] influenced you, if at all?

R: I guess it's encouraged me about the work that I'm doing, because it's made me more believe that it's substantial work. I guess you have this idea that, you know, research is kind of, you know, "A lot of money, much to do about nothing." But, I guess I feel better about it [now. I feel it's] really doing something, and that it has some substance to it...[I came to this conclusion] partly just...getting the feeling that we're not as removed from the industry as you feel you are as a student. And I guess nothing really happened to make me feel that way, but I guess I felt more that way this summer [in the DMP].

I: So you could see how the research could be applied, and be made useful?

R: Right...

I: What are your feelings about doing research as a career?

R: I think it would be, I would like it--which surprises me, but {laugh}

I: Oh. Tell me why it surprises you.

R: Well, I just have never taken it that seriously before....it just seemed like one of those things that people do when they can't think of anything else to do...I take it more seriously now, and I think it's something I would be interested in doing...[The program has] made me more or less assume that I'm going to do it, rather than assume that I'm not...Partly because I believe it's...the kind of work that I'd like to do--that I think it's serious work, because I wouldn't be interested in doing something that I didn't think was serious work...

I: And when you say serious work, what do you mean by that?

R: Work that is going to do some good, work that is going to -- is meaningful, hopefully going to help someone, or produce some results that are helpful or meaningful.

Later in the interview, this student went on to discuss that the program gave her a fuller appreciation of the way in which academic research and industrial applications were closely linked. This strengthened her desire to pursue a career in academic research.

I: Right. Tell me more about how your conception is different from, is different now from the way it was before about how useful research was.

R: I think that I get the feeling that people are actually interested in making the process of working with computers, whether you're programming or testing or whether you're -- whatever you're doing, making the whole process more organized and more efficient and more productive. So in that way I think research is important, because it's the kind of work that people that are out in the field that are in the industry don't have time to do. But it's stuff that could be very helpful to them. And I think that research raises questions

that you don't think about when you're in the thick of things.

I: And your conception of research as you just stated it, how different is that from what it was previously -- prior to the program?

R: I guess not too different except that before this, I think like I said I didn't take it terribly seriously, and I kind of thought, "Well, even if you did something that was actually good people that are out in the industry are not using it anyway. So who cares." You know? And now I think I believe that they are, that they're interested, and that there's a closer relationship there than what I had thought.

Feeling that research did not seem to be connected enough to the "real world."

After the DMP, some students felt that CS research might not be connected enough to the "real world" to satisfy them in terms of what they wanted in a career. They saw little connection between research and applications which would help other people.

I: ...What about your thoughts about going into academia, or industry. You said in your first interview that you didn't want to do into academia.

R: No, not for a career. I wouldn't mind working as a professor, teaching a class or something on the side too, 'cause I think that that would be something that would be interesting. But I don't think I could make a career in academia.

I: And why not? . . .

R: Because it doesn't interest me, really, to stay there forever. I'd rather be out where it's more useful, and applied to real -- it's that useful thing again. You know, I know teaching is useful, but it's hard to see the results of your efforts. Whereas if you're out in industry you're doing something for a product, you know?

Another participant made similar comments.

R: I don't want to focus on teaching or research.

I: Ok, so what do you want to do in industry then?

R: Applications that people can really use. That are helpful in their jobs.

The student quoted above discussed that she did not understand how her DMP research was going to be useful to her mentor's research.

R: I don't know what I was supposed to be doing, you know--what it was going to be used for. I felt like this research had already been done--a higher level of research had

already been done and proven to be better. And so I didn't exactly understand why I was doing the low level of research I was doing when there was already higher level research that had proven to be effective...[The project was] something that would somehow relate to...these other [graduate] students' projects.

I: Ok, but you still ended up feeling like you didn't know quite how it was going to be useful, right?

R: Yeah, when other people had already done prior research that I felt could be used in place of what I was working on.

b. Deciding whether or not the research environment appeals to them: importance of working with other people

By being inside their mentor's CS departments and experiencing the CS academic environment, students were able to consider whether or not they would enjoy working in this type of environment long-term.

Increased commitment to pursuing research because they found the research environment interactive and stimulating

Through this process, some participants decided that they would be fulfilled in an academic research environment. Many of the participants came into the program knowing that they wanted a career which would allow them to work with other people. Some of the participants were surprised to find that the academic environment provided many opportunities for working with other people, and this made them feel more interested in pursuing careers in academia.

The participant quoted below stated that the program had solidified her decision to go into academic research and then stated that one of the reasons was that she enjoyed the stimulating intellectual interaction that she experienced during her DMP summer.

...I got to hang out with some of the grad students and we would kind of sit around and talk about different projects. The whole interaction thing at that level. I want that. I guess I'm a geek! {laugh} I enjoy geeking out with people, and I don't want to just work nine to five and go home, and clock out. You know. I like keeping my head into what I'm going and having little puzzles to solve all the time.

She further explained,

It was really important to me, because it kind of showed me the kind of people that I want to be around. They have a really great group of grad students at [my mentor's institution] in computing...and they hang out together all the time, they're like, "Let's go to lunch." Every day. And it's really neat. They discuss their projects with each other, but they're all kind of working on different things, too...They were good people, really interesting,

from all over the world. And that's another reason I'm thinking about research, because I think a lot of those are the kind of people who go into research.

Feeling unsure about whether or not a career in academic research would provide enough opportunity to work with people

Some of the DMP participants stated in their post-program interview that they were unsure about pursuing careers in academia, because they wanted to work more with people and they did not know if a career in research would afford them this opportunity.

In the following quote a student discussed that she believes she might be more satisfied working in industry where she would be working on a project team. In the DMP she worked primarily by herself.

I: So how did you get interested in software engineering as opposed to something with vision?

R: I mean, I guess it's just more -- it's more purely computer science that I've been wanting to do. The image processing, a lot of people specifically have degrees for, and I didn't like it as much, and it was more just me working by myself, whereas I like the idea with a software engineer that I'm going to be working in a team, more contact with other people.

Another student who worked primarily by herself during the DMP indicated that she was questioning whether she would enjoy a career in research because she felt it was a field in which she would not receive a lot of immediate feedback or have the opportunity to interact with people as much as she wanted.

R: I think that's more it [that I was interested in other things besides graduate school]. I think to be in a research environment you have to have a lot of internal motivation, and I'm not sure I had that. I'm one that needs a lot of, I don't want to say approval outside, but I need some kind of measure of how I'm doing, and when you're doing research it's very difficult. Unless you're getting a lot of things published there's not a lot of immediate feedback. I like -- in a job you have a little more of that.

I: Was that something you learned through the program or through your [other research project]?

R: (pause) I'd say through both, through both. I think research was a lot -- you'd be left on your own for three or four weeks, and then there'd be some determination of where I was, and that was fine for the kind of projects I was doing. I like a little more interaction with people, and I think I get that a little more in a job setting than I do in a research environment... at least with what I've experienced. And maybe it depends on the kind of research project it is.

Evaluator's Question:

Both of the students quoted above worked primarily alone during their DMP experience. Would they have come to different conclusions about the amount of interaction with others that a career in academic CS would afford had they been involved in a more collaborative research process involving graduate students and more contact with their mentors?

c. Learning about unique issues women in CS face, especially balancing career and other interests including family

Many of the interviewees discussed that through the program they had gained insight into the unique issues which women in CS face and how to address those issues. The participants learned about these issues primarily through interacting with their mentor, a successful female in academic CS, but also through observing and interacting with female graduate students. See Section III for a full discussion of the importance of a female mentor.

In the following interview excerpt a participant discussed the types of issues she was able to learn about through the program.

R: I really liked it, especially the fact that it was a female mentor, especially in a computer field. Maybe this isn't true as a whole, but at least at [my home institution] I had one female professor in computer science. It's encouraging to see another female in the field you really like. I felt I got some advice, not only as far as graduate school, but also from how she dealt with things as a woman, 'cause she had some -- she had some instances where she had sexual discrimination against her at the university, and how she proceeded through that. Then also, how she had made some decisions about her family life, which I don't think I would have felt comfortable talking to a male mentor about.

I: Can you give me an example?

R: I think maybe some of the family examples, and like the marriage, getting married. I mean, we didn't talk about that a lot, but she kind of had addressed how she got into graduate school and her marriage and how that had worked into things. I don't know that I would have felt comfortable talking to a male mentor about those things.

Learning whether or not it is possible to balance career and other interests including family

Most of the participants expressed concern about having a career that would allow them to have balance with other interests including family. It was important for them to address this issue because they considered it a primary factor in career decisions. Prior to the program many had doubts that it was possible to have this balance as a computer scientist in academia or even in industry. Through the program they gained knowledge about this issue. Participants came to a range of conclusions.

As illustrated in the following quote, through observations and interactions with their mentors and/or graduate students, some participants came to believe that it was possible to achieve balance.

I: Was it important to you to see that [your mentor] had kids and a career?

R: Yeah, I mean it's just something I never thought about and there I saw it and it just made me think about it. It's like, "Wow, someday I want to have kids." And I never had really thought about, "Well where does the career go when that happens?" 'Cause my dad had the job and she had the part-time job that wasn't as important. And I mean in the town I was raised in, that's how it was. I mean most of the men, the fathers had jobs and the moms stayed home and raised the kids or had a part-time job. So I think it's really been a good experience seeing that she's had kids and can still have a job as well, and an important job that she likes and that is important to her.

This student went on to say that seeing her mentor's success at balancing family and career had increased confidence that she could do the same.

R: Yeah, so she's really been a great influence just to see how -- I mean she has kids now and it's just so interesting to see someone -- I mean I don't have any real role models that I've ever looked up to. Just to see that she's gone through college and gotten her Ph.D. and now is teaching and has kids. It's interesting to see that first hand. The same with [one of the female graduate students] too. She has [an infant], so she had him during the middle of getting her Ph.D.

I: Does [observing] that influence you in what you can do?

R: Yeah I think it did. It just made me think that you really can do anything, I mean [if you] just put your mind to it. I think a whole part of getting your Ph.D. is, I mean it's a long haul but if you want it bad enough you're gonna be able -- I think you can do it. I might be a little bit too optimistic, I don't know.

Another woman came to a similar conclusion through observing her mentor -- that it was possible to balance family and career.

I: Ok. Was there anything in particular that you learned about that that you feel would be useful in your life?

R: Um, not anything new really, you know probably more confirming what, I don't know. It made me feel a little bit better about the possibilities, I suppose.

I: Oh, that's good.

R: More than anything, you know. And then also, the rest of it, the other thing that I think is nice is that among the other faculty, I think most of them, most of the other ones if not all of them are married and a lot of them have kids, and do, and their families are important to them, I mean it's not just, and they're very committed to their family so it's, it's nice because you see that it's possible to work hard and still have something left over for home.

Some of the participants came away from the program feeling ambivalent about whether or not it was possible to achieve balance. One student discussed that she feared that if she went into research she would find it too difficult to keep the important parts of her life "separate." Her own experience of finding it difficult to leave her work at the office during her research made her question this.

I: Ok, so what are your thoughts about doing research as a career now?

R: As a career? {laugh} I don't know. Just that it seems like constant work, but, as far as maybe going on to grad school or something and doing some research, I think it would be interesting.

I: Ok, well, tell me what you mean by, it seems like constant work.

R: Well, just, it's like, it's not just a nine to five job, because you, you always need to be thinking about it. You can get a thought when you're, I don't know, in the middle of a weekend somewhere, and be like, "Hey, I can do it this way." And it just, it seems like it would be so hard to separate yourself from your work. And I think as far as a career, it's important to be able to separate....[Right now] I don't have all my priorities worked out, but I think that, yeah, I like to keep a lot of different aspects separated, so.....[And with research it seems like] even I would be just sitting there eating dinner and going, "Hmmm, there's got to be a way to figure this out." And it just seems like you'd always have to be sort of -- it would be on your mind, in the back of your mind all of the time.

Two additional student excerpts illustrate this viewpoint.

Oh, I do want to get my Ph.D., and I do want to teach. That's still probably my main motivation. I do want to teach at the university level. However, I'm not ruling out this research thing. I think I like it. I think it's fun. The only thing that worries me, I guess, [is that] in society today, unless you're willing to dedicate your entire life to research, you maybe aren't going to be perceived as the most dedicated researcher because there are people out there who are willing to dedicate, literally, their entire life to working on things because they don't have any other life. So, we'll see. I'm sure that's got to change, though. People can't live like that forever.

