LEARNING FROM THE EXPERIENCES OF WOMEN OF COLOR IN MENTORNET'S ONE-ON-ONE PROGRAM

Carol B. Muller,[1]* Stacy Blake-Beard,[2] Sylvia J. Barsion,[3] & Christine Min Wotipka[4]

[1]*President, Blue Sky Consulting, Palo Alto, California 94303, USA, and Executive Director, WISE Ventures, Stanford University, Stanford, California 94305, USA*

[2]*Associate Professor of Management and Senior Faculty Affiliate, Center for Gender in Organizations, School of Management, Simmons College, Boston, Massachusetts 02115, USA*

[3]*President, SJB Evaluation & Research Consultants, New York, NY 10022, USA*

[4]*Associate Professor (Teaching) of Education and (by courtesy) Sociology, Director of the master's program in International Comparative Education and International Educational Administration and Policy Analysis, and Interim Director of the Program in Feminist Studies, Stanford University, Stanford, California 94305, USA*

*Address all correspondence to: Carol B. Muller, E-mail: cblue@stanfordalumni.org

MentorNet (www.MentorNet.net), a nonprofit organization founded in 1997 as an online network for women in engineering and science, developed a large-scale one-on-one mentoring program, which has served tens of thousands of participants over the years of its operation. As participation grew, the increasing numbers of participants who self-identified as people of color eventually provided a large enough dataset to analyze the program by race/ethnicity. This study seeks to shed light on the experiences of women of color, as programs designed to benefit the majority population may not serve all participants equally well. We also know that the group of professionals volunteering as mentors was not as diverse as the group of students seeking mentoring.

Program evaluations based on responses to end-of-relationship surveys, taken together with data collected when participants first applied for the program, reveal that many students of color are particularly interested in discussing issues of race with a mentor. Even in cases where students initially expressed a preference to be matched with a mentor of the same race, however, their satisfaction at the end of a mentoring relationship was no less if they had been matched with a person of a different race. Students of color were more likely than White students to attribute their retention in college and increased motivation to succeed in their chosen fields to having an external mentor. Professionals participating as mentors who were people of color reported increased self-confidence from the experience, more so than did White mentors.

KEY WORDS: *Women, women of color, minorities, mentoring, e-mentoring, STEM, university/college students*

1. INTRODUCTION

"I have grown very comfortable sharing difficult issues with my mentor. My mentor is like a friend, except that she has wide knowledge about working and how to succeed." (Barsion, 2002)

Research on mentoring has advanced considerably over the last three decades, particularly in understanding its utility in advancing underrepresented groups in organizations and disciplinary areas (George and Neale, 2006), and in understanding the many components of effective mentoring (Allen et al., 2006; Blake-Beard, 2001). At the same time, new research and development projects have also focused on electronic-mediated communications and learning (Single and Muller, 2001; Muller, 2009). E-mentoring builds on the age-old practice of mentoring, linking it with newer and emerging electronic communications technologies to create relationships that could not otherwise exist due to constraints of time and space.

E-mentoring has been deemed specifically and especially effective for women of color as it "crosses boundaries of race, class, and gender by targeting marginalized groups in society such as minorities...and women" (Bierema and Hill, 2005, p.559). The online format allows groups traditionally excluded from mentoring—a title that unfortunately includes women of color—to access these beneficial learning relationships, thereby enriching their professional opportunities. Further research has noted that e-mentoring offers the added benefit of "demonstrat[ing] that technology is appropriate for women in a variety of careers across the disciplines by inviting women who use the Web as a regular part of their writing and communication in the workplace" (Haaset et al., 2002, p. 245). It can foster the creation of an online community of female professionals, parallel to and therefore exercising the benefits of the peer-based congregations—for example sisterhoods or sororities—that have traditionally dominated female relationships. These postulated benefits of e-mentoring for women of color have been repeatedly proven in studies concretely demonstrating its effectiveness (Johnson-Bailey and Cervero, 2002; Hansman, 2002; Murrell et al., 2008).

This paper considers the ways in which results of year-end program evaluations for an online mentoring program for those underrepresented in the fields of science, technology, engineering and mathematics (STEM) may shed light on the mentoring needs of women of color in STEM fields. Data show that mentoring is an important support for women of color and a vital contributor to their success and persistence in engineering and science. While women and minorities have experienced steady increases in their STEM undergraduate degree attainment, the same cannot yet be said of their post-graduate degree attainment or representation in the STEM workforce (NSF, 2009). How well, or differently, does e-mentoring serve women of color in engineering and science – both protégés and mentors? It is worth highlighting that in considering outcomes for both mentors and protégés, our work addresses one of the gaps in the current literature on mentoring, where much of the reported research has focused on protégé experiences and only infrequently looks at results for mentors, and even rarely from both groups offered in tandem. And how do women of color differ from their White counterparts in terms of interest in discussing issues of race or ethnicity with their mentors or having mentors of the same race or ethnicity?

The program under study was designed and executed by MentorNet (www.MentorNet.net), a nonprofit organization founded in 1997 as an online network for women[1] in engineering and science. Since the inception of its One-on-One program in early 1998, tens of thousands of undergraduates and graduate students in engineering and related sciences at hundreds of colleges and universities across the U.S. and in several other nations have been matched in structured, one-on-one, email-based mentoring relationships with male and female scientific and technical professionals working in industry and government (Single et al., 2005). During the period of our study, the One-on-One mentoring program featured online information, applications, matching, training, coaching, and evaluation. Developed with a strong underlying base of research related to effective mentoring, women's experiences in engineering and science, and the use of electronic communications in supporting the development of meaningful professional relationships, MentorNet used regular evaluation of its programs for both continuous quality improvement and assessment of outcomes.

Participation by women of color in MentorNet's One-on-One program was on a steady rise between the time the program started in 1997-98 and 2002-03; in 2002, more than 1,000 students responded to MentorNet's annual program evaluation questionnaire, yielding sufficient representation by women of color to enable analysis of data by race/ethnicity, with some surprising and to some extent, gratifying, results.

Interpretations and implications for future practice and research, as well as recommendations for policy and action are suggested. We begin by providing a definition and overview of the benefits of mentoring and by reviewing the latest research related to mentoring for women in STEM fields, with special focus on e-mentoring, and the mentoring experiences for women of color.

2. LITERATURE REVIEW ON MENTORING WOMEN OF COLOR

Mentoring is a frequently-prescribed strategy presumed to enable more women and others under-represented in many scientific fields whose participants have been predominantly White males, in order for these newer populations to succeed in these disciplines and professions (Bearman et al., 2007; United States GAO, 2006). Although the term "mentoring" is used in a variety of contexts, what we mean by mentoring in the context of this paper, consistent with the results we are reporting, is a learning relationship built between a more experienced individual and a less experienced individual, which assists the development of the less experienced individual, and benefits both (Kram, 1985). Mentoring can be a powerful lifelong learning process, facilitating the intergenerational transfer of knowledge and "know-how" (Murrell et al., 2008). Embracing the process of continuous improvement for human activity, intentional mentoring may also be a significant tool for change (Ragins and Kram, 2007).

Mentoring relationships are beneficial, some would say essential, to the professional development of successful scientists and engineers, but they do not naturally occur for all. Where geographic, cultural, economic, and other differences create barriers to identification of those commonalities, mentoring relationships are less likely to form. Women and people of color may less often be engaged in naturally occurring mentoring relationships and less frequently have

---

[1] Though its initial focus was on serving the interests of women in engineering and related sciences, MentorNet has always allowed participation by all interested, and in 2005 deliberately expanded its stated mission focus to *all* those underrepresented in engineering and science fields.

access to mentoring networks.[2] While classroom learning and professional training concentrate primarily on the subject matter knowledge and related skills required of emerging professionals, mentoring is often the informal means by which people are guided and encouraged, learning how to conduct themselves and their work, developing judgment in choices and decisions in the process of progressing in their chosen fields.