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I mean I'm definitely going into computer science unless I drop out and raise sheep or

something. I think it's a really demanding field time-wise and it just eats your time. And so that's my major concern is time for a family or time for you know, other people, friends, spouse, whatever. I think you know, if you're not careful computer science will take over your life. I mean it certainly takes over my life during the school year. So that's my major concern.

d. Considering whether a research career was right for them in terms of the nature of research: comfort working with a relative lack of structure

As discussed earlier, for many students, the DMP constituted their first experience in doing open-ended research. Through this experience they were able to better understand the research process and to determine whether or not they would enjoy a career in research. For most students, the most important issue for them to consider was whether or not they were interested in working on problems to which there was not a clear solution, or whether they were more interested in working on discrete and well-defined tasks.

Finding they are capable of working with less structure on open-ended research problems

A few students found that despite their initial fears about doing research and being asked to work independently, they were capable of working in the less structured environment of research and facing the challenge of solving open-ended problems. They also found that they enjoyed this type of work. This made them more likely to pursue research careers. The following quote illustrates this viewpoint.

I: So how has the program influenced you, if at all?

R: I'm pretty certain that I want to go into research. I mean I had kind of thought about it before, but it was like well, you know, "I'll go where the money is, or I'll see where the jobs are." And at this point I'm like, "I want to learn all I can learn," and the only way to do that really is to go into research. So I'm pretty sure. Either in industry or maybe in the university. I don't know.

I: And what about this summer helped you solidify that?

R: The challenge. You know, I mean you get into trying to do something that hasn't been done yet. You know. Or if it has been done then you have to find out where it's been done. And then you have to modify it to make it do what you want it to do, which to me is what computing is all about. Getting a machine to do, what you're trying to do. You know, it's a tool, and you have to figure out how to use it the way that you need it to. So I think that was a big influence for me.

Another student discussed how the program allowed her to explore her reactions to working on an open-ended research problem and that she had become more comfortable with this type of work through the program.

[Another] thing [I learned from the program was] finding out whether you're the kind of person that *can* do that, that *wants* to do that, that wants to spend hours and hours doing that kind of work -- where you don't have someone necessarily telling you exactly what to do and what you're going to find, and what to do with it. You know, and, I think that I'm comfortable doing that now. But I did have a question in the beginning as to whether that was something I wanted to do, because I'm so used to having an assignment, finishing it, and then it's done, and you know, and going on. And this is such a more long term kind of thing, where no one says, "Well if you do this you're going to get an A," or "If you do this you're going to be fine." And it's not that way at all. So I guess that was probably the other thing, that was a question that I had...And I'm much more comfortable now. I did question it in the beginning, whether I would be happy, because it's not a, you don't reach goals on such a regular basis as you're used to [in a classroom setting].

Finding that research did not provide enough structure or short-term gratification

Other students realized through the DMP that they wanted a job that provided more structure than a research career would provide. These women indicated that they wanted to pursue careers in which the task was more clear and more readily achieved. In the following interview excerpt, a participant indicated that research was very uncomfortable for her, because it necessitated that she had to "fumble around" for solutions. Therefore, she was more interested in working in industry on applications of existing research.

R: [For a career] I see myself using what's already out there -- using tools that other people have already developed -- making them work to fit my specific problem that I have to solve. So it's nothing new that I have to [develop]. Well it may be a new software that I have to understand, but it's all documented there. Whereas research to me is like new, but it's just *totally* [new]. You don't know anything about it, and you just kind of have to fumble around and figure out what you're doing; you know, which is a very uncomfortable situation for me. I like to have all the bugs figured out and little instructions on how to use the software or whatever and then you can design what you want to do with it and make it do that.

Another student made similar comments. In the following interview excerpt, she contrasted the interests of the Ph.D. students at her mentors institution with her own.

I was hanging out with the Ph.D. students, and they wanted just to research and study. I didn't want to just do research. I wanted to go out and do more assignment type things, not necessarily bang my head against the wall trying to figure out something new.

Another aspect of research which some of the participants felt they would not enjoy was that it required long-term work with few short-term, tangible results. The following quotes illustrate this point.

I like the gratification of having a final result within a short time period, ...because I'm a producer type person, I like to have final results and say "Done, I did it." And with research I don't see that a whole lot [of that.] I mean it's like years and years of research and then you come up with something. At least for the average person. I know that every once in a while somebody will stumble across something great and it will just be fantastic but I think normally they really have to work at it.

* * * * *

I think I would have trouble after a while finding new things to research...I get unmotivated sometimes. Even if I find a new topic, I may not like it for more than like, two weeks. And then I want to move on, and stuff like that...I like changing a lot. So unless somehow a topic amazingly interests me I couldn't probably stay with it for more than two or three weeks, without getting bored. So if I could have a job where topics remained for like two or three weeks, that would be kind of nice. But I don't know if that's really, if that's realistic or not though.

e. Expanding their understanding of career options associated with a Ph.D. in CS

Through interactions with graduate students and their mentors, many participants discovered that a Ph.D. in CS would give them more career options than they had thought. Prior to the program they believed that going through a doctoral program in CS would only be prudent and necessary if they planned to become professors in CS. For various reasons, learning that the Ph.D. would provide more options made some participants more interested in getting a Ph.D. For some, this was because although they were interested in research, they were not interested in teaching. For others, they did not want to be locked into pursuing a professorship, because of the limited number of positions available. Knowing that a doctoral degree would expand, rather than limit, their options was encouraging to these women. The following quotes illustrate this viewpoint.

Before going this summer I was just going to go for my masters, and after talking with my advisor and the last graduate student there, I thought maybe I should consider Ph.D. although I haven't decided for certain, I'm going to apply for the Ph.D. program now...Because [my mentor], I guess she cleared up some of the misconceptions I had about, it, I was pretty much, "Ph.D., you're going on to go into academia, professor; that's not what I want to do." I guess she kind of showed me that there are a lot of interesting things you can do as a Ph.D. student and still you have a little bit more choice about what you want to do after you get out...And I don't know, I guess she kind of showed me that it's not just for people who want to be professors...[And] I just can't see myself teaching or...I mean, I could do, I could do the research part of it, but I'm not really, I'm not really interested in teaching.

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...It helps that a lot of people there really were advocates of getting a Ph.D. and really, you know, were enjoying what they were doing and were very positive that that's what they wanted to be doing, and they weren't, it didn't seem as though they were all going to become professors, it was just they had -- I guess I didn't speak extensively about what they planned to do with that. But it certainly wasn't because they were going to end up in universities. It was, you know, to be doing a job that they wanted to do, or to get a job, or to be in a position that they wouldn't otherwise be qualified to be in...

One student indicated that through the program she had decided that she did not want to become a professor because she did not want to experience the constant pressure to publish. She was interested, however, in pursuing further research experiences to help her decide what career path to take.

What it takes to be a professor of computer science? Oh! (laughs) Let's see, a lot of patience, I suppose. I don't want to be a professor. I want to go to graduate school to learn more and to, you know, I'd like to take some great part, a few years, or perhaps a lifetime, I don't know, to some specific area of CS and stuff. But being a professor, I don't think it's as glamorous as a lot of people think somehow. I don't know. I saw [my mentor], the things she had to do, and I don't want to be in that position. She has to constantly publish stuff, and she has to be on her toes all the time. She has to compete constantly. I mean, you have to compete everywhere, but if you want to get tenure somewhere, it's going to be -- it's kind of harder to get there. It's harder to get there, it's harder to -- I don't know. I don't -- no way. I don't want to be a professor! ...I don't know [what I will do]. I really don't know. I mean, there's a lot of Ph.D.'s out there that have jobs in companies...I want to continue going to school and do some research, and whatever happens, happens.

Contrasting view: higher degrees are only necessary if you want to pursue research

After participating in the program, a few students still held the view that a Ph.D. was not necessary for careers other than becoming a professor. In addition, some participants thought that higher degrees were only necessary or desirable if one was interested in pursuing a career in research. Some of these women indicated that they would be able to find lucrative positions with a Bachelor's degree and that this made it less likely that they would be interested in graduate school.

III. Essential Program Elements

The Distributed Mentor Project consists of three primary structural elements: a research experience, a strong mentoring component with a female mentor, and immersion in a research university setting. In this section we discuss the ways in which these three elements worked to bring about the primary benefits of the program. Because all three of the elements interacted to produce the full set of program benefits, this discussion does not attempt to establish one-to-one correspondence between particular benefits and individual structural features. Rather we seek to portray the range of experiences which the participants were able to have because of each element and link these experiences more generally to the full set of benefits discussed in Section II. This section also addresses program implementation issues for each of the program elements.

A. Essential element #1: Mentoring experience

The mentoring component of the program was an important element in most students' experience in the DMP, and many of the outcomes discussed in the previous section are associated with the interactions between the students and their mentors in an academic setting. In this section we first discuss the multiple roles that the mentors played in relation to their mentees. Then we discuss the participants' perspectives on the importance of having a female mentor. Finally, we address effective ways of facilitating the mentor-mentee relationship, as determined through analysis of participants' interviews.

1. Multi-dimensional role of the Mentor

The mentor played a critical role both in facilitating a positive experience for the students during their participation in the program as well as through acting as a role model and a professional resource.

a. Orienting and helping students in their research project

For many students in the DMP their project was their first experience with research. Therefore, they needed guidance in how to begin their project and how to work throughout the summer on solving their particular problem. Much like an advisor to a graduate student, the mentors acted as guides through the research process. Most of the student interviewees indicated that although their mentors gave them a certain amount of responsibility for their projects so that they could use their own resources and abilities, their mentors also gave them enough support that they did not feel completely lost. This allowed the students to test their own research abilities while still having the benefit of their mentors' experience. In the following quotes, students discussed this dynamic.

She gave me the project and basically told me the eventual goal of what I wanted to accomplish. And then, she basically let me start. And then I'd just come to her with questions. And if I asked her a question, she not only would answer that question, but

kind of give me more advice about what I needed to do or say, “Oh this is something that you left out. You need to do this too.” So she answered the questions I asked, basically, but she didn’t try to [take over the project].

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R: I like [my project]. It’s definitely interesting. It’s something I’ve never done before. [My mentor] said, “Ok, I know nothing about it, but it looks ok and it might be a good idea. I think it will work, so why don’t you try it?” And she gave me the book, and I sat down. She generally told me what she wanted. I mean, we were in constant contact because my little cubicle was a whole 25 feet from her office. It worked out very well.

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I: What did [your mentor] do in the mentoring program?

R: She did a lot. She basically sort of steered us or not really steered, but helped us get started in a big way. I mean she said “Well, you guys can choose whatever you want.” Or, “If you have no idea, here are four ideas,” you know? And, “You can pick one of these if you want.” [The other DMP student] and I were like “Hmm, Ok.” (laughs) And so she made sure that like we met with [another person on the research team] and she was like, “You know, it’s a really good idea if you guys give talks.” And so she didn’t really sit down there and do the programming or anything, she just sort of directed us and sort of helped us do research.

b. Orienting students in the field of CS&E

Some students discussed the value of having someone prepared and available to answer their questions and orient them about a career in CS&E. They looked upon their mentor as a reliable resource to address their questions about graduate school, research and academic life.

I mean that was just nice to have someone who expected the questions that you were going to ask you know, about grad school or about research, or about careers or whatever. So I mean she was really helpful both directing our research and talking to us about whatever we wanted to talk about GRE’s or whatever.

* * * * *

I: Now you’re about three weeks into it. What is turning [out to be valuable to you]?

R: It’s the mentor thing, because I can go and ask her anything. And it’s great to be able to do that because she’s done it and she’s been through grad school and she’s done this and she’s searched through all them and she’s done the job hunt. I mean, she’s been through all of it. So if I have a question about it I can ask her, and she’ll be able to

answer.

Many students commented that their mentor introduced them to the culture of academia by giving them professional advice and direction.

R: I talked to her a couple times about grad school and what it's like to be a grad student or what it's like a professor or how you get in or explain the whole grant getting process, and that kind of thing.

I: You asked her to explain that?

R: Yeah. We had quite a few talks on the whole, how the research world works, stuff.

I: Was that important to you?

R: It was very helpful. I mean, I know a heck of a lot more about it now than I did then.

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Actually, I mostly talked to [my mentor] trying to figure out what college to go to for grad school. She was firmly encouraging me to go to the one with the best name that I could get into, just because then you can get a job at a place with a better name and you have more choices.