Mentoring has been repeatedly cited as an effective method for recruiting and retaining women of color in STEM fields (Settles et al., 2007; Hewlett et al., 2008). A STEM workforce that truly represents the demographics of the world population, including the minority group constituted by women of color, has been cited as critical in creating efficient and effective "policy, programs, practices, and institutions" (Leggon, 2010). Women and people of color, however, remain systematically under-represented in STEM-related fields. This deficiency has been effectively combatted by career-oriented mentoring in college, graduate school, and professional environments; protégés have cited including greater visibility into otherwise obscure fields, enhanced confidence about themselves and their ability to succeed in industries traditionally dominated by the "majorities," and greater self-efficacy in general (Seymour and Hewitt, 1997; Chesler and Chesler, 2002; Reisberg et al., 2010).

Protégés identifying as women of color have stipulated that the programs addressing their unique needs and experiences have provided the most productive experiences; these statements have been corroborated by the success of such individually-targeted mentoring programs (Patton, 2009). What's more, it is the particular attention paid by the mentor to the situation and needs of the protégé that seems to be the universal determinant for the success of the relationship (Thomas, 1993, 2001). Mentoring participants have noted that the recognition of "racism as a hidden destructive force" in cross-cultural mentoring, an understanding of the "learning and power" dynamics underlying interactions, and "visibility" into each other's specific backgrounds are all essential to building the trust that constitutes the foundation of the relationship (Johnson-Bailey and Cervero, 2002). While mentoring in any form may be beneficial, the most effective partnerships are those that target the specific situation and needs of the protégé.

Structured mentoring programs ideally provide matching, training, coaching, and facilitation for mentoring relationships, which taken together increase the likelihood of satisfying mentoring relationships (Boyle and Boice, 1998). E-mentoring is mentoring conducted primarily via email, building on the Internet as a social technology that connects and affiliates people (Muller, 2009). Email has the obvious advantages of convenience, efficiency, asynchronicity, and facilitating distance communication among busy and geographically-dispersed people. But mentoring via email and related electronic communications technologies also enable thoughtful, deliberate communication, provide a useful record of that communication, use the power of writing as a reflective learning tool and as a strategy for socialization into a professional culture, and limit status differences that might otherwise inhibit communication between protégés and mentors (Muller, 2009). In addition, the restricted channel of communication helps build relationships, especially for those who feel isolated (Sproull and Kiesler, 1991). Moreover, online mentoring for women of color entering STEM-related fields has been deemed specifically valuable as it allows the creation of a mentoring community comprising primarily those who otherwise remain minorities in their fields (Sahib and Vassileva, 2009). Analysis of other more recently collected

---

[2] The literature is mixed on this issue. Blake-Beard et al. (2007) observe that "…while some people of color may find difficulty in gaining access to any type of mentoring relationships, the issue of access may be a function of the specific attributes of mentors with whom protégés of color are paired, along with the organizational context that either supports or acts as a barrier to the formation of interracial developmental relationships." (p. 228).

4

data from the MentorNet community suggested that while having a mentor of one's own gender or race was felt to be important by many of the students surveyed, matching by race or gender did not affect academic outcomes or confidence with their perceptions of "fit" with science. Students who had a mentor of their own gender or race did report receiving more help (Blake-Beard et al., 2011).

3. OVERVIEW OF MENTORNET AND ITS ONE-ON-ONE PROGRAM

MentorNet's One-on-One program enabled the matching of mentoring pairs in which the protégés were undergraduate or graduate students, postdoctoral scholars, or early career faculty members, and the mentors were professionals with similar disciplinary backgrounds by education and/or experience to those of the protégés.[3] It also provided guidance and direction for both mentors and protégés through several months of a mentoring relationship (Single et al., 2003; Single et al., 2008). Online information on MentorNet's web site provided initial orientation to participants, an interactive set of case studies online augmented that information with training for mentors and protégés. In addition, series of regularly emailed coaching "prompts" which follow a "coaching curriculum" appropriate to the developmental stage of the protégé, were sent weekly to undergraduate protégés and their mentors by email, and every two weeks to the other protégés and their mentors. The program was administered through a patent-pending, technology-supported set of systems, which integrated a web site interface; a database of demographic and other information about participants; a matching algorithm which considered the expressed preferences of both mentors and protégés in the matching process based on multiple characteristics; and multiple series of scheduled email messages with guidance and discussion topics, varying according to the educational level of the protégé, as well as links back to the program staff as needed for additional consultation, coaching, and problem-solving. Those participating were also able to join online topic-based discussion groups, as well as receive a monthly electronic newsletter.

The ability of the program to combine the long-standing practice of mentoring along with electronic communication was exemplified in the words of a protégé in commenting about how she "[m]et a total stranger on the web who became my real mentor." Another attested to "[b]eing able to talk to someone [who] had no preconceptions of you."

4. PRIOR FINDINGS AND IMPETUS FOR THIS EVALUATION

As MentorNet's One-on-One program grew and evolved during its first five years, so did related evaluation and research activities. As part of an ongoing process designed to establish clear expectations for the program and its participants, mentoring relationships were initially designed to last for one academic year. At the conclusion of that time, participants had the options to end the relationship, continue to communicate informally, sign up for another year with the same

---

[3] Initially, MentorNet's One-on-One program supported undergraduate and graduate students as protégés, pairing them with mentors who were professionals in their fields working in industry or government. In 2003, in response to often expressed interest, with a grant from the National Science Foundation's ADVANCE program, MentorNet expanded its program to enable matching of graduate students, postdoctoral scholars, and early career pre-tenure faculty members with tenured faculty members as their mentors as an option. By 2006, undergraduates could also opt to be matched with faculty members as their mentors, and non-tenured faculty members were able to serve as mentors.

mentor or protégé (as long as both agreed), or be paired with another mentor or protégé. As the initial structured term of their mentoring relationships came to an end, all participants were asked to complete an evaluation survey. Analyses of data from these surveys, linked with demographic data collected when participants first signed up for the program, comprised a major part of the program evaluations, coupled with a few other select and targeted studies. Results of the "end of relationship" surveys particularly assisted formative evaluation and also provided simple measures of satisfaction, program participation, and self-reported data concerning possible outcomes.

An evaluation report of MentorNet conducted in 2001-02 (Barsion, 2002) uncovered five notable outcomes for students participating in the program. First, students (66% agreement) reported ongoing encouragement, reassurance, and moral support along with a boost in confidence from their mentoring relationship. As one protégé put it, "The most valuable aspect is the inspiration from my mentor. Because there are times when you are so stressed out that you don't know what you should do next. My mentor always gives me the encouragement that I need... Sometimes those few words make a big difference to me."

The second outcome for protégés related to the career information, alternatives and inspiration received while learning about their mentor's workplaces. Three-quarters of respondents reported that their mentors suggested specific strategies for achieving career aspirations and nearly as many were learning about their mentors' jobs and workplaces. Slightly less than half of the protégés agreed that having a mentor increased their understanding of skills used by engineering, science, or math professionals. Close to two-thirds of protégés felt that their mentoring experience was affecting their desire to pursue a job in their field of study.

Academic advice and support, including being able to relate academic experiences to the workplace, provided the third benefit for protégés from the program. Just over half of the protégés emphasized they had a better understanding of career and postgraduate opportunities available to them, as exemplified by comments such as the following: "My mentor gave me the opportunity to vent when school was stressful. She offered suggestions for scholarship searches. She gave me practical advice on classes, especially that the grade is not the most important thing. Basically, my mentor was a friend."