2. Value of a female mentor

The DMP is unique in that it provides mentoring experience for women by women. Therefore, we focus on the participants' perspectives about the significance of a female mentor, and the ways in which having a female mentor was an important factor in bringing about many of the benefits discussed in Section II.

a. Greater comfort with female mentor increased potential for benefit

Many of the participants whom we interviewed expressed that they felt more comfortable with female professors than with male professors, and that as a result, they valued the fact that their mentors were female. The quotes below are indicative of this viewpoint.

R: Well I mean [working with a female mentor] stood out just because -- I mean especially in there in computer science, females definitely aren't the predominant factor. And it's not only a predominant factor because of that reason, but I mean I also like that they're all females because it's a more comfortable environment I think. And, you see that your mentor is a female in the computer field and, and I think you'd, at least I felt more at ease having a female mentor.

I: Why?

R: I don't know. Just a natural ease you feel with someone of your own sex.

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I: How important to you was it that [your mentor was] going to be a woman? What did that mean to you?

R: I liked that. I mean, not that I don't get along with male professors that I have or whatever. But it certainly opened more doors for bonding, or getting along better, or having more personal experience with that person, throughout the time that you worked with them.

In many cases this greater comfort with female mentors provided opportunities for important informal interactions which these women felt would not have been possible with a male professor.

R: ...I am glad that I had a female mentor because I think there are, she definitely, our [road trip] definitely was something that couldn't be, probably duplicated, you know, had a man been with me.

I: Why was that? Tell me about that.

R: Well I mean we talked about things. I mean I'm not necessarily comfortable -- I would probably be much more reserved with a man of that status and age. [Whereas on the car trip with my mentor] most of the time we didn't talk about academics. We went over a little bit of that just because it was necessary. But, you know, she talked about her family and talked about places to go or places she had lived. It was really very casual. You know, we [spent almost a long time together in the car]...and it was just like this outrageous trip that took like far longer than we'd expected it to take, but yet it was really, really good that we had that chance to talk and that experience. And, I don't think there's any point at which I would have been comfortable with a man in the car for that amount of time...I don't think I would have let my guard down if it had been a man.

A few mentors also commented that they were more comfortable advising or relating informally with female students. The quotes below illustrate this point.

I: Ok. Well, did you notice differences this summer in mentoring women as opposed to men?

R: I think that, you know, as much as I try to be fair to everyone, I think that I relate differently to women students that I'm advising. Sometimes it kind of bothers me that this happens, but I think I tend to not be on guard as much with women students. So I can

kind of talk to them about a wider range of issues, whereas with male students I feel like I have to sort of be an authority figure, and kind of maintain a sort of fence between us. So in that sense it has been different, yeah.

Students offered many reasons for why being mentored by a female was more comfortable. This comfort allowed them to gain more from their mentoring experience.

1) Comfort discussing issues which are most relevant to women

Many of the participants discussed that they valued having a female mentor because it opened up the possibility that they could discuss issues which were most relevant to being women, such as balancing family and career and dealing with discrimination or harassment. Because the participants were engaged in a process of deciding what a career in CS would be like, having opportunities to discuss these critical issues was very important.

I: Ok. So what did it mean for you to have a female mentor?

R: A lot of it was just having someone to talk to about other things that were of concern, things like a career and a family and things like that. The work itself, it was just the work itself, and it probably wouldn't have made much of a difference. But a lot of the work itself is worries about other things, and feeling comfortable being at work and doing this work when you know that there's stuff at home that, you know, getting comfortable with changing roles and things like that.

I: Why is that more comfortable for you with a woman?

R: Oh, because it's a completely different perspective for a man. Because if I want to have children I have to *have* the children. I mean, there is no choice. A man can have the choice of marrying a woman that wants to stay home and have children...It's a completely different perspective. I do, I think that women deal with things differently, and I think that they have different things that they have to deal with. I think for men it's the same thing. They have things that they have to deal with that women don't have to deal with, at least in society the way it is today.

* * * * *

R: Why do I think all the mentors were women? I think it was to give us a female perspective. I don't know. Maybe I would have gotten along just as well with the male mentor. I don't know. I mean, I've never had any problems with my male professors, I think I could get a more accurate view of how I was going to go through life through a female mentor's experience. Does that make sense?

I: Meaning that you'll have similar experiences?

R: Right, and we had similar concerns. Some of the things males think -- like, especially if I want to have children, that's something most males don't consider as necessarily their responsibility, and it was something I knew if I wanted to have kids some day I had to approach and address. And I felt comfortable talking with her about that, and I don't think a male mentor I would have felt comfortable talking to that about.

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I: Was it important to you that your mentor was female?

R: Yes. It wasn't important in that -- the academic stuff, the theory, and the math and stuff, it could have just as easily be a male, but I can't really ask a male professor, "So, have you encountered much sexism since you entered grad school?" No, I wouldn't really get the kind of answer I'm looking for, the truthful answer, or the answer that would be most relevant to me. But I asked her stuff like, "Did she encounter sexism? Did it help to be female when she was looking for a job?" That kind of thing.

2) Lack of fear that they would confirm negative stereotypes about women

In Section I, we discussed how many of the DMP participants expressed that they were often self-conscious about asking question or looking "stupid" in front of their male peers and professors. In contrast, they did not feel as fearful of being judged negatively by female professors. This may have been an important component of the DMP mentor-mentee relationships because, for some participants, it created the potential for a more honest flow of communication in which the mentee was free to ask basic questions that revealed the level of her current understanding with less fear of appearing "stupid."

In the following quote a participant discussed her relative lack of comfort with male professors because as a woman in CS she questioned whether or not they would believe in her abilities.

I've had to learn to relate with male professors. [But in the past], I had like a lot of stereotypes running around in my head. And it was as if they would be thinking -- like they would have a different idea of me than a female professor would...They wouldn't believe in me as much or believe in my ability.

In the following quote a DMP participant reflected on this issue in relation to her current work environment. She explained that at her programming job her supervisor was a woman, and that she felt much more comfortable asking her supervisor questions than asking her male colleagues, because of all the "stereotypes in society."

R: I guess deep down inside I am [concerned about the lack of females in CS&CE] because it always makes me feel good knowing that my boss is a woman and I can always go to her. And I feel much more comfortable asking her questions than anyone else. So that's my only concern although it's not a great one. But the lack of females is a little bit

intimidating.

I: Why is it intimidating?

R: I don't know -- I wish I knew but I just, I know that I feel much more comfortable going in and asking [my supervisor] questions as opposed to some of the guys that I work with. I really wish I knew why, I don't have any reason why it might just be because of all the stereotypes in society today. I really don't know what the reason is.

One student who had attended an all women's school talked about her experience there and how empowering it was not to have to compete with men and to see so many women in positions of power.

I: You said that you find that you're less concerned about what others think of you through your experience at [a women's institution]. What was it about [this institution] that you think is producing that result?

R: First of all, it's just the, the focus at [this institution], as I'm sure it is in most institutions of higher learning, is more on academics, and not on, you know, who's wearing the best skirt today...And again, since it's an all women's school, the sense of empowerment for females, and not having to ever compete with males, just because they're not there -- confidence in yourself and, and in women in general, just comes naturally, just because women are doing all things.

I: And that's affected you then, you're saying.

R: Yeah, that naturally boosts my confidence in myself.

Her experience makes the point that when working in an all-female environment, the intimidation and the threat of confirming negative stereotypes about women is lessened -- allowing students to focus more on their work rather than on proving themselves. It is reasonable to assume that, to a lesser degree, a similar dynamic is set-up when female students are paired with female professors in a mentor-mentee relationship.

3) Lack of sexual tension

A few women explicitly discussed that one of the reasons they felt less comfortable with male professors was because they sometimes felt there was sexual tension or the possibility of sexual tension with male professors.

I: Why is it easier for you to do that with a woman than with a man?

R: Well, there's different levels of why that's easier. First of all, I really think, and I don't know if other people have the nerve to say this or whatever, but no matter what, I think that a male, there's always the thing that like, you're a woman and he's a man, and {pause} there's some sort of -- I certainly sometimes don't feel entirely comfortable, because you're this young woman and you might be attractive and here's this guy, and what if you're wearing something that's kind of cute, and you know what I mean? There's like, that kind of thing. And I really, I don't know. I mean you just can't talk about the same kinds of stuff, and there's always that issue of, like, that they *look* at you. I mean not all of them, but they could. You know what I mean?

I: Yeah, there's like this sexual attraction, or there's something --

R: Well I mean it might not even be attraction, it's just there. It may be there, and it may come out and it may not, but it's always like, there in the background -- a possibility...And I think that makes it hard to get into, certainly, I mean, like I can talk to a woman about {pause} questions and stuff, or

I: Like what sorts of things?

R: Like about my boyfriend, or relationships, or how hard to, what to do about, I don't know what sorts of things. Anything! Just sitting in a room talking to them comfortably is easier. About anything.

In the following quote, a woman expressed that it is easier for male students to build a rapport with male professors, because, among other things, there is no threat of sexual tension.

I: Why do you think the DMP was just for women?

R: Because I think when you're in competition with guys you don't always end up the winner even though you could do just as good a job. The measuring stick is skewed in their favor.

I: Why is that?

R: They definitely build a relationship with professors. It's tough when you're a woman because it's a little difficult going to talk to a professor. If a man's friendly to you, there's that sexual issue going on, so it can get uncomfortable. I'm not saying all the professors here at [my university] are leeches, but it's definitely harder to build a rapport with a professor if they were male.

I: How -- because they are male they have different life experiences?

R: I don't know. The guys can just talk with male professors a lot better, and once you get talking, you get to know them. There's your recommendation letter, there's someone

who can vouch for you, say, “Hey, take that student on. He’s really good.” If you don’t build up a rapport with the professor and get that relationship going, it screws you down line.

b. More accurate role models: “If she can do it, I can do it too.”

Many of the participants whom we interviewed expressed that they felt that their mentors provided them with a role model for a successful woman in academic CS. They felt that the experiences of their female mentors was more likely to be representative of what they would face in graduate school and beyond, and found it valuable to have a chance to develop a relationship with their mentors. In the quotes below, participants discussed how having their mentors as role models and being able to interact with and observe them, boosted their confidence that they too could “make it.” Some also came to have increased confidence that they could balance a career with family or other interests. (See also Section II.)

I: If you look over the past year, what stands out about your experience in the mentoring program?

R: I think it helped me a lot to be close to a woman. I think that was the major part of the mentoring program. I’m close to a lot of professors here in my department in my university, but somehow I haven’t developed the same type of rapport as with [my mentor]. That was very important to me that I got to work with a woman, with a person of the same sex. I think more women need role models to pursue their goals. That was probably the thing that really stands out in my opinion.

I: How did working with [your mentor] help you?

R: Because I don’t really see that many women in CS. I go to classes, and I’m the only woman, or maybe just another one with me sometimes. I feel sometimes left out. I don’t know. That’s why I feel it helped me to be with her. I saw it as a woman who achieved certain goals that I would like to achieve also, and I said, “Hey, she can do it, so I can do it too.” We talked about these kinds of issues and how she felt a little bit intimidated sometimes when she was the only woman in classes or going to conferences and things like that. And if she was able to overcome that, I suppose I can also overcome it.

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I: So what stands out about [your mentor]?

R: I think just working with her. I guess it’s just in having the experience of working with a woman and it’s just been such a great experience that she’s just been a great role model and just seeing her with a family and seeing how well she’s done in her field. I respected her very much.

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I think one of the other things I was worried about was grad school because like from what I heard -- I mean if I think they're few women in my classes now, it's going to be even worse in graduate school because even a smaller percentage of women. And -- I don't know -- I guess it was just good to talk to a woman who's been there, been through graduate school you know, as a woman, and just can give me encouragement that it's not going to be terrible. I'm not going to feel like a Martian.

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Well, that was the purpose of the program, was to help encourage women to go to grad school, to see these successful female mentors who hadn't been beaten down or anything and they were there, so if the women undergrads were having trouble then they would see that there was a mentor who had made it.

* * * * *

I think I really liked the fact that it was female mentors. It's sad but true that you really don't see that many women in computer science. I mean there are more now, but we just got our first woman faculty member at [my undergraduate institution] this year and that's been really neat. And so it was a chance to see how women balance computer science and families and. And just to see, maybe not your future, but what your future might be.

Some women could not identify with their mentors because they had "different priorities"

A few participants did not view their mentors as role models because they were unable to identify with them. They felt that their mentors had prioritized elements of their lives very differently than they themselves planned to. One of these women indicated that she wished she had been able to talk to her mentor about "future concerns" but that their differences made this impossible.