What's more, such advice was viewed as being particularly important for women, who, if matched with female mentors, were offered the chance to see female role models in STEM fields. For some, like one protégé in physics, before working with her mentor, "it almost seemed like no such women existed." Another put it nicely when she wrote, "My mentor is a successful woman in industry. I see her achieving things that I hope to some day. She is a great role model and provides excellent feedback regarding my questions."

Finally, protégés appreciated learning about and exploring options for balancing family and work with their mentors. Forty-six percent strongly felt they had a clearer perspective on balancing career and family, now or in the future. One protégé who has children reported that her mentor, also a mother, "helped me look at some difficult issues with dealing with working full-time, being a student part-time, and being a full-time mother and wife because she has been there."

These prior studies also looked at outcomes for mentors, finding that that mentors also reported positive outcomes as a result of their mentoring experience through the MentorNet One-on-One program, especially the personal satisfaction in helping the next generation move ahead. On a 5-point scale where 5 equaled "A lot", three-fourths (those choosing ratings of "4" and "5") said their MentorNet experience gave them a great deal of personal satisfaction in helping the

next generation. Even more (81%) emphasized they had a significant opportunity to pass along what they have learned to the next generation.

The data supported the idea that mentors do make a positive and important difference in the lives of many students. Mentors reported strong beliefs that it is important for a student to have a mentor. In addition, mentors said that the discussions via email with their protégés provided an impetus for their own reflections: 69% felt strongly that the experience led them to reflect on their own careers.

5. RESEARCH QUESTIONS

Knowing that educational programs designed to benefit the majority population may not serve all participants equally well, we were eager to undertake the analysis reported in this paper to learn more about the experiences of women of different races and ethnicities in MentorNet's One-on-One mentoring program. We also knew that the group of professionals volunteering as mentors was not as diverse as the group of students seeking mentoring— not a surprising situation, as the current diversity of students in STEM fields is not yet reflected in a workforce that has been predominantly male and White (NSF, 2009).

The motivation behind these specific data analyses was to learn whether or not women of color were as well-served as White women in the program, and to learn more about the experiences of women who identified themselves by specific racial or ethnic groups. Our main research questions follow:

1. Do women of color report different experiences and benefits of being mentored than White women? If so, how are they different? What differences exist among mentors of color compared with White mentors?

2. Are women of color more interested than White women in discussing issues of race and ethnicity with their mentors?

3. Do women of color prefer mentors of the same race or ethnicity more so than their White counterparts?

Next, we discuss the methods and data retrieved from program participants' initial enrollment in the program, and those collected from surveys of participants at the conclusion of their mentoring relationship over a two-year period, with a focus on the experiences of women of color participating in the program.

6. METHODS AND DATA

Participation by women of color in MentorNet's One-on-One program was on a steady rise between the time the program started in 1997-98 and 2002-03, when these data were collected, as seen in Table 1. By 2001-02, with more than 1,000 students responding to MentorNet's annual program evaluation questionnaire, there was sufficient representation by women of color

completing the surveys to enable closer analysis of data by race/ethnicity, with some surprising and to some extent, gratifying, results.

Among the pairs of students and mentors participating in the program in 2001-02, 82% of White students were paired with mentors of the same racial/ethnic background. For students of color, the same could be said of just 16% of Asian-Americans, 8% of African-American, and 5% of Hispanic students. During the period of time under study (and continuing into the present), the population of professionals in science and engineering in the U.S., from which the mentor pool for the MentorNet program was recruited, was significantly less diverse than the body of students studying in these fields in U.S. institutions of higher education, from which the protégé pool was recruited. As a result, not surprisingly, the pool of mentors available had proportionately fewer mentors of color in comparison to the pool of protégés.

TABLE 1 ABOUT HERE

Using analysis of variance (ANOVA), we could then measure the degree to which differences among racial/ethnic groups in their responses to certain questions from the end of relationship surveys were statistically significant. Preliminary data analyses showed differences by some major racial ethnic groups not previously identified in earlier cohorts. By the time the data analyses began to emerge, we had also collected data from the 2002-03 program participants, enabling us to review and analyze the data from that cohort as well.

The program requires each student-protégé and mentor to complete an online profile. This profile is used to make the matches between the prospective student-protégés and mentors and to develop an understanding of the populations served. Most of the demographic data reported comes from these profiles. During the years of this study, the One-on-One program was designed to last for one academic year at a time.[4] Near the end of the year, students and their e-mentors were asked to complete an online survey designed to assess their experiences and provide data on satisfaction and outcomes. Table 2 shows the number of students and mentors returning surveys and the response rate for the survey based on the number of students and mentors that were matched in each year.

TABLE 2 ABOUT HERE

Included in the analysis were data collected from 1,051 respondents who were both women students and U.S. citizens who had participated in the program as protégés, and from 2,633 professionals who served as mentors in the program. For purposes of analysis of the experiences of women of color participating in the One-on-One program, we decided to limit the student sample to females who were citizens of the U.S. Though men were welcome to participate in the program, there were too few in these cohorts (for example, men represented 7% of the student-protégés in 2002-03) for reliable statistical analysis once the samples were divided into racial/ethnic groups. Because international students bring with them cultural backgrounds and norms that may differ widely from those of U.S. citizens, we determined that including their responses could skew results and not allow us to have a good understanding of the experiences of

---

[4] In 2003, in response to formative program evaluation, a significant revision of the technology underlying the program's administration enabled year-round program entrants, so that prospective mentors or protégés could join the program at any time and be matched throughout the year. From then on, mentoring relationships were designed to last for eight months at a time, regardless of when they started.

U.S. students of color. For instance, Black students from outside the U.S., and particularly those who have come to the U.S. for higher education, have frequently had very different experiences from African-Americans born and raised in the U.S. (Weber, 2010).

By eliminating males and students who were not United States citizens, the 2001-02 student sample was reduced in size from 1,101 returning the year-end evaluation survey to 790, and the 2002-03 cohort decreased from 1,126 students to 870. The resulting student samples allowed better opportunities to learn about and compare the experiences of U.S. women students who were Asian-American, African-American, Hispanic/ Latina, and White. The numbers of American Indian/Alaskan Native and multiracial students were each too small to yield reliable data. We did not, however, similarly limit the overall mentor sample because we wanted to capture a representative sample of those providing mentoring for U.S. women protégés, who could have been male as well as female, or international in location or nationality.

For many analyses, we wanted to be able to consider the responses of both student-protégés and their mentors. Doing so required us to limit the sample still further, since within any given pair, it was possible that only the mentor or the protégé responded to the survey. Table 3 shows the number of students in each racial/ethnic group that completed the year-end survey and whose mentor also completed the survey. Results from these students and their mentors provide the complete data set for both years being studied. These samples are roughly consistent with proportions of students that were matched from each ethnic group, keeping in mind that all non-citizens were excluded, thus decreasing the proportion of students of color in the sample. To illustrate: 23% of students matched in 2002-03 self-identified as Asian or Asian-American; by eliminating those who were not U.S. citizens, that proportion decreased to about 12%, a figure very close to the 14% of the sample that is studied here.

TABLE 3 ABOUT HERE

7. RESULTS

Our initial review of data from students and mentors returning evaluations at the end of the 2001-02 academic year showed some interesting results, which motivated us to examine these data and those for the following year in more detail. With any program serving majority populations that shows beneficial results, we want to know how well it serves minority populations. Overall, statistically significant differences in the needs, experiences and perceived benefits were found for African-American, Asian-American, Hispanic/Latina and White students and mentors. African-American students especially, but also Asian- American and Hispanic/Latina students, wanted a mentor to discuss issues of race/ethnicity with them; however, there were very few same-race matches and White mentors felt less comfortable than women of color in discussing such issues. From some students' perspectives, this desire for same-race matches is a critical need that remains unmet. In contrast, however, student satisfaction with e-mentoring was not related to race or to whether a student was in a same-race or cross-race match. In fact, students of color were more positive than White women about the range of MentorNet features that supplement one-on-one e-mentoring. They also felt more a part of MentorNet's "virtual community," which aligns with previous research (Blake-Beard et al., 2007).

7.1 Motivation to Continue in Field and Other Benefits for Protégés

Students of color directly attributed both increased motivation to succeed in their field of study and the fact that they got through the academic year to having a mentor and to their participation in the MentorNet One-on-One program. The difference between students of color and White students on these two variables was statistically significant as seen in the table below.

TABLE 4 ABOUT HERE

Written comments provided by students responding to open-ended questions on the surveys illustrate how important it was to them to have their e-mentor cheering them on from the sidelines as well as providing strategies for learning, time management and other factors that enabled students to persist in their major. Below is a sampling of such comments from students of various races/ethnicities and majors.

"Professionally I realized I have more options than I thought in my field. Academically she made me feel as though I could do anything. She also opened my mind up to more ideas regarding where I want to attend school. Personally she helped me understand that the pressure I feel is normal." – African-American Mathematics major

"Continuous positive encouragement has made a huge impact on me. When someone's there constantly telling you, 'yes, you can do it,' it's hard not to listen." – Asian-American undergraduate in Mechanical Engineering

"Keeping in touch with my mentor has taught me a lot about myself as well as the field that I have chosen as my own. Speaking with my mentor has showed me that perfection is not needed in college in order to be successful after the college experience. " – Asian-American majoring in Biological Sciences

"It is a great relief to find out how there are professional engineers who had a tough time academically at school. It was a great motivator for me to keep on going in this field even if it's not the easiest." – Hispanic/Latina student in Electrical Engineering in a community college

"Being able to write to someone who made it through and succeeded in engineering made me a lot more optimistic about school." – Hispanic/Latina first-year Aerospace Engineering student

Statistically significant higher proportions of African-American (76%) and Hispanic (79%) students were satisfied overall with their one-on-one MentorNet relationship, compared with Asian-American (69%) or White (72%) students. The same pattern occurred for respondents who said they were "very satisfied."

7.2 Interest in Discussing Issues of Race and Ethnicity

10

As part of their application process, students rated ten issues on a five-point scale asking how interested they were in discussing each with their e-mentor, with "0" = No Interest and "4" = Very Strong Interest." Those topics were as follows: general support; school decisions; industry knowledge; work vs. graduate school; balancing work/family; job search and resume advice; women's issues; self-confidence; race/ethnicity issues; and, sexual orientation issues.

For each of these issues, and for both years (2001-02 and 2001-03), an ANOVA was conducted using the five-point scale response to each issue as the dependent variable and the four racial/ethnic groups as the independent variable. The most striking difference as seen in Table 5 was that students of color were significantly more interested than White students in discussing issues related to race or ethnicity, which was described on the profile form as follows: "Discuss race/ethnicity issues with a mentor, how these issues influence academic and career development, and ways to overcome barriers related to race or ethnicity." Among women of color, significantly more African-American students[5] were *strongly* interested in discussing issues of race with their mentor than were the Asian-American or Hispanic/Latina respondents. In addition, Asian-American and Hispanic students were significantly more interested in discussing racial/ethnic issues than White students. These findings were true for those participating in both the years evaluated. We discuss the significance of these findings in the Discussion section.

TABLE 5 ABOUT HERE

7.3 Desire for Mentor of Same Race

In its matching process, MentorNet's One-on-One program gave would-be student-protégés the option to specify preferences for mentor demographic characteristics on a number of dimensions: academic degree level; gender; alma mater; work sector; company/organization; location (by nation); race/ethnicity (starting in 2002-03). The matching process also provided the opportunity to weight one's flexibility with these matching criteria, enabling prospective protégés to specify if they didn't care about whether or not their mentor had a characteristic, if they had a slight preference for a mentor with that characteristic, if they had a strong preference for a mentor with that characteristic, or if the mentor must have had that characteristic for the protégé to have been willing to be matched with that mentor. The MentorNet matching algorithm also weighted the protégés' disciplinary field(s) of interest in matching them with prospective mentors' backgrounds.

Results from ANOVA analyses (F = 11.1, df = 474, p < .05) revealed that African-American students had a greater interest in being matched with a mentor of their own race than did would-be protégés of other races, a finding consistent with their greater desire to talk about issues of race and ethnicity with their mentors. Though this preference was not as strong for Hispanic/Latina students as for African Americans, these students were more interested in being matched with a mentor of the same race than were Asian-American and White students.

Among the pairs of students and mentors each of whom responded to the year-end survey in 2002, just 16% of Asian-American students, 8% of African-American students, 5% of Hispanic students—compared to 82% of White students—were paired with mentors of the same

---

[5] We find that similarly for mentors, compared to mentors of other races, African-American professionals indicated the greatest level of comfort in discussing issues related to race or ethnicity.

racial/ethnic background (Barsion, 2002). The reality of the pool of available mentors through the MentorNet program—reflecting the demographics of the scientific and technical workforce in the U.S. today—is that there were insufficient women or men of color available as mentors to meet the demand from students who preferred to have a match with a mentor of the same race. For example, in 2002-03, a representative year, 75% of all mentors were White, 14% Asian-American, 4% African-American, and 6% Hispanic/Latina/o. As a result, many students who expressed a slight or strong preference for being matched with a mentor of the same race were not. A student who indicated a requirement to be matched with a mentor of the same race was only matched if a mentor of the same race was available, *and* if the mentor was a good match based on other preferences or requirements of both the prospective protégé and mentor; otherwise, that student would not be matched with a mentor at all and would not be reflected in the data found in Table 6.

TABLE 6 ABOUT HERE

7.4 Mentor Findings

We also found notable differences among responses reported by mentors of color. Response rates to the year-end surveys are found in Table 7.

TABLE 7 ABOUT HERE

Forty percent of African/African American mentors reported that MentorNet improved their skills for recruiting new talent as compared with 22% of all other mentors. Roughly the same percentage of Hispanic and Asian-American mentors conveyed an increase in their own self-confidence resulting from their participation as a MentorNet mentor as compared with 25% of all other mentors. About half of Hispanic and African-American mentors described experiencing a renewed commitment to their field due to their MentorNet participation as compared with one-third of all other mentors. Finally, 36% of Asian-American mentors said the MentorNet experience improved their supervisory skills compared with 23% of all other mentors.

The 2002-03 year-end survey was the first time MentorNet asked e-mentors to describe their "insights into women's experiences in engineering, science, technology or math" gained as a result of serving as an e-mentor. Only some e-mentors took the time to respond to this question but some of the comments received from mentors of various races were instructive:

"Being a mentor for a young woman in the field of engineering is extremely important. They have no idea the obstacles that may be faced once you are out of school. Women in the field of science and computers are growing. However, we have a long way to go." – African-American female design engineer

"This woman was fearful that she wasn't smart enough to be an engineer. Yet, from what I could see, she was very smart and had a lot of great attributes that would make her a great engineer (inquisitive, excellent writing skills, asked intelligent questions, learned quickly, etc.). I kept encouraging her during the school year and telling her she had everything a great engineer should have." – White female electrical engineer

"I feel that more needs to be done to drive the desire for young women to pursue IT and science related jobs, more avenues need to be created to make that happen as well." – Asian-American female working in computer science

"[I learned] that self-confidence is a very large issue for women in these fields, and that women are still not gaining much of this from the men they interact with. In order to succeed, it is vital that young women form networks with other technical women, AND seek out 'champions (either male or female).'" – White female electrical engineer

8. DISCUSSION

Although some previous studies have examined the value of same-gender and/or same-race mentoring pairs (Dreher and Cox, 1996; Koberg et al., 1998; Thomas, 1990; Leggon, 2010), comparing them with cross-gender and/or cross-race mentoring matches, results taken in the aggregate have been inconclusive. The findings of this evaluation study – indicating a high rate of satisfaction by students of color despite the relatively low rate of same-race matches – expand upon earlier prevailing wisdom that there are numerous benefits to be gained by matching students of color with mentors of the same color in mentoring relationships. To understand the ways in which mentoring can contribute to essential learning to support advancement in study and careers in STEM, we need to deconstruct and better define mentoring in context, including differentiating between the benefits of mentoring and those of role modeling. Further, we need to consider the learning and support needs of the particular protégé with respect to a given mentor. There are a variety of ways in which protégés of color still stand to gain whether or not their mentors are of the same race. There are also circumstances under which matching by race (and/or gender) may be essential to achieving desired outcomes.