R: [When my mentor expected me to keep working all hours, I said,] "Well, you know, I do have other things I have to do!"...So you know, when it was time to go home, I went home. And I forgot about work -- I left it at work. And she just didn't think that was the best way to handle it.

I: Oh. How was she different, as far as how she dealt with her life?

R: Well, her life *is* her work...I mean, she gets up and she comes to school and she worked with us and did her own research, whatever she was working on, and she really had no outside obligations. So she just didn't understand that, there are other things that have to be done too...

I: So then I don't suppose you saw her really as a role model. Or how much did you see her as a role model?

R: I admire her dedication. I really do. [But I did not feel she was] much of a role model. I was hoping it would kind of be somebody that I would be able to, you know, talk to about stuff for the future. But, we're too different...It was uncomfortable, I guess, to talk about stuff like that, because we prioritize totally differently.

It is interesting to note that the student quoted above did not indicate in her interview that she had come to the conclusion that an academic CS career would not afford her the opportunity to have a family along with a career. This is important because it suggests that this student perceived her mentor's life as just one model for a woman in CS, not the *only* model.

3. Effective ways of facilitating and defining the relationship

In this section we discuss ways in which the mentor-mentee relationship was successfully facilitated and defined. First we discuss the challenges presented by the structure of the Distributed Mentor Project, with regard to facilitating strong mentor-mentee relationships.

DMP attempts to create mentor-mentee relationships by matching based on technical interests and background

As one mentor discussed in her interview, most mentoring relationships naturally “spring up” in a setting where the mentor and the mentee happen to be working together.

I: So how would you define mentoring?

R: I guess it's a relationship that springs up, often informally, sometimes formally, [where people are] paired up, in which a more experienced person in a field takes a less experienced person under their wing, and kind of looks after them, both technically and otherwise.

I: That's interesting that you say that, you started to say that it tends to spring up. What do you think about the aspect of this program, that it is more formalized? That it's an attempt to make, a match is made, and it's set up before you know this person?

R: Well, I guess there are lots of different, in my own career there are lots of different things on which I've wanted mentoring. And it's very difficult for me to imagine one person being able to do all of that. I think that this program does a pretty good job of making a technical mentoring match, and then hopes that the rest can happen. So I think it's impossible to find perfectly compatible people via a paper application process.

I: But you think it serves a strong purpose in the sense of the technical mentoring?

R: Yeah, and I think that's the most useful thing. Because I think that if the technical match were bad, then I don't think the rest of the advice that I would give would really

click. You know?

The DMP mentoring situation differs from the traditional description of “natural” or “informal” mentoring relationships in that it attempts to create mentor-mentee relationships through pairing mentors and students based on research interests and background. However, because this program pairs female students with female professors there is greater potential for a true “mentoring” relationship to “spring up.” This is due to the greater degree of comfort that these women felt with female faculty members.

Creating a successful mentoring relationship was challenging, particularly given the time constraints of the program. Through analysis of both the positive and negative experiences students had with their mentors, we have found that the positive relationships were more often characterized by the types of interactions that are discussed below. These interactions helped facilitate the growth of a more personal or informal relationship with their student. Our analysis of data from participants in the three program years corroborated the findings presented in the January, 1996 report and provides further illumination on these findings.

a. Importance of the mentor defining the working relationship

Most students expressed that they knew what their mentor expected of them and were able to function within that framework. However, a few students felt unclear about the protocol for interacting with their mentor or didn't feel that they had an understanding of their mentor's expectations. It appears that generally, in the successful mentoring relationships, it was the mentor who laid the groundwork and established clear expectations. This was important because the students viewed their mentors as authority figures and were uncomfortable, at least initially, with approaching her with questions and concerns. A number of these students lacked confidence about their skills and abilities, and were reluctant to initiate interactions and discussions with the mentor. As a result, the students placed the responsibility on the mentor for defining the nature and frequency of interactions during the program. Thus, the mentor can reduce her student's anxiety about their interactions, both professional and social, by defining when and how often they meet, what was expected of them in these meetings, and the times at which the mentor would be available for questions (outside of the regular meetings).

b. Types of interactions

1) Importance of formal and informal interactions focused on research

Most students and mentors found it helpful to have some formal research meetings arranged either at a regular weekly time or as was convenient. This provided a structure which gave the student a sense of accountability. It also provided the security that there would be a time to talk over important issues or problems that the student had encountered in their research.

Some mentors chose to meet frequently with their students about the research, most often on an informal basis. These mentors tended to spend more time with the students. This type of

interaction was also quite beneficial.

In cases where the mentors did not establish regular meetings and did not initiate frequent informal interactions, the student often felt that their mentor either was not available or was not a good resource. When students felt that they didn't have much contact with their mentor, they were disappointed with the program and questioned the value of the mentoring aspect of the program. In fact, when students perceived their mentor as too busy to meet with them, many felt as if their presence, rather than being helpful, was more of a distraction.

2) Importance of informal, social activities -- developing a more personal relationship

Although formal meetings between mentors and mentees seemed to be a good avenue for discussing research-related issues, informal, social activities seemed to provide the best opportunity for developing a more comfortable, personal relationship. Students indicated in their interviews that informal time spent either traveling, dining, or simply chatting in the office with their mentors often lead to discussions about more personal issues, such as balancing family and career or learning about the mentor's life and career choices. These types of interactions were viewed as quite valuable to the students. They gave them a fuller understanding of their mentor's lives. They were able to draw upon their mentors' experiences in order to more fully understand their options and what was important to them. These interactions also helped the students develop stronger connections with their mentors.

Mentor interviewees also discussed this issue. In the following quote, a mentor discussed that when she went to lunch with a student or went hiking with her students, it was much more natural to discuss personal issues that would be relevant to her mentees' career decisions.

R: I took her out to the mountains one day...A lot of the stuff came up when [my mentee] and I went up to [the mountains and] did a hike...Because it's really beautiful and she got to take lots of pictures,

I: What sort of stuff came up?

R: Family. You know, "How do you manage a family? What do you do with kids? How do you manage a career? What's this thing about tenure?" You know, when you're in a car for [a long time] with somebody one way, and you're hanging out, it's just easier to pop these questions that they're bringing up. And so I highly recommend that...[These more personal issues] sort of came up naturally, so while you're asking sort of more like personal life stuff and boyfriends and stuff just sort of kind of drifts in there. You know, a lot more naturally than it would while you were giving them orientation and you're talking about [research]...

c. Shared mentoring positive for some: importance of accurate expectations and clear roles

Some mentors decided to mentor their student along with another faculty member or along with a

graduate student. In some of these cases, the students felt that they had an additional resource in the other mentor.

In other cases, the students felt disappointed that they did not have enough contact with their mentors. These students had come into the program expecting a close relationship that would include daily contact with their mentor. However, when they arrived, they found that they would be working more closely with a graduate student. The mismatch between their expectations and the reality caused these women to feel some disappointment in their relationship with their mentor.

The two 1996 participants quoted below described such an experience. They indicated that one of the reasons they were disappointed that their mentors were not working closely with them was that they had wanted their mentors to become familiar with their capabilities so that they could provide a strong and accurate letter of recommendation.

I wanted more attention. And I suppose [it might had been different] if it had been from the start made clear that I was going to be [working more closely with someone else]...[But as it was] I kind of felt like s/he wasn't the one I was really supposed to be learning from, and s/he wasn't the one who can write me a good recommendation, and s/he wasn't the one, you know what I mean? So just to have me working with him/her, wasn't entirely the same kind of benefits for me.

* * * * *

I got a little peeved midway through the summer because if my connections or acquaintances this summer were going to help me in the future, I was going to need recommendations. The only person that people would respect recommendations from was my mentor and I felt very strongly that she really didn't know how my summer was going at all. She didn't see me in there from eight till five, or you know, working as hard as I was and it really was distressing to me that none of this was being seen by anyone that could, you know, convey that to anyone else.

It is quite possible that had these students had a more accurate view of the type of contact they would have had with their mentors, they would not have experienced disappointment.

d. Importance of shared goals between mentor and student

It became clear through our analysis that in some cases, the mentor's and the student's goals for the DMP differed somewhat and that these differences were a source of dissatisfaction on the part of the students and the mentors. In particular, some students who viewed the program as a chance to gain a research opportunity in addition to gaining a sense of graduate school life, had mentors whose primary goal was to have the student produce high level, publishable research during the program. This lack of agreement on goals caused both the mentors and the mentees to become frustrated with the program; this frustration hampered their ability to relate comfortably

and build an effective mentoring relationship. See more about this in Section III.B.2.

B. Essential element #2: Research project

In this section we discuss the function of the research project in the DMP; the role it plays in fostering many of the program benefits. We also address important implementation issues which created variance in the level of effectiveness of the research process.

1. Primary vehicle through which participants become “honorary graduate students” and “try CS on for size”

Of all of the structural features of the DMP, the research project is in many ways the most crucial because it acts as a vehicle allowing the participants to become immersed in the academic CS environment. It is through their ability to have a role in academic research that the participants became “honorary graduate students.”

a. A meaningful role in research provides students with an entree into CS academia

The research project provided students with a meaningful role in the academic environment, allowing them a unique type of access to faculty members and graduate students. As undergraduates, students typically interact with professors and graduate students in a classroom-based, student-instructor relationship. The DMP research project allowed the participants to take on the role of “honorary graduate students,” and gain entrance into the research aspect of academia. The following quote illustrates this process.

I: You said that it was something you wouldn't have been able to do otherwise. Which part were you talking about?

R: To get a chance to see what the work is like, to get a chance to work in that environment, not as much just as a student. Because up until now, I've just been sort of a student, and so you're more separated from what goes on at the research end of it, and what the faculty's doing and stuff like that. It's an experience I couldn't have gotten just by taking classes or something. So.

I: Yeah, how did it feel to be included in that?

R: Nice. I liked it. It was really nice. And the faculty was -- all of them, not just my mentor, but all of them -- were really supportive.

Research project created a dynamic of “mentoring in context”

Many formal mentoring initiatives involve structured interactions between mentors and mentees without a component that involves a shared research project. The DMP is somewhat unique

because it combines mentoring with work on a research project. Analysis of student and mentor interviews indicates that this combination is a primary strength of the DMP. The relationship between the mentor and the mentee is fostered through this pursuit of a common goal. This often allowed a more informal mentoring process to emerge and develop. The following quote from a mentor illustrates that through working closely with her mentee on a research project, informal conversations about important non-research issues emerged.

...I kind of found opportunities to talk about something that would be worth talking about and often I just worked it into casual morning conversation over coffee. You know just sort of chatting and then sort of... so it wasn't sort of in your face mentoring. "Today's lesson is on" ... It was more a matter of talking about some things that were going on with me and how that kind of related to life in academia in general and stuff like that. So in some sense in terms of the role this summer I'm sort of feeling like the mentoring.. what I was trying to do is to convey to [my student] a little bit about what academic life is all about in addition to sort of working with the research project. So you know sometimes I would focus on the research and a lot of times I would just talk about other issues more in terms of my life to sort of expose her to.

Research project allowed students to gain access to graduate students: see their lives from the inside -- not just as their instructors

Most participants indicated that prior to the DMP, they had only interacted with graduate students in a classroom-based, student-instructor relationship, and that these interactions had not given them any sense of what graduate school involved. Through their work on their research project these students were able to have new kinds of interactions with graduate students: interactions which helped the participants learn about graduate school and about whether or not it was right for them. Through either working jointly with graduate students on their research projects or simply sharing an office with them, the participants took on the status of "honorary graduate students." Thus, rather than being viewed as undergraduates who were more "separate" or different from them, they were included in both academic and social activities.

I: Ok. How much do you think your impressions of graduate school changed? I mean did you know much about graduate school before you went to the program?

R: I don't think they changed that much. Because I knew the graduate students at our school although it's different because there's not as much opportunity for outside jobs here...But I think these [graduate students] seemed more excited, than at my [home institution]. I mean maybe the students at my school *are*, but I just don't see it because they don't show it to me, because they think I'm just an undergraduate or something. Whereas these students were like, "Hey, let's go out and do this." ...Just like, everybody's always talking and social, and stuff like that.

* * * * *

...being with the grad students directly gave me a better view of them and what they do, as opposed to just seeing them as TA's. 'Cause TA's are like, they're always complaining about all the work that they have to do, and I don't see them excited about their projects. So I saw them in a different light than I get to see around here [at my home institution].

The importance of these new types of interactions with graduate students is discussed further in Section III.C.