Mentoring is a highly individualized learning process. An effective mentoring relationship responds to the particular needs of the protégé and works to enhance his or her learning, while moving the protégé from a state of dependence to greater independence. Each individual will present different needs, experiences, and backgrounds; effective mentoring considers these unique situational aspects. The value of mentoring experiences will vary depending upon individual needs, and opportunities to connect with a mentor who can address those needs. Thus, if a protégé desires further learning about navigating an educational or work environment in which there is real or perceived evidence that race and/or gender can affect the individual's experiences or progress, she or he may well benefit from seeking out a mentor who can help with that need. For example, one African-American graduate student participating in the MentorNet One-on-One program as a protégé wrote:

> Before my mentorship experience, I had only met two African American engineering faculty members…This was very discouraging, since I aspired to become a professor. Not only did my mentor tell me about her experiences as a graduate student and faculty member, but she introduced me to other faculty members of color that can serve as a support system for me (MentorNet, 2006).

The results of this study make clear that many African-American students have a keen interest in discussing racial and ethnic issues, both in college and as their career advances, with a trusted person in their chosen field. In some cases, they are clearly seeking role models who show it is possible for women of color to be successful in these fields; too few of these exemplars are frequently visible or present in their educational environments. Women of color in engineering and science, particularly African-American women, may need to "shift" – as they move into and out of different worlds (Jones and Shorter-Gooden, 2003) – among states of being a woman in a career still dominated by men, a person of color in a field still dominated by Whites, and as a woman with other life roles beyond her profession. A mentor, whether of the same or a different gender or race, can assist with these transitions and with the individual's level of comfort in becoming a scientist or engineer, in a way that feels honest and authentic based on his or her own experience and background.

Mentoring enables those involved to learn – mentors as well as protégés. Less well studied but potentially powerful learning on the part of mentors may result from cross-race and cross-gender mentoring, helping each to appreciate the other's cultural experiences and differences. This learning could contribute to transforming organizations and culture in support of more inclusive practices. Mentoring also builds networks which are beneficial to professional development and advancement for both protégés and mentors (Thomas, 1999; Linehan and Scullion, 2008; Bridgeford, 2007). In examining mentoring relationships, and particularly those that cut across gender and ethnic/racial identity, we should also consider how implicit bias may affect cross-gender and cross-race mentoring pairs. From other research findings, we know it is human behavior to hold implicit biases based on race and gender, and to perpetuate stereotypes (Joll and Sunstein, 2006; Banaji et al., 2003; Reskin, 2005). In response to recognizing situations where implicit bias based on race and gender is likely present, organizations may seek to counteract these biases with mandatory diversity training. Yet however well-intentioned or well-designed, mandatory diversity training rarely proves effective (Kaley et al., 2006; Anand and Winters, 2008; Kochan et al., 2003). In contrast, two-way learning relationships which develop through voluntary mentoring relationships hold some promise for the reexamination of one's own biases and stereotypes that is needed for progressive changes in thinking about the capabilities of individuals of diverse backgrounds, and related expectations, which can influence outcomes.

Our findings for mentors align with previous research, which suggests that mentors experience professional and personal rewards comparable to those gained by their protégés. The most clear-cut benefit to mentors is the "sense of satisfaction and fulfillment received from fostering the development of a younger adult" (Ragins and Scandura, 1999). This advantage can be easily corroborated by Erik Erikson's classic Theory of Psychosocial Development, which demonstrates that adults engage in acts that benefit future generations, or generativity, to develop a sense of immortality (Erikson, 1963). Reported mentor benefits have been positively correlated with mentor job satisfaction, mentor organizational commitment, and intention to mentor in the future (Eby et al., 2006). Those who mentor younger colleagues from within their organizations build loyalty and support from protégés as well as credit for developing their talent (Kram, 1985), which are particularly beneficial to those who are underrepresented minorities.

9. CONCLUSIONS AND RECOMMENDATIONS

In sum, our examination of hundreds of mentoring relationships built between women students and professionals in STEM fields, shows the following findings related to the experiences of women of color:

- Women students of color are particularly interested in having mentors who can discuss with them issues of race and ethnicity, and frequently desire to be matched with mentors of their same race/ethnicity. African-American women feel these needs even more acutely than do other women of color.
- Probably due to the difference in demographic diversity between STEM professionals currently in the workforce and today's student population, there are too few mentors of color available to meet these expressed needs, a problem particularly highlighted by the additional finding that White mentors feel less comfortable than women of color in discussing race and ethnicity with their protégés.
- Yet, overall student satisfaction with these e-mentoring relationships appears unrelated to whether a student is in a same-race or cross-race match, and students of color were even more likely to report value in terms of academic success and motivation from having an external mentor through the MentorNet program than were White students.
- Finally, the data show specific benefits for mentors of color, as follows:
  - Professionals of color serving as mentors reported increases in their own self-confidence as a result of their mentoring experiences, and African-American mentors also highlighted perceptions of improvement in their skills for recruiting new talent to their fields as a result.
  - More African-American and Hispanic/Latino/a mentors described experiencing a renewed commitment to their field through serving as mentors, compared with other mentors.
  - More Asian-American mentors reported the experience improved their supervisory skills than did other mentors.

Popular culture often emphasizes differences by gender. At the same time, many Whites express beliefs that we are in a post-race America, though Blacks and others are far less likely to agree. In reality, individuals represent combinations of characteristics, capabilities, preferences, styles, attributes, beliefs, behaviors, needs, experiences, and identity with groups, and are far more complex in their experiences and needs than stereotypes of surface characteristics of gender, skin color, or ethnic heritage might suggest. Authentic and useful communication between individuals across common interests and experiences in mentoring relationships can enable great results, and meet individual needs, many of which transcend roles or experiences limited to one's gender or race and ethnicity. Recognition of these findings, particularly those which challenge the assumptions that same-gender or same-race pairings are always more desirable, helps to avoid the traps of assuming either that we cannot meet the needs of all those women of color seeking mentors because there aren't enough mentors who are women of color, or that men, or White women, have little to contribute to the mentoring needed by women of color. Furthermore, cross-race and cross-gender mentoring relationships may be able to contribute to improved understanding and mitigation of bias and the ways in which gender and race/ethnicity may currently negatively shape experiences for women of color.