Research project fostered collegial interactions with other CS academics and professionals

In addition to providing access to mentors and graduate students, many students discussed that they were able to interact with other professors or individuals from industry through their research projects. The significance of these interactions is discussed in Essential Elements: Research University Setting. These interactions were important because they allowed students more opportunities to learn about the field and to experience, in a limited way, being a contributing member of the CS academic community.

b. Being engaged in the research process itself allowed participants a unique opportunity to apply their knowledge in a non-classroom setting

As we discussed in the both Sections I (“Context”) and II (“Impact”), many of the women in the DMP indicated that prior to the program they had never been involved in “real research.” The DMP research project provided them a unique opportunity to engage in an open-ended research process. This was a crucial aspect of being able to “try CS academia on for size,” and brought about many of the program benefits discussed in Section II. The two most important functions of the research project are discussed below.

1) The research project involved students in a self-directed, exploratory process in which they had to apply their knowledge

Most of the DMP research projects were considered “real research” in that they were open-ended and did not have a clearly defined solution. In most cases the students perceived that although the mentors had ideas about how to solve the problems, the mentors did not have one “best solution” in mind. Most students were given a significant amount of responsibility for working independently and generating solutions to their problems. Most students described their projects as challenging and felt that they needed to apply their knowledge to a new situation in which procedures were unclear and they had to “figure out” how to solve the problem. They indicated that this differed considerably from their classroom experiences, in which both problems and potential solutions were more clearly defined. The following quotes illustrate the nature of most of the students’ research processes.

I expected it to feel like I had a bunch of homework. Especially to feel like I was sort of in school, just not going to class, and I had a bunch of homework to turn in. But it wasn't

like that at all. I was much more of an equal with [my mentor]. Instead of going and having her tell me to do something and I'd go home and do it, I'd go, and she'd tell me about a problem -- sort of an open problem or a problem that is very hard. So she wanted to generate some test cases to look at them to see if there's any trend that she might be able to use to figure out or conjecture about a problem or something. I thought that was really neat. I like to program, so I'd just go program these things and do them, and it was fun. I'd come back and say, "This is what I did. This is how I did it, and everything."

* * * * *

It was really a change I think for both of us because usually when you're in a class or something they say, "Write a program that multiplies x, y, z." They don't have a set way that you should do it, but they're trying to teach you something. Or, this program has been written before, but what we were writing had never been written before and that was a really new experience for both of us.

* * * * *

Here what I'm doing is just like pretty much my own thing. You come here, they say, "Ok, this is what you have to do here, it's a bunch of reading material -- just read it and do it." And it's just for you [to do], and you have to solve problems yourself pretty much. When you're in school, they take you by your hand, and they tell you, "Ok, read the lesson dah-dah-dah-dah-dah, and do this thing," and they teach you everything. Here you're on your own. I had to learn a new system on my own. Nobody taught me. I had to figure out how to program in it and stuff, ... and that's very good practice.

* * * * *

R: Being in a research environment really is a lot different from going to classes every day and doing homework.

I: And how is that different?

R: You don't have a set assignment. You have work that you're doing, and you're kind of on your own, and you're trying to figure things out. And your homework is just kind of like, "You have to read this." Or, "Finish this assignment." So it's a lot different way of studying, I think. It was fun...[I liked the] freedom to do your own thing. I mean, you were on your own to do research, in general. Whatever you wanted to do was what you were able to do. You're like your own teacher, kind of. Everything you learned, you did on your own.

For many students this transition from a classroom learning style to an open-ended research process was a difficult one at first, but many participants indicated that by the end of the summer they were more comfortable with this new style of learning and working.

Being engaged in working on their own unique problem provided a confidence-building opportunity

An important component of the research process was that most students were given a research problem that was primarily their own and in which they had a great deal of responsibility. This differed significantly from their undergraduate experiences in which, for the most part, all students were given the same assignment and, often, students worked together. Thus, in the undergraduate classroom setting it was easy for students to question how strong their own skills were; and, as indicated in the “Context” section, many of the DMP students did question their ability to “perform on the job.” In the DMP, however, these students were given the opportunity to work somewhat independently. Most had some success at their independent research. Thus, their confidence in their ability to tackle open-ended problems and, for some, to pursue a career in research, was increased. In the following excerpt a student discussed her research experience and its effect on her confidence.

I: If you look back after a year, what would you say stands out about your mentoring program experience?

R: Probably that it was the first time to do some research where I had more control over what I was doing, and it was more independent and less, “Do this, this, this and just this.”...I had to deal with the day to day stuff and all the details on how to do it weren’t exactly laid out. And also the other thing is that there was no one else doing this, too, so it’s not like in class where if you have a problem you can go and get someone else to help you with it...[And that has] probably just made me a bit more confident with doing stuff where I didn’t have didn’t know exactly what was, what I was doing.

I: Right. And have you encountered places where that came up in school, or?

R: Not so much in school yet, but certainly in the job I have this summer...

Not only did the research project differ from the students’ classroom experiences, it also differed from their experience in other jobs. For many, this was the first job where their “boss” gave them general guidance, but it was up to them to decide how to achieve the goal.

I: How do you think the program has influenced you, if at all?

R: Like I said, it was a really good experience. I learned a lot this summer about just using my resources to find, you know, find out things, to work on my own. And to take indirect orders from a boss. Because all the jobs I’ve had before, you know, the boss tells you to go do something, you can go do it.

I: Yeah, it’s pretty clear.

R: Yeah, “Go wipe off the counter.” That’s not too difficult! But like, “Figure out how

to [do this],” that’s a lot different. And when you’re kind of on your own, you’re allowed to make up your own schedule or whatever, it’s totally different. So that was valuable, I think. I really liked it.

2) The research project gave students the opportunity to be contributing members of CS research

Most students’ DMP research projects were in some way related to their mentors’ research. Thus, their projects constituted “real” research problems that were important to others in their mentor’s sub-discipline, giving the students a sense of connection with, and contribution to, the existing body of research. By working on a problem which not only was open-ended and exploratory but was also considered important to the field, students were able to experience being contributing members of CS research. Most students expressed a high degree of ownership in their research projects. This was important because it created a situation in which the students felt, often for the first time, that their work mattered and that their results were tied to their own efforts and abilities. This experience allowed students to “try on for size” being a CS researcher, and through this process many of the benefits of the program were fostered.

In the following interview excerpt a student discussed how satisfying it felt when she came to understand that her mentor and her mentor’s graduate students felt her work was useful.

I: So do you feel that the work you did this summer was important?

R: Yeah, there was a grad student in the lab and when he saw me [having success on my project], he came over, and he was so impressed. He said, “Wow, that’s great!” That made me feel like, “Wow, I must be doing something good, because this is obviously a program they need, and here I am making it work better.” So that made me feel like it was pretty important.

Another student discussed that the DMP research experience was the first time that she felt she was actually contributing something. Although she had done previous research at her home institution, she had never understood how it fit into the “big picture.” In the DMP it was more clear to her what her role was, and how she was making a contribution. This fostered a more positive feeling about research.

R: I guess I felt completely lost in some of my other projects [at my home institution], and really did not understand what was going on, and there was no defined role for me. And my advisor kind of left me to figure out what I was doing, and I hadn’t had enough experience with the topic to really pick that out...

I: And did you feel like you had a defined role [during the DMP project?]

R: Yeah, I finally did, I had a certain, there was a goal in mind, and we were shooting towards it...

I: Did it affect your feelings about research?

R: Somewhat. I guess before the summer, I was beginning to wonder if that was really what I had an interest in doing. And I think for the most part my summer experience was good, so I came out of it with a little bit more positive feeling about research...[My experience in the DMP] shaped my impressions about how I can succeed at research. Like I said, [prior to] this summer, I was kind of lost and didn't really feel like I contributed anything, so I didn't really feel like I was succeeding at research...And then, this summer kind of helped show me that I can actually contribute something to research still.

This factor was important particularly because many of these women indicated that they were seeking careers in which they could feel useful. Many of them came into the program questioning whether or not research was right for them, because they were unsure how applicable research was to the real world. Although many students did not discuss that their research project was clearly related to the "real world," they did come to understand more about how different aspects of research contributed to a growing body of knowledge which was then useful to others.

2. Research project: Implementation issues

Based on interviews with participants from the '94-'96 program years it became evident that there were several important issues for mentors to consider when designing and implementing a DMP research project. The most commonly raised issues are discussed below.

a. Importance of guiding the students to understand the way their project fits into the "bigger picture"

We found that when students understood the purpose of their research project in terms of how the results of their project might be used, they tended to report that they felt as though their efforts resulted in significant contributions. For these students, this appeared to be correlated with more positive program outcomes. These students tended to express more investment or ownership in their projects, and thus, they felt more pride in the results and enjoyment of the research process. They also tended to see themselves as having an authentic CS research experience. (Note: Most of these students worked on sub-problems of the mentors' research.)

When students did not understand how their research would contribute and/or apply to the "real world," they found their projects frustrating and less satisfying

A few students discussed that although their research project was related to their mentors' research, they were unsure how their research was going to be useful. They expressed a lack of clarity on just how their research results would be used by their mentor. In addition, they wanted to know how their research might be applied to the real world. These students became frustrated with the research process and did not express as much interest in continuing to explore research.

The following student interview excerpt illustrates this point.

I: So do you feel that the work you did this summer was important in terms of whether or not it could be taken further...?

R: {Pause} Yeah, it would be nice. {Pause} I don't know, because the entire point of the project was to find a quick way to do something, and I'm not quite so sure that we found the quickest possible way to do it! It did accomplish the purpose, but I'm not so sure that the purpose was worth the accomplishment... We... found a way to [accomplish our goal,] and nobody else has that way to do it. It's just that --

I: You don't see the particular relevance.

R: Yeah. And theoretically, it's very important. And like I said, nobody's ever done it that way before... But realistically, is it ever going to be useful? No... [And] I'd rather see something that can be useful... [I] wished we would have been doing something more useful, more programming, you know, more stuff that can be applied to real life situations.

It is quite possible that in these cases, the students simply needed more discussion with, and explanation from, their mentors about the applications and significance of their research so that the students could come to better understand how their project fit into a larger context.

Being given the opportunity to decide what was interesting to them: a unique opportunity which created investment in, and excitement about, research

Some mentors gave their students quite a bit of freedom to choose which project they would work on for the DMP. For these students, this was a new experience. The interview excerpt below suggests that this was an important developmental opportunity for this student, because it was the first time she had been oriented toward what interested her, rather than trying to "please others." Through this process, the student was able to carefully consider her own interests in combination with what she felt would be useful and thus, how she could contribute.

I: Well tell me more about that. What are you afraid of when you're given something [an assignment where you have to be creative,] and why did you think you might not be able to pick [a project in the DMP]?

R: One [reason] is that... I just wanted to be like useful. I just wanted them to say, "You know what would be really great, is if [you do X]." ... And I'd say "No problem, I'll do that for you." So it was hard [in the DMP], because everyone wanted me to like be personally satisfied rather than useful to the people there. And it was really tough because I guess usually I'm goal-oriented toward pleasing others, like doing well in school and [hearing], "Hey, good job." [For instance, when people ask me,] "What do *you* want to be in your life?" I've always had problems telling people like what my future plans were, because when you're sitting in school very seldom does anyone ask you about that. You

don't have to think about it...

So [when I was told to pick a project in the DMP], I took a lot of input about what people needed done...[But then I started looking for things] that really piqued my interest [and that] I had a little bit of confidence that I could handle...[And the project I picked] was really what suited me most, I think. [And another undergraduate who was there] really sort of let them tell her what to do. And had, what I considered, a very, very boring project. And I was really glad that I had spoken to people about what I wanted to do, and what I could do, and what they needed and really come up with a project that was very satisfying and interesting.

Although other students' experiences suggest that it was important for the mentors to provide possible project choices, the above interview excerpt suggests that the selection process itself can be an important personal learning experience if the students are provided with some aspect of choice in the project.

b. Importance of reasonable expectations regarding research progress and need for balance with other goals of the program

Based on interviews with mentors and students, it became clear that for most, the perceived goal of the program was to give students a chance to see what graduate school was like so that they could make more informed choices about whether to pursue careers and/or further education in the computer science field. This goal differs somewhat from other summer undergraduate research programs in which the primary goal is to give students a research experience. In essence, the goal of the DMP is broader in that it incorporates a strong mentoring component designed to give the participants the opportunity to observe and interact with a potential role model.

Importance of providing more guidance than advisors would generally give to graduate students

Through participation in the research project, the participants became "honorary graduate students." However, student interviews indicate that it was important for the mentors to treat the students somewhat differently than they would graduate students. The students felt they needed more guidance than graduate students would to be successful at their research projects:

R: Well it was a little different than I expected because I had much less guidance than I expected from my professor... So that made things a little difficult to actually do a whole lot of personal research...

I: What did you expect?

R: Oh, just more interaction. You know, even daily. I guess just help with the research. I understand that as a graduate student you're going to be doing a lot of research on your own, but since I'm not a graduate student yet, then I guess I expected a little more daily contact and more of just the nuts and bolts of getting the research done type of stuff, you

know. Not that I would have to have help every step of the way from her, but, you know just in some of the actual doing the research having helped, because, I don't know how to do research. That's what I'm supposed to be learning.

Importance of “taking the pressure off” -- having fairly low requirements for student output, so that students can focus on the process and on learning about the environment

The experience of many mentors and students who were interviewed showed that it was important that the mentors challenge the students by giving them responsibility for a research project. However, it also showed that it was important that the mentor did not give the students a part of their research which was so important that if it was not completed it would not pose serious problems for the mentor. The following mentor quote is representative of most mentor interviewees thoughts on this issue.

I think a lot of [how well the experience goes] has to do with the mentor's expectations for what they're going to get out of it, get out of the summer. I mean, if you're hoping to get Nobel prize winning work, and someone comes in the first day and asks what latency is, then that can put you in a bad mood. But if you're fairly philosophical, that this will be a fun experience, and you hope to get something out of it, but you don't count on it, then it doesn't necessarily temper your feelings about the project so much.

In the following student quote, a participant discussed how her mentor made it clear to her that although she had confidence in her abilities and believed that she would be able to contribute, that even if the student did not end up making significant progress on the research project, that it would be fine. The mentor stressed that the student should view the DMP as “something for her” -- a time to focus on learning about graduate school, rather than on proving herself. As she discusses, this had the effect of mitigating the fear of failure that the student felt at the beginning of the summer.

I: [You discussed that during your undergraduate courses, you felt you had to prove your abilities to yourself at every stage.] Did you have that same sense of wondering whether you were going to succeed this summer?

R: I did in the beginning, but the [woman] that I was working with was very kind, in that the day I got there, she basically said to me, “You know what, nobody cares if you do a good job or a bad job. This is for you...And if you don't even get anything [finished], we're not going to think you're a horrible person. I mean you might not get the awesome letter of recommendation, but it's fine.” So I didn't feel a lot of pressure there.

I: Yeah, tell me more about what that did for you.

R: Well... I didn't feel a lot of pressure...[in the sense that], “If you don't do a good job, the whole project's going to fail,” And I had said to her...[that] I was afraid that they would forget -- like, “Hey I'm only third year; I'm not even a senior.” It's not like I'm

some graduate student. I was afraid they were going to forget that and give me some big ridiculous graduate level thing. And they didn't. They gave me a project that was right about my level.

When mentors had high expectations for research output, both mentors and students became frustrated because of the time constraints of the program

A few mentors had the expectation that their students would produce results which could be incorporated into articles or presentations. In some of these cases, the students were able to fulfill these expectations and the mentors were fairly satisfied with the program. In other cases, the students were unable to fulfill these expectations and the mentor and the students became frustrated. In the following interview excerpt a mentor discussed that because the DMP takes place over a limited time period, and she wanted her student to finish her project, she had to keep pressuring her student to work at an "unnaturally fast pace."

One of the main problems is, usually during the rest of the year they are extremely busy, so the only time that they have really any time, for a research project, is in the summer. And I really think that a two and a half month period is extremely short, to get going on a research project. It takes them like, three weeks or whatever to just get into it, and sink their teeth into it for another two, three weeks, and by that time it's getting to be time to wrap it up, write it up, and doing things like that. And it's not a natural pace at all. It's for example, not the pace that a grad student would follow. I don't mean by pace that the grad student is in any way less efficient or anything, over the long period of time. Over the year they probably do six times as much work as these kids did in two months. But, it's just a more natural pace. Because in research you often get, you don't have motivation now and then, especially theoretically, so if you're not getting anywhere, you lose motivation, you have to switch around, you have to do other things for a while. You might just slack off for a while. And then you come back to it really hard after a while. Almost everybody that I know of works that way. And there's no time to do that with a short research project. I have to just keep them on, just keep pushing them the whole time. And it's somehow unnatural.

This mentor went on to say that she believed the primary goal of the program was to give the participants a research experience. This goal did not encompass the broader goals of students experiencing academic CS. Most mentors felt that given the program structure of the DMP that it was not reasonable to expect the student to produce publishable results. However, many mentors did discuss that they wanted to be able to ensure that their mentee had a reasonable chance of arriving at a satisfying conclusion to their research project and that would be more likely if the program duration could be extended. They suggested that the program could formalize continued collaboration on the research project during the fall semester, possibly through arranging for independent study or honors thesis credit.

c. Types of projects which were most successful

Certain types of projects made for a more successful research experience.

1) Research projects which were related to the mentors' research

As discussed above, students found it very helpful when they understood the purpose of their research. When students worked on projects which were related to their mentors' research, they were more likely to understand the relevance of their projects and the way in which their work would contribute to a larger research effort.

Ensured the mentor's investment in the student's research process

An additional reason why it was beneficial for students' projects to relate to the mentor's research was that this tended to ensure that the mentor was meaningfully involved in the research and boosted the likelihood that time spent by the mentor on the program would result in progress on their own research.

2) Projects that the student considered "real research" in that they were open-ended

Projects which were considered "real research" in that they were open-ended resulted in more positive outcomes for the participants. This was due, in part, to the fact that this type of research was considered similar to the work of graduate students and professors, and thus was considered a more authentic "trial-run" of graduate school work. Also, most students had never had an opportunity to do open-ended research, and this was important for their development as it gave them a chance to experience this type of work.

In the following quote, a mentor discussed the importance of giving the DMP students new and undiscovered problems.

R: I felt that in [my mentee's] instance [the DMP] would really make a difference, how she would handle graduate school.

I: You mean for the confidence issue?

R: Absolutely. Yeah. And the fact that she's worked with hard problems, she knows she can do them. And she knows she's been working on problems that no-one else has been working on. And that's important! Because when you are an undergraduate, all you work on are problems that everyone's solved, and you just re-solve them. And you only work on problems that the teacher knows the answer to, or that you know the answer to, or the guy that wrote the book knows the answer to. But when you do research you're working on problems no-one knows about. And you're working on problems that maybe have no answers. And we don't give students the skills to cope with that. Or how to deal with

problems like that, how to approach them, how to solve them. Yeah, and students get frustrated, because research is 99% frustration and 1% terrific inspiration. How do you get through the 99% of head banging frustration? Because you give them the experience of that 1% great feeling, give them a taste of that before they get into graduate school, and they'll stay there because they'll want the same high! {laugh}

Students who did not have a project which was open-ended were somewhat disappointed with the research component of the program. As illustrated by the following interview excerpt, one student felt that her project was similar to a "big homework project." Therefore, she did not feel that she was given a full taste of what graduate school involved.

I: So how did you feel about the project, the type of project that you had?

R: Well, that's not the type of project I expected. I thought that it was, like I said, like something I would have gotten from a class. There actually is a class...[where] that's exactly what they do, to tell you the truth. {laugh}

I: And so, what type of project would you have preferred?

R: Well -- I just didn't feel like that gave me an idea of what grad school is about or what research was, at all. I felt, what I thought that was, and I think what other people thought it was as well, was that that was something that they needed...[to be done. Whereas], I kind of thought that's what the program was for, to give you a research experience, to show you what it would be like in graduate school...

I: Because you're thinking of going to graduate school...?

R: Yeah! I wanted to see what it was like...But I was just like, "This isn't research!"

Even non-research type projects gave students a sense of accomplishment and facilitated many of the impacts discussed above

Although "real research" projects brought about more positive results for the students, even students who had non-research type projects, ones that simply involved implementation of a fully formed design, benefited from the experience of doing the project. In the following quote, a participant who had such a project discussed her sense of accomplishment.

I worked hard and did a good project...And the project turned out really great. I mean everybody was just like, "Wow! It's fabulous!" You know? And were really quite pleased that it was done. I mean they all wanted it and needed it to be done. And I did something that they needed. Which when you think about it, what maybe is more important? Something that they will [use]? I mean, basically what I did is not something I consider research, but certainly I got just got an email from [the research group and]...they're going to [use my work]...And my name's on it, and he said he's going to

keep me informed about what happens with it, and stuff. I mean, they're definitely using what I created. And they're going to be using it for a while. And that's pretty neat! Whereas instead of doing something that was really research like, and then never having it have any usefulness, I mean, I think there's probably, that's probably another, a different kind of project to do.

3) Projects that match students' general interests

A few students indicated that their projects were in CS sub-disciplines that did not interest them. As a result, they felt less satisfied with their research experiences. This is not to say, however, that they did not benefit from the experience. The research project still served to give the students a meaningful role in the mentor's departments, which facilitated many different types of interactions and outcomes. In addition, these students did engage in an open-ended research project.

4) Projects that include students in a collaborative process

When students were required to work with others on their research project, the students tended to have a higher degree of interaction with a larger group of people in the department. This led to a more immersive and more successful experience.

In addition, having a greater resource base to bounce ideas off of, enhanced the students' satisfaction with the research process and helped them learn and accomplish more. As one student stated,

I worked on my own until like the last two weeks. And then I worked with someone else, another grad student who was there...I thought it was a lot better being able to work with someone because I wasn't very knowledgeable on the subject, I never done anything like this before and then I was working with someone else, it seemed like I learned a lot more in the last two weeks than I did the whole time that I've been there, because I could bounce ideas off him and he had a lot more knowledge on the subject than I did.

Students who worked solely with their mentors tended to express that they felt isolated in the DMP and that their research process was too solitary.

C. Essential element #3: Research university setting:

The third essential element of the DMP is the research university setting. By providing the participants with a meaningful role in their mentor's department, the program allows the participants to experience an academic environment as an insider.

1. Access to important interactions

By becoming insiders most participants were able to interact with graduate students and other CS faculty members. These interactions were quite instrumental in bringing about the benefits of the program.

a. Interactions with graduate students provided participants with models for “the next step” in pursuing an academic career

As indicated throughout this report, interactions with graduate students were extremely important for the DMP participants. Students who were able to work with graduate students on their research projects as well as interact informally with them tended to express that they had a picture of graduate school life and whether or not it would be right for them. The following excerpt illustrates how the DMP allowed students to be immersed in graduate student life.

I got most of the insight about graduate life from the graduate students rather than from [my mentor]...And I asked [questions] about [it at first], but then I was so immersed in it that it stopped being like, “Well, let’s talk about grad school again today!” You know? So, well it sort of seeped in, but I stopped actively seeking information and advice.

The following quote provides further illustration of how contact with graduate students was linked to program benefits. Her comments suggest that these interactions were an important component of this feeling of assurance that she could succeed in graduate school.

R: ...[During the summer the grad students were studying for qualifiers]...So they were studying for them all summer. And they were around, and it was really weird for me to be talking to them on a person to person individual basis, as equals, not as teacher-student. Because you know I never really thought about being equals, and I was taking a class this summer, and one of my former instructors was asking me about what answers I had gotten for these questions, because he was studying the notes from the class for his qualifier. You know? And he was asking me what I thought about this, and what did I say about this question on the final, and -- wow. So that was a really weird experience for me. And I think it was the first time I had ever been treated as an equal by people who were {pause} I don’t know -- grad students.

I: And could you see yourself being like them?

R: Yeah. Yeah, I could see that.

Through interacting with, and observing, graduate students, the DMP participants gained many insights into the graduate school experience. For example, as the quotes below illustrate, many students learned that there were multiple paths they could take in terms of when to pursue graduate school and what type of degree program to undertake.

And some [graduate students] -- I met this guy who was leaving, you know, a lot of them actually were leaving - never finished their Ph.D. Not a lot of them, but I mean, I don’t

know, three or four. I don't know! People that I met who were like, going to go work, start, they had been offered a great job working at some company, and they only had their Masters, they'd gotten their Masters. And they just were floundering with their Ph.D., so they just left the program. And that's also another option. You know, like if you don't make it through, or you're not going on the right track, they went off and got these good jobs anyway. And that's an interesting -- just to see different things the people are doing.

* * * * *

I: Ok, well just tell me more about that, about what was interesting to you and what you learned about that.