We also need to remember the limitations of these findings. They are reported from data collected for the purpose of program evaluation, rather than for a research study with a randomly selected sample and control group. Further, the population may not represent an accurate sample

of the universe of science and engineering students, or even of women students in these fields, but rather those who wanted to engage with mentors. Since the population involved sought out external mentoring relationships through an online network, they may also be more representative of a select group of particularly motivated individuals with unusually strong initiative, rather than being representative of the majority of the population. The sample itself may or may not be representative of the experiences of all those who participated in the program; those who responded to the end of relationship surveys may have been more likely to have had successful relationships, and/or may have been more open to mentors different from themselves. In fact, those who selected the choice of being matched *only* if they could be matched with someone of the same gender and/or ethnicity, would not have been matched at all if such a mentor or protégé was unavailable in the pool, and thus would not have been part of our sample of respondents. Importantly, too, the differences between mentoring that occurs in a virtual environment (e-mentoring such as that experienced by participants in MentorNet's program) and mentoring that is a hybrid of virtual and face-to-face communications, or even all face-to-face, needs further consideration. Both self-selection of participants and the characteristics unique to virtual environments may mean the findings won't be as readily extended to face-to-face settings.

There is need for considerable additional research to understand more deeply the elements of matching a protégé and a mentor to realize the best outcomes of mentoring relationships. Qualitative or ethnographic studies might enable deeper examination of the value and shortcomings of different or various mentoring approaches, enabling us to unpack further the "chemistry" factor that leads some mentoring relationships to succeed where others founder. Clearly, many complex factors are at work when gender and race/ethnicity still drive variances in opportunities and perceptions that enable or limit individuals in pursuit of their interests and goals. In particular, it will be important to study the potential differences by gender and ethnicity in matching for mentoring relationships that develop exclusively in online environments in comparison to those which enable considerable face-to-face interaction.

Yet, there are advantages to the findings of these analyses despite these limitations. The large number of participants in this study provides insight into broadly shared experiences, rather than just the experiences of one person or a very small number of individuals, which has been more typical of the literature to date. Particularly, our findings suggest strong potential for mentoring programs to improve opportunities for women in STEM even if they lack mentors who match protégés in terms of race, ethnicity and gender. Since the demographic disparity in diversity between the STEM workforce and the STEM student population is unlikely to be erased anytime in the near future, it is important to recognize and embrace cross-gender and cross-race mentoring relationships, and to provide guidance to enable individuals to become more comfortable in these relationships and in having needed discussions about these characteristics where desired.

The results we have documented, however, taken together with other research findings, lead us to make several recommendations for mentoring practices, which we argue have the potential to improve opportunities for women of color in STEM. Our findings make evident that those involved in mentoring women of color in STEM fields should avoid making assumptions about the needs of the intended beneficiaries. Too often, when it comes to mentoring for women or people of color, there is an implicit assumption on the parts of would-be protégés, mentors, and program organizers that they should be matched with an individual of the same race or gender, and preferably both. As we have seen, while there may be specific circumstances when such

matching is entirely appropriate and desirable, it is important to know what the individual's needs are before building such assumptions into a matching process. In addition, we need to recognize that strong mentoring matches depend a great deal more on "deep" commonalities (Harrison et al., 1998) – values, life interests, and priorities, to name a few – much more so than they do on relatively more surface characteristics such as color and gender.

How do these findings help us to improve opportunities for women of color in STEM fields?

For those like the African-American participants and others in this study who did state a preference for mentors of the same race/ethnicity, we recommend they work with more than one mentor. In fact, this recommendation is advised for any individual seeking to gain the value of mentoring, whether as students or as professionals. The value of multiple mentors is well-known (Higgins and Kram, 2001; Burlew, 1991); as would-be protégés develop relationships with mentors, they should seek out a number of individuals who will meet their needs in complementary ways, recognizing that it is unlikely they will find one individual who can meet all of their specific needs and interests as a mentor. Individuals – mentors, protégés, or (preferably) both – should recognize the benefits of multiple mentors and expect to have them. They may seek mentors inside and outside their fields as well as family networks, personal friends, and religious communities (Enomoto et al., 2000; Mendez-Morse, 2004).

As mentors and protégés approach a mentoring relationship, it is also important that they clarify their objectives and articulate them to one another, developing a shared plan for the mentoring relationship to which both can agree. With the knowledge that women of color in STEM fields often have a special desire to find ways to discuss issues of race and gender with a mentor, program designers should support and enhance coaching to enable such discussions as comfortably and readily as possible, especially in cross-race pairings. To do so, they can identify research-based findings related to racial differences as well as common beliefs not backed by research, and encourage discussion of personal and alternative perspectives.

There are some strategies that will be useful in guiding all those approaching mentoring relationships. First, program designers, as well as individual university faculty and staff members, should do more to help all students, or other prospective protégés, identify their own individual needs in advance of seeking out mentors. Such self-awareness and ability to articulate the decisions protégés face, the encouragement or clarity they seek, the role models they may want, information or advice needed, will help their mentoring relationships develop more readily, completely, effectively and efficiently.[6] Furthermore, this preparation will enable prospective protégés to make better decisions about which mentors may be best suited to work with them in achieving their goals. If successful mentoring relationships are primarily built around the protégé's needs, those creating mentoring programs should consider how to lead a prospective protégé through a needs assessment exercise *prior* to identifying or being matched with a mentor. With a "profile" such as the MentorNet One-on-One program uses, or other applications collecting information used to match protégés and mentors through a mentoring program, the needs assessment may be able to be built into the process. In fact, MentorNet's online profile during the time of this study did ask each prospective protégé to indicate her or his interest in discussing a variety of topics, and the prospective mentors to indicate their comfort in discussing these topics (including among other areas, women's issues, issues of race or ethnicity, and sexual orientation, as well as topics such as academic work, job prospects, and so forth),

---

[6] This process may also identify short-term needs which can more readily be met by less time-consuming activities than mentoring, such as taking advantage of campus advising, career counseling, and counseling services, peer support groups and relative activities, reading materials, job-shadowing experiences, seminars, and the like.

enabling the matching algorithm to avoid matching students with strong interests in certain topics with mentors uncomfortable discussing those topics (Thomas, 1993). A stronger needs assessment, however, in this or any other mentoring situation, might help prospective protégés focus more on identifying the most appropriate mentors.

Second, policymakers, college and university faculty and staff, and other designers of mentoring experiences all need to help everyone understand the benefits of multiple mentors, and establish expectations that individuals will want to seek out diverse perspectives and role models. The value of mentoring does not come so much from the protégé attempting to become a replica of the mentor, but rather from the value of the learning dialogue between the protégé and mentor. Though commonalities between a protégé and a mentor do help the relationship get off to a good start, surface commonalities often have little power in ensuring an effective and satisfying mentoring relationship in the long run (Harrison et al., 1998). A process that enables would-be protégés to identify their current mentors of all kinds, as well as their needs, could then enable them to seek out one or more additional mentors as needed to address needs not currently being met.

Third, we need to help mitigate the tendency of policymakers, program designers, students, and professionals to assume that the best, effective, or even only possible mentoring relationships develop between those of the same gender and/or race and ethnicity. Instead, an understanding of the individuals' identified needs will help determine whether or not a same-gender and/or same-race /ethnicity match will be particularly valuable. A student particularly interested in learning how her future experiences in the workplace may be shaped by her gender or ethnicity might well benefit from ensuring that at least one of her mentors shares those characteristics. Or, a student wrestling with choices facing a scientist who is also a parent of small children wanting to understand ways to find a successful balance of time devoted to each role may particularly benefit from having a mentor who has experience with those roles as well. But if the protégé's primary interest is in learning about a particular potential future occupation and to build early networks with individuals in those fields, she may have her needs better met through mentors in specific lines of work regardless of their gender, ethnicity, race, nationality, etc. While shared experiences of race and gender may well be desired and helpful for those under-represented in STEM, it would be a mistake to assume that they should be the drivers for every mentoring relationship.