R: It was just interesting to see the different things that they were doing, the different possibilities of areas that you could be doing work in and also partly just the different ways that they were working things out. I mean, you know, there were some that were -- some students that were really young and going on for graduate work right after their undergraduate degree, and then there were some students who were returning and had families, and some students that are working as well, and doing graduate work in addition to that there were some undergraduates in town also and they were working, that were working on some other things, and that was fun.

Many students expressed that they learned that it was possible to have some degree of balance in their priorities during graduate school.

I mean I didn't ever really get into any of their research, like look at it that thoroughly or anything. But it seems like, a happy time. And you know, people came in and worked hard and then they all went out and played, and they all played together, and it just seemed like the social aspects of it were nice. Although those were like, first and second year students, and then the fourth and fifth year students were a little less, they were kind of like, "I've got to finish! I'm sick and tired of being here." You know? So, but the ones in my office, they had put me in an office with first and second year students. And it seemed like a lot of working and playing.

Many students also discussed how they learned about the application process and how to succeed in graduate school from their interactions with graduate students.

...the one thing I learned, a lot of stuff I learned, is a lot of people just said, "Oh, my god, it is so important to have a good advisor. And if you don't get along with your advisor, or if they're not doing what you want to be doing, get out, and go find somebody else." And that's not, I never knew that! You know what I mean?...And different stories about people who had bad advisors...They said it was really important. [And] that [your advisor] can make or break you. [It's important that] your advisor is good or on your side, or in an area you want to be in, and you get along with them.

The graduate students also provided a resource for questions about the research project which the participants considered “stupid” or not important enough to request help on from their mentor.

[Having graduate students around] gives students someone to ask questions of, other than mentor. It’s less intimidating.

* * * * *

R: [For] the stupid questions I’d usually go to like one of the students at the lab first, and if they still thought it was dumb, and like, they thought it was stupid, and they’d just answer it right away, and it wasn’t a big deal. Sometimes, they would be like, “Oh, I don’t know, ask [your mentor].” So, I’d go and ask my mentor about it.

I: Ok, and why did you choose to go to the student first?

R: Just, that’s much less scary. Plus, it’s usually, like if it was something stupid then it was usually something that they had all encountered before anyway, so...

b. Interactions with a wider group of CS professionals (other professors and industry people) provided the opportunity to explore being a “contributing member” to the field and more models for possible career paths

Through the DMP, many students were able to interact with other professors or individuals from industry through their research projects. These interactions were important because they allowed students more opportunities to learn about the field and to experience, in a limited way, being a contributing member of the CS academic community. In the following interview excerpt, a student discussed her interactions with her mentor’s research group.

R: When we had the meetings on the project, she and I and another one of her students, and then the two other professors on it, would get together -- those were the meetings that I thought were kind of fun. And we would discuss a lot of projects. And they really treated me well; I mean, they treated me like a colleague. And that was nice...

I: Yeah, so how did they make you feel as a colleague?

R: It made me feel really good. At first it was kind of awkward. We sat down for [one of] the first meetings...and everybody kind of looks at me and goes, “So, what do you have?” {laugh} So all of a sudden I’m conducting this meeting! “Ok, well, I have some little things I just typed up with concerns and questions and ideas.” And he goes, “Ok, hang on a second!” And he grabs it all and went and made copies and handed them out! ...And it made me feel good, because they were taking my work seriously. It made me feel a little uncomfortable, because I wasn’t sure -- I mean I didn’t really have enough background to just get to say, “Well hey this is really definitely the right direction.” It would be like, “Well, based on my pitiful understanding of the project, this is what I think we should do.” But that made me feel good.

A mentor discussed that she actively encouraged her mentee to interact with other faculty members about her DMP research project. She indicated that the students' confidence was boosted through this process.

The other thing I was able to do is to introduce [my mentee] to my colleagues, so she could go talk to other people. I think it's crucial that we don't limit the experiences of women to just women alone! So I used this opportunity to say, "Go talk to so and so, and tell them what you're doing." So this way, she gets to talk to my other colleagues, and build confidence that she can approach anyone who is somewhat interested in what she's doing, and actually tell them what she's doing. And feel that she can go up to them without fear of being sort of "pooh-poohed" or whatever. That's how you build confidence. I know that's how I did it.

I: And you said you talked with her at length being sure of herself, and those sorts of things.

R: Yeah, I mean, it's very hard, I don't think I gave her a lecture on being sure of herself! Because I know if anyone did that to me, I'd say, "Oh, yeah, right." {laugh} Much more indirectly. By having her, if someone came to my room and asked, "What are you doing?" I would say [to my mentee], "Why don't *you* explain it to them." Giving her the opportunity. The first time I did that she sort of looked -- you know, if looks could kill I'd probably be dead! Like, "How could you do this to me?" But then she realized that I was doing her a big favor, really training her to stand up there and defend what she was doing. And so by the end, when I'd have people come up, and I'd say, "Ok, well, [she'll] tell you everything," she responded beautifully! She'd get up there and enthusiastically tell them what she was up to! So yeah, so I think she didn't realize that she actually had that ability. And I hope that by the end she realized that yeah, she could stand up there and give a coherent presentation....

Through providing funding to attend an academic conference, the DMP allowed a few students to gain exposure to an even broader group of CS academics and professionals. In the following excerpt, a mentor discussed the importance of this type of opportunity.

I like the idea of being able to try to get the money to go to conferences. I think that's the next big step is for them to see what large numbers of professionals in a room look like and act like and dress like, it gives you more of a feel [for the field]...So they walk over and it's like, "Oh, this is [a well-known person in the field]." And, you know, they've read his paper. "This is [another well-known person]. We use his textbook." You know, and [this person is] not like eighty years old. He's like this forty-five year old, gangly guy that I first met by the swimming pool...[But these students think,] he's gotta be wearing a suit and have a bald head and look very distinguished. [But in reality], no one will accuse [this person] of looking distinguished. And it makes it just more real that these are real people and that, and also the diversity of; you can be a professor, you can work in a research company, you can work for the military, [etc.].

2. Implementation Issues

a. Facilitating and maximizing the effectiveness of interactions with graduate students

1) First and second year graduate students were able to provide a more accurate picture of what the transition to graduate school life would involve

Students indicated in their interviews that they were more able to identify with the first and second year graduate students than the graduate students who were in the final phase of their degree programs. These graduate students were able to provide a better view of graduate school life for the DMP participants. The following student quote addresses this issue.

The [first and second year graduate students] were younger and just more frivolous. They weren't so stressed out about "Got to get my dissertation done!" and all that stuff. So, I'm really happy I was in a room with them. Plus they were closer to my age...

2) Need for a formalized introduction or formalized roles to foster interaction between graduate students and DMP participants

Student interviews revealed that those students who had a natural way to interact with graduate students, either through working on their research project with them, sharing an office, or attending seminars or research meetings with them, interacted more frequently with graduate students. Through this interaction they were able to learn more from the graduate students. As indicated in the following quote, students who did not have a formalized way of meeting the graduate students were less able to make these connections.

I: Ok. What about your social life during the summer? How was that element?

R: I'm pretty good about finding stuff to do. But I think I would have had more fun, I would have had a better summer, if I had been introduced to the grad students in the lab where I ended up doing a lot of my work. Because I didn't get an account on that lab machine until about halfway through the summer. And even if I had not had an account on that machine, because as I said, from the beginning, we didn't even know I was going to be doing that project, but if somebody had just -- I was down the hall, where there were maybe two or three other students. There was nobody else down there. And if somebody just said, "Ok, this is where all the grad students hang out; let me introduce you around," it would have been a lot better for me, I think. Because I met among the grad students I met people that I would really like to keep in touch with but I don't think I was there long enough to have established that kind of relationship. So I think that would have been really helpful from the outset.

b. Distributed nature of the DMP creates the possibility of social and academic isolation --

Possible solutions

Because most of the DMP students go away to another institution and are the only students participating in the program at their mentor's school, it is easy for them to become isolated both socially and academically. Some students were the only undergraduate working in their mentor's CS department during the summer. These students felt the need for interaction with peers. Although a few students were able to find peers through other means, some expressed that they felt quite isolated during their summer in the DMP.

In the following interview excerpt one student discussed how during the program she did not have interaction with peers and how difficult this was for her.

[Before I left for the program]...I didn't really want to leave this area, so it was, the hesitancy was getting up and moving half way across the country for the summer...And it was, it was pretty rough at first actually...That's one comment I have about the program is that it splits everybody up and you don't really have any peers that you're working with...[because] all the people are going to different universities...So, it was a pretty lonely feeling at first, I didn't know anybody at all in the area, I was just kind of dropped off...I mean, I got to know people after a while, but...

Another student expressed similar thoughts:

I: So what was it like at the beginning, when you didn't know anybody, what were your evenings like?

R: They were so pitiful!...Basically I came home and watched TV...I think if I had gone to a town where I had a couple friends, that I certainly would have been happier, whether or not the [research] project was [going well or not.] Not having any friends or anything, I was really lonely, and that made it hard for me to be happy [during the program].

Below we discuss three possible solutions to the problem of isolation in the DMP. The solutions are based on the experiences of participants.

1) Having two DMP students assigned to the same CS department provided the participants with peer interaction and support

Students who were paired with another DMP participant tended not to express that they felt isolated during the program. In the following interview excerpts, a student who was paired with another DMP student discussed how valuable this was because she had someone to help her with research and someone with whom she could identify.

I: So did other people play a part in your research?

R: [The other DMP student] helped me a lot...Like I would get stuck with a problem --

usually something I knew but yet I couldn't think of, like a formula or that we both should have known -- [and] she would help me out with that. Or if I was trying to reason something through, she'd sit [down with me], and I'd show her what I was trying to do. And she'd like fill in a missing step, and stuff like that...It was nice to have [her there]! I would help her, and she would help me back. And it was really nice to have somebody else who's also doing research, besides just the grad students. And she's we're [considering similar career paths]..., so that was helpful too, because we both kind of like, "Well, I don't know what I want to go into, but I want to go into [this one particular area]."

Another student who was paired with another student working at the same institution said that both she and the other DMP student had considerable difficulties during the program. She indicated that they provided support for each other during these difficulties and that this was an important factor in being able to cope with the situation and still derive some benefits from the program.

2) Providing a peer base through arranging for students to interact with undergraduates in other programs such as the REUs

Some of the participants discussed that during the DMP they had been able to get to know other undergraduates who were participants in an REU program, sometimes in CS and sometimes in other fields, and that this provided them with a social network. Some students lived in the same dorm as REU participants and others participated in REU functions, such as workshops and social events. Students who had this type of peer interaction tended to feel less isolated than those who did not have access to peers.

3) The '96 program email discussion forum was not completely successful at providing a peer network

The email discussion forum was set-up in an effort to provide a peer network so that if students encountered difficulties during the program, they would have a larger network of peers, as well as mentors, to interact with in an attempt to solve these problems. However, interview and survey data suggest that the forum was not successful at accomplishing this goal; most of the participants who were interviewed did not find this avenue to be particularly strong for communicating with other DMP students or mentors. As indicated by the survey data, approximately half of the participants used the email forum, although only about a third posted a message and only a fifth responded to a message. Approximately half of the mentors reporting having used the forum, although most had not posted or responded to a message, but had simply read messages and/or posted an introduction of themselves. This indicates that the level of discussion was fairly low.

When asked why they did not participate in the email discussion forum, 30% of participants cited a lack of time or the fact that they do not normally participate in these types of forums. The low level of interaction was cited by 20% of the students. Another problem that two students raised in the interviews in relation to the email forum was that although it was supposed to provide them with an avenue to discuss problems they might be having with the program, they did not feel comfortable doing so, because it was not anonymous. They felt it was likely that either students or mentors would be aware of either the identity of the student who wrote the email or of the mentor of that student.

In addition, some of the students were accidentally provided with the mentor password, instead of the student password at the beginning of the program. This made them question whether or not the mentors had been given the student password and made them uncomfortable about discussing sensitive issues over the student forum.

Most of the mentors who were interviewed also indicated that the mentor forum as it existed during the 1996 program did not spark much interaction. In the interview excerpt, a mentor discusses her belief that the email discussion forum was not a useful medium for stimulating interaction among people who did not already know each other and have a rapport with one another. She suggested that combining the email forum with a conference for all of the participants would be more effective.

R: One other thing that might help is to have one common meeting of all these mentors and mentees, like a conference...over a weekend. It would give us all a chance to see each other, and talk about these things. Because although much is said about email communications and the Web and stuff like that, without having met anyone at all in the first place, it is extremely difficult to get anything going. [The email discussion forum was valuable] just as an information source,...but as any kind of forum for discussion it's useless. straightforward requests for pieces of information.