The reported experiences of women of color participating in MentorNet's One-on-One program have enabled us to gain new insights about the process of mentoring. These insights can be applied to the design of mentoring programs, as well as considered by individuals engaging in mentoring relationships, to improve the quality and success of mentoring relationships. It is important to identify the individual protégé's needs when selecting mentors, assume that individuals will need to find multiple mentors who can collectively address their needs, and to align and articulate the needs with appropriate mentors in developing successful mentoring relationships.

REFERENCES

Allen, T. D., Eby, L. T., and Lentz, E., (2006) The relationship between formal mentoring program characteristics and perceived program effectiveness, *Pers. Psychol.*, 59(1), pp. 125-153.

Anand, R. and Winters, M-F., (2008) A retrospective view of corporate diversity training from 1964 to the present, *Acad. Manage. Learn. & Educ.*, 7(3), pp.356-372.

Banaji, M. R., Bazerman, M. H., and Chugh, D., (2003) How (un)ethical are you? *Harvard Bus. Rev.*, 81(12), pp. 56-64.

Barsion, S. J., (2002) *MentorNet: The E-Mentoring Network for Women in Engineering and Science 2001-2002 MentorNet Evaluation Report, December 2002*, SJB Research Consulting. Retrieved January 5, 2010 from http://www.mentornet.net/documents/files/evaluation/01-02/0102evalreport.pdf

Bearman, S., Blake-Beard, S., Hunt, L., and Crosby, F. J., (2007) New directions in mentoring, In T. D. Allen and L. T. Eby Eds., *Blackwell handbook of mentoring: A multiple perspectives approach,* New York: Blackwell, pp. 275-295.

Bierema, L. and Hill, J.R., (2005). Virtual mentoring and HRD. *Adv. Dev. Hum. Resour.,* 7(4), 556-586. Retrieved December 16, 2010, from http://adh.sagepub.com/content/7/4/556.

Blake-Beard, S., (2001) Taking a hard look at formal mentoring programs: A consideration of potential challenges facing women, *J. Manag. Dev., 2*0(4), pp. 331-345.

Blake-Beard, S., Bayne, M. L., Crosby, F. J., and Muller, C. B., (2011) Matching by Race and Gender in Mentoring Relationships: Keeping our Eyes on the Prize, *J. Soc. Issues*, 67: pp. 622–643.

Blake-Beard, S., Murrell, A.J., and Thomas, D.A., (2007) Unfinished business: The impact of race on understanding mentoring relationships, In B. Rose-Ragins and K. Kram, Eds., *Handbook of mentoring at work: Theory, research, and practice,* Sage Publications, pp. 223-248.

Boyle, P. and Boice, R., (1998) Systematic mentoring for new faculty teachers and graduate teaching assistants, *Innov. High. Educ.*, 22(3), pp. 153-179.

Bridgeford, L. C., (2007) Mentoring programs still have a place in the 21st century, *Employee Benefit News*, Washington, D.C.: Aug 1, 2007, p. 1.

Burlew, L. D., (1991) Multiple mentor model: A conceptual framework, *J. Career Dev.*, 17(3), pp. 213-221.

Chesler, N. C. and Chesler, M. A., (2002) Gender-informed mentoring strategies for women engineering scholars: On establishing a caring community, *J. Eng. Educ., 9*1(1), pp. 49-55. Retrieved December 18, 2010 from http://vtb.bme.wisc.edu/Chesler_JEE_2002.pdf.

Dreher, G. F. and Cox, T. H., (1996) Race, gender, and opportunity: A study of compensation attainment and the establishment of mentoring relationships. *J. Appl. Psychol.*, 81(3), pp. 297-308. Retrieved December 16, 2010 from http://www.getcited.org/pub/103361332.

Eby, L. T., Durley, J. R., Evans, S. C., and Ragins, B. R., (2006) The Relationship between short-term mentoring benefits and long-term mentor outcomes, *J. Vocat. Behav.*, 69(3), pp. 424-444. Retrieved December 16, 2010 from www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ746423.

Enomoto, E. K., Gardiner, M. E., and Grogan, M., (2000) Notes to Athene: Mentoring relationships for women of color, *Urban Educ., 3*5(5), pp. 567-583.

Erikson, E., (1963) *Childhood and Society*, New York: W. W. Norton.

George, Y. A. and Neale, D., (2006) *Report from Study Group Meetings to Develop a Research and Action Agenda on STEM Career and Workforce Mentoring*, American Association for the Advancement of Science Directorate for Education and Human Resources Programs, December 2006. Retrieved January 5, 2010 from http://ehrweb.aaas.org/sciMentoring/MentoringReport.pdf.

Haas, A., Tulley, C., and Blair, K., (2002) Mentors versus masters: Women's and girls' narratives of (re)negotiation in web-based writing spaces, *Comput. and Compos.,* 19(3), pp. 231-249. Retrieved December 17, 2010 from http:// homepages.findlay.edu/tulley/professional/Mentors-1.pdf.

Hansman, C. A., (2002) Diversity and power in mentoring relationships, In C. A. Hansman, Ed., *Critical perspectives on mentoring: Trends and issues,* Columbus, OH: pp. 39-48. ERIC.

Hewlett, S. A., Luce, C. B., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., Sumberg, K., (2008) The Athena Factor: Reversing the brain drain in science, engineering and technology, *Harvard Bus. Rev. (Research Materials*, Product no. 10094).

Harrison, D. A., Price, K. H., and Bell, M. P., (1998) Beyond relational demography: Time and the effects of surface- and deep-level diversity on work group cohesion, *Acad. Manag. J.,* 41(1), pp. 96-107.

Higgins, M. C. and Kram, K. E., (2001) Reconceptualizing mentoring at work: A developmental network perspective, *Acad. Manag. Rev.,* 26(2), pp. 264-288.

Johnson-Bailey, J. and Cervero, R. M., (2002) Cross-cultural mentoring as a context for learning, *Critical Perspectives on Mentoring: Trends and Issues,* 96, pp. 15-26.

Joll, C. and Sunstein, C. R., (2006) The law of implicit bias, *Calif. Law Rev.,* 94(4), pp. 969-996.

Kalev, A., Dobbin, F., and Kelly, E., (2006) Best practices or best guesses? Assessing the efficacy of corporate affirmative action and diversity policies, *Am. Socio. Rev.,* 71(4), pp. 589-617.

Kasprisin, C. A., Single, P. B., Single, R. M., and Muller, C. B., (2003) Building a better bridge: Testing e-training to improve e-mentoring programmes in higher education, *Mentoring & Tutoring: Partnership in Learning,* 11(1), pp. 67-78.

Kasprisin, C. A., Single, P. B., Single, R. M., Ferrier, J. L., and Muller, C. B., (2008) Improved mentor satisfaction: Emphasizing protégé training for adult-age mentoring dyads, *Mentoring & Tutoring: Partnership in Learning*, 16 (2), pp. 163-174.

Koberg, C. S., Boss, R. W., and Goodman, E., (1998) Factors and outcomes associated with mentoring among health-care professionals, *J. Vocat. Behav.,* 53(1), pp. 58-72.

Kochan, T., Bezrukova, K., Ely, R., Jackson, S., Joshi, A., Jehn, K., Leonard, J., Levine, D., and Thomas, D., (2003) The effects of diversity on business performance: Report of the diversity research network, *Hum. Resource Manag. J.*, 42(1), pp. 3-21.

Kram, K. E., (1985) *Mentoring at work*, Glenview, IL: Scott, Foresman & Co.

Leggon, C. B., (2010) Diversifying science and engineering faculties: Intersections of race, ethnicity, and gender, *Am. Behav. Sci.,* 53(7), pp. 1013-1029.

Linehan, M. and Scullion, H., (2008) The development of female global managers: The role of mentoring and networking, *J. Bus. Ethics*, 83(1), pp. 29.