I: Because you don't have that rapport with people?

R: Yeah, you don't have the rapport with people. I mean, I tried. I put some stuff on there, and there was no response at all. The only things that ever had any responses, were just straightforward requests for pieces of information.

D. Conclusion: Multi-faceted program

It is important to note that many of the participants experienced some difficulties during their DMP experience. There was generally at least one component that was somewhat uncomfortable or dissatisfying for students. However, even the students with the most serious problems (lack of guidance or enough contact with mentors, social isolation, etc.,) stated that they would participate in the program again if given the chance and discussed numerous positive outcomes from the program.

IV. Additional Implementation Issues: Evaluator's and Mentor's Viewpoints

A. Types of students the program should target

1. *Mentor's perspectives*

In interviews and surveys of the 1996 mentors, we explored the issue of what types of women the mentors felt should be targeted for participation in the DMP. Based on data from the first year of the evaluation, we identified four overlapping groups of female CS majors that had participated in the program. We gathered information regarding the mentors' views about including each of these groups in the program: 1) those who had attended smaller schools such as four-year liberal arts institutions, 2) those whose credentials (GPA, type of institution, etc.) would probably *ensure* their acceptance into graduate school, 3) those who might not be accepted into graduate school without the benefit and extra credentials of the program, and 4) those who had already been accepted into graduate school in CS&E. On the 1996 mentor survey, most of the mentors indicated that it was important to target all four groups. However, the degree of importance assigned to each of these groups varied. For example, all 14 of the mentor respondents indicated that it was "very important" to include students from small schools, whereas only 7 of the mentor respondents felt it was "very important" or "important" to include students who had already been accepted into graduate school. Interview data confirmed these survey-based findings.

Providing those who had attended smaller schools a completely new window on graduate school and connections to research professors

Mentors indicated that it was important to target women from small liberal arts colleges for participation in the DMP, because these students had not been exposed to a research institution, and therefore had even less exposure to graduate school life than their counterparts from research institutions. In addition, mentors pointed out that participation in the program would give these women an advantage in the graduate school application process when they were compared to other students who had done their undergraduate degrees at prestigious research institutions. The following quote from a mentor interview illustrates this point.

One thing I will say though is that...[women] from small schools...are the people that we really need to be targeting. I mean...[a student of one of my colleagues] was rejected and apparently she got displaced by women from schools like MIT. I mean the grade points were the same and they said that they'd go for the women from the bigger, better-known school. Well my argument is that those women are already there. I mean, what else do you need when you're going, when you're in Computer Science at MIT? You may not be working with women, but you've got everything else you need in life to be successful. It's the one from [small departments] that you want to pick up...[ones from] the smaller schools where you don't have the graduate program and it doesn't matter if you have women professors or not. If you don't have a graduate program, you probably don't have anybody that's telling them the things that we're telling them. So anyway, I'd just like to try to catch the people that are the cream of the cream but for financial reasons, for family reasons, [such as being] the first ones to go to college, that don't look as sexy on the applications.

Problems associated with including women from smaller schools were that they sometimes lacked the background necessary to get started quickly on a research project, and the difficulty of coordinating schedules with schools that were on the quarter system. However, none of the mentors suggested that the solution to these problems was to not include these types of students in the program.

Allowing the “best and brightest” women students to experience graduate school so that they see if is right for them—hopefully get them excited about research

Virtually all of the mentors indicated on the survey that it was “very important” (9 of 14 survey respondents) or “important” (2 of 14) to target women whose credentials would probably ensure them admission into graduate school. As in the following mentor interview excerpt, they indicated that often the “best and brightest” women undergraduates lacked confidence in their abilities or enough knowledge about graduate school life to make them interested in pursuing higher degrees in CS. They felt that the DMP was a way to provide these students with more exposure to research so that more of them might be retained in the field.

I: Why did you get involved in the program?

R: Well particularly in the case of [my mentee]...I knew she was definitely capable of graduate work and I wasn't sure...how seriously she was thinking of graduate work. And I was thinking that this would be a really good opportunity to show her that she could do it...[I saw the program as] sort of a way of drawing her in. She's a very good student and is very interested in what she's exposed to. So I thought, “Let's pull her into the research.”...[This program can help these students] realize that they can do it and get a taste of how exciting it can be. Because I think for a lot of students it's...an unknown.

This mentor went on to say that her mentee had in fact decided to pursue graduate school in CS&E with the goal of becoming a researcher.

Providing the “second tier” students with experiences that boost their confidence

Virtually all of the mentors felt it was important to include students who were reasonably competitive, but who might not be accepted into graduate school without the benefits and extra credentials of the program. As the mentor quoted in the following excerpt stated, these women often had the same credentials as many male students who were accepted to graduate school, and it was important to boost the confidence level of these women so that they could be competitive despite their lower grade point average.

...I'm thinking of one of our students that didn't get accepted. She's definitely graduate school material there's no doubt on my mind...[So if you]...compare it to men..., there's a lot of men who go on to graduate school. And they're not all 3.9-4.0 [students]. And they might not all get into the very top grad schools, but they do go to good grad schools. And they do well and they go on to faculty positions or whatever. I think there's a lot of women who are in that [category]. So, it's important to get the 3.9 and the 4.0 [women in

the DMP], but there's a lot of women who are just as capable as the vast majority of men that are going on to graduate school who I think aren't being encouraged...[So,] there are lot of women out there that should be encouraged and that could benefit [from a program like the DMP]...[and we need to do this] if we're going to get more women [to stay in the field]...

Mentors also pointed out that many of these students lacked research experience prior to the DMP, and that this added credential could be the deciding factor in gaining admission to strong CS graduate programs.

Providing some women who had already been accepted to graduate school in CS&E more preparation to increase the likelihood of their success

Although mentor respondents to the survey were divided on the importance of including women who had already been accepted to graduate school into the DMP, interview data from mentors who worked with students who had already been accepted, as well as data from the mentees themselves, suggests that the DMP experience was quite valuable for these students. The mentors and the mentees felt that it provided the students with more preparation for graduate school and that this would increase the likelihood that these women would be successful in graduate school. The mentors who worked with these types of students indicated that their students were in need of this additional preparation. They did not feel that the DMP would be necessary for all graduating seniors who were planning on attending graduate school immediately, but that for some women who lacked experience and/or confidence the DMP was very beneficial. The following mentor interview excerpt illustrates this point.

I: What are your thoughts about who should be participating in the program? Should students who are already accepted into graduate school be included?

R: I think they should be ... included for the following reason. Many women will apply to graduate school -- I mean, I've seen this happen -- they come in, and then they drop out after two years. Ok. The attrition rate for women...[based on my experience is high]...I've seen very bright women coming in and dropping out. And I think it's because they're inadequately prepared. They don't have either some experience in doing research, and that frightens them. And when you're a graduate student, very rarely do you get mentored. If you're lucky you get an advisor who's also a mentor. But more often than not, it's like, you're thrown into a big pond and you're expected to swim. If you give someone the experience to work, sort of, with training wheels on, before they go into graduate school, I think that experience really helps them through the whole graduate school process. I think, while it's important to make sure that we get more of our sophomores and juniors excited about graduate school, make sure they apply to graduate school, and get into graduate school, it's equally important that we make sure we equip them with the tools to succeed there. So I think seniors, even ones with an accept from [prestigious departments] or wherever, should go through this. But maybe for the seniors, you could do it on a case-by-case basis -- you know, by saying, for seniors you need a special nomination, that says I need someone to certify that this person would actually

benefit from this program. I was willing to write such a letter for [my mentee] case, because I felt that in [her] instance it would really make a difference in how she would handle graduate school.

2. Evaluator's perspective

Data from students and mentors about the types of students which should be included in the DMP suggest that this is a program from which all of the above types of students can benefit greatly. During the third year of the evaluation, we will conduct a systematic analysis of the survey data to explore patterns in outcomes for students of different groups.

B. Mentor outcomes

1. Personal satisfaction

Many of the 1996 mentors who were interviewed expressed that they had experienced great personal satisfaction through their participation as a mentor in the DMP. These mentors tended to express that they had enjoyed working with their students and had felt rewarded by the experience. As in the following mentor quote, these mentors valued being a part of the developmental process of their mentees and seeing their mentees gain skills and confidence through the program.

R: My experiences from last summer [as a DMP mentor] are probably among the most positive of my [experiences at my institution]. So I think [the program] is great. And I look forward to being able to see these people, you know, going to grad school, or doing well in their careers, whatever they choose.

I: And why was it so gratifying for you, compared to your other experiences?

R: Well, because it's sort of a clear win! {laugh} I think it's because it's a very one on one kind of thing, where it's easy to isolate the effect that you had, whereas with other students here at [my school] that I've advised, I've given them advice and other professors have given them advice. So, when they go off and do great things, it's hard to separate your effect from other people's effects.

Mentor survey data provides confirmation that many mentors felt satisfaction through their participation in the program. For example, 85% of the mentors surveyed from all three program years indicated that they were "satisfied" or "very satisfied" with the program, eighty-one percent of mentors felt "effective" or "very effective" as mentors, and virtually all of the mentor respondents indicated that the DMP was an effective way to increase the number of women choosing to pursue higher degrees in CS&CE.

Relationship Between Mentors' Expectations and Satisfaction Level

The mentor interviewees who expressed a high degree of personal satisfaction also tended to report that, by their definition, their DMP students had “contributed” to their research efforts. However, these mentors also stressed that it was important for mentors in the DMP to have relatively low expectations of undergraduates participating in a ten week program. When the students performed above their level of expectations, the mentors’ satisfaction level rose. On a related point, most mentor survey respondents (75%) indicated that they did not expect the mentee to contribute greatly to their research efforts. As it turned out, most mentors had appropriate expectations and felt that they got as much as (36%) or more than (45%) they had expected from their mentees.

2. Effect on mentors’ research program varied

Based on survey and interview data, the mentors were divided as to whether their participation in the DMP had resulted in time lost in terms of their research programs. Many of the mentors (56%) indicated that the student had taken little or nothing away from their *own* research efforts, while 34% felt that their research program had been “somewhat” negatively impacted, and 10% felt that their program had been significantly, negatively affected. In the 1996 report we discussed the issue of the contributions of the students’ research to the overall mentors’ research.

3. Recognition: varying levels of satisfaction

Mentors differed in their views on whether or not they felt satisfied with the level of recognition they had received for their participation in the DMP. Approximately one third expressed that they were “somewhat satisfied” (13%) or “satisfied” (19%) with the amount of recognition. About 43% expressed dissatisfaction. Nineteen percent indicated that they did not expect any recognition. Interview data suggests that there are two issues relating to the level of satisfaction with recognition: whether or not participants were aware of the letter sent by the PI of the DMP grant to the an official at the mentor’s institution, and the degree to which the mentor’s department chair was supportive of service efforts aimed at increasing diversity in the student population.

Effect of the letter from the PI to an official at the mentor’ institution

Some of the mentors who were interviewed were aware that the PI of the program had sent a letter to an official at the mentor’s institution recognizing the mentor for their participation in the DMP; a few were not. Two of the mentors who were made aware of the letters related that they received recognition because their chairpersons had received the letters. This was important for them, simply because they wanted their department heads to be aware of, and appreciate their service efforts.

Evaluator’s Viewpoint: Because there is variation regarding the value of “outreach” or “service,” the program may need to provide broader recognition

Some mentors expressed that service was very important to their department chairs and that their efforts as a mentor in the DMP would be lauded by their department; others expressed that this was not the case. Most mentors expressed that their participation would be considered either neutral or somewhat positive in a tenure decision-making process. This may mean that a letter of recognition to the departments may have little or no effect for some mentors. Therefore, the program may wish to consider providing broader recognition for the mentors by making the CS research community aware of their efforts.

C. Value of mentor/student training materials

Although we asked all 1996 student and mentor interviewees about the value of the training materials provided by the PI to participants regarding best possible implementation strategies, most did not remember them well enough to provide much feedback. Those who did remember using these materials tended to state that they provided some guidelines and may have assisted them in starting the program in a positive way, because they knew more about what to do and what to expect.

[The materials were] helpful, although I didn't follow it exactly...If nothing else it gave me a sense of what the expectations were of what other people had done. Whether or not I followed the structure it gave me a sense of what the program was about. I want to see something, I may or may not follow it, but if I do the same thing with recipes...It gives me a sense of security [that]... "I'm in the right ballpark!"