Luna, V. and Prieto, L., (2009), Mentoring affirmations and interventions: A bridge to graduate school for Latina/o students, *J. Hispan. High. Educ.,* 8(2), pp. 213-225. Retrieved December 15, 2010 from http://jhh.sagepub.com/content/8/2/213.

Mendez-Morse, S., (2004) Constructing mentors: Latina educational leaders' role models and mentors, *Educ. Admin. Quart.*, 40(4), pp. 561-590.

MentorNet, (2006) With Mentors, People of Color Go the Distance, *MentorNet News, February 2006*, Retrieved January 5, 2010 from
http://www.mentornet.net/Documents/About/news/newsart.aspx?nid=7&sid=1

MentorNet, (2007) *Success sustained by study: A documentation of MentorNet's growth and a summary of research findings – October 2007*, Retrieved from
http://www.mentornet.net/documents/files/evaluation/1996-2007SuccessSustainedByStudyReport.pdf

MentorNet, (2008) *Students' perceptions of the value and need for mentors as they progress through academic studies in engineering and science, a report to the National Science Foundation concerning a Small Grant for Exploratory Research (SGER) EEC-06397621, March 21, 2008,* Retrieved August 8, 2009 from
http://www.mentornet.net/documents/files/evaluation/studentperceptions.completereport.pdf

Muller, C. B., (2009) Understanding e-mentoring in organizations, *Adult Learn.* 20(1), pp. 26-31.

Murrell, A. J., Forte-Trammel, S., and Bing, D., (2008) *Intelligent Mentoring: How IBM Creates Value through People, Knowledge and Relationships*, Boston, MA: Pearson Education, Inc.

National Science Foundation, (2009) *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2009*, Arlington, VA: NSF, Retrieved December 18, 2010 from http://www.nsf.gov/statistics/wmpd/.

Patton, L. D., (2009) My sister's keeper: A Qualitative examination of mentoring experiences among African American women in graduate and professional schools, *J. High. Educ.,* pp. 510-537.

Ragins, B. R. and Kram, K. E., (2007) *The Handbook of Mentoring at Work: Theory, Research, and Practice*, Thousand Oaks, CA: SAGE Publications, Inc.

Ragins, B. R. and Scandura, T.A., (1999) Burden or blessing? Expected costs and benefits of being a mentor, *J. Organ. Behav.,* 20(4), pp.493-509.

Reisberg, R., Bailey, M., Burger, C., Hamann, J., Raelin, J., and Whitman, D., (2010) The effect of gender on support and self-efficacy in undergraduate engineering programs, *Proceedings of the American Society for Engineering Education Annual Conference & Exposition, Vancouver, BC.,* Retrieved December 16, 2010 from http://www.coe.neu.edu/pathways/EffectofGender.pdf.

Reskin, B., (2005) Unconsciousness raising: The pernicious effects of unconscious bias, *Region. Rev.*, 1st Quarter, 14(3), pp. 32-37.

Sahib, Z. and Vassileva, J., (2009) Designing to Attract Participation in a Niche Community For Women In Science & Engineering, *Proceedings from International Conference on Computational Science and Engineering,* Vancouver, Canada, Retrieved December 15, 2010 from http://www.computer.org/portal/web/csdl/doi/10.1109/CSE.2009.442.

Settles, I. H., Cortina, L. M., Stewart, A. J., and Malley, J., (2007) Voice matters: Buffering the impact of a negative climate for women in science, *Psychol. Women Quart.*, 31(3), pp. 270-281.

Seymour, E. and Hewitt, N., (1997) *Talking about leaving: Why undergraduates leave the sciences*, Boulder, CO: Westview Press.

Single, P. B. and Muller, C. B., (2001) When email and mentoring unite: The implementation of a nationwide electronic mentoring program, In L. Stromei, Ed., *Implementing successful*

coaching and mentoring programs, Cambridge, MA: American Society for Training & Development, pp. 107-122

Single, P. B., Muller, C. B., Cunningham, C. M., Single, R. M., and Carlsen, W. S., (2005) MentorNet: E-mentoring for women in engineering and science, *J. Women Minorities Sci. Eng.*, 11(3), pp. 295-309.

Single, P. B. and Single, R. M., (2005) E-mentoring for social equity: Review of research to inform program development, *Mentoring & Tutoring: Partnership in Learning*, 13 (2), pp. 301-320.

SJB Research Consulting, (2004) *MentorNet: E-Mentoring for Women of Color in Engineering and Science, Final Report to the Engineering Information Foundation, April 2004.* Retrieved January 5, 2010 from http://www.mentornet.net/documents/files/WomenofColorFinalReportMay2004.pdf

Sproull, L. and Kiesler, S., (1991) *Connections: New ways of working in the networked organization*, Cambridge, MA: The MIT Press.

Thomas, D. A., (2001) The truth about mentoring minorities: Race matters, *Harvard Bus. Rev.,* 79(4), pp. 98-107.

Thomas, D. A., (1993) Racial dynamics in cross-race developmental relationships, *Admin. Sci. Quart.*, 38(2), pp. 169-194.

Thomas, D. A., (1990) The impact of race on managers' experiences of developmental relationships (mentoring and sponsorship): An intra-organizational study, *J. Organ. Behav*., 11(6), *pp.* 479-491.

Thomas, D. A. and Gabarro, J. J., (1999) *Breaking through: The making of minority executives in corporate America,* Boston, MA: Harvard Business School Press.

United States Government Accountability Office (GAO), (2006) *Higher Education: Federal Science, Technology, Engineering and Mathematics Programs and Related Trends. Report to the Chairman, Committee on Rules, U.S. House of Representatives*.

Weber, L., (2010) *Understanding, race, class, gender, and sexuality: A conceptual framework* (2nd ed.), New York: Oxford University Press.

Table 1: Students of Color Participating in MentorNet's One-on-One Program, 1998-2003

| | **Academic Year** | | | | | |
	1997-98	**1998-99**	**1999-2000**	**2000-01**	**2001-02**	**2002-03**
Students Participating	n=225	n=539	n=1,250	n=2,000	n=3,191	n=2,816
Asian-American	31%	29%	25%	24%	23%	23%
African-American	4%	8%	7%	7%	9%	12%
Latina/ Hispanic	2%	3%	3%	4%	4%	5%
Native American	1%	1%	1%	1%	1%	1%

¹ Not included are data on White or multiracial students.
² Data are self-reported, by percentage; 4% did not respond.

Table 2: MentorNet One-on-One Program Participants Completing Evaluation Surveys, 2001-03, by year

| | **2001-02** | | **2002-03** | |
	Student-Protégés	Mentors	Student-Protégés	Mentors
# returning survey	1,101	1,420	1,126	1,397
Response rate	37%	54%	40%	47%

Note: Some mentors work with more than one student.

Table 3: Students Included in Analysis of Mentor-Protégé Matches, by Race, by Year

	Asian-American	**African-American**	**Hispanic/ Latina**	**White**	**Total**
2001-02 cohort	74 (14%)	55 (10%)	31 (6%)	381 (70%)	541
2002-03 cohort	69 (14%)	38 (7%)	19 (4%)	384 (75%)	510

Table 4: Comparison of Mean Scores[1] on Motivation to Continue in Field

	Asian-American	**African-American**	**Hispanic/ Latina**	**White**
Mentor main reason got through academic year	(n=68) [2]	(n= 37)	(n=17)	(n=382)
	2.6	2.3	2.5	2.0
Due to MentorNet, more motivated to succeed in chosen field	(n=67)	(n=37)	(n=18)	(n=382)
	3.7	3.7	3.8	3.3

¹ Data available only for 2002 – 2003 students.
² Number of cases varies because students had the option of checking "Don't know."

Table 5: ANOVA Comparing Interest in Discussing Race/Ethnic Issues with E-mentor[1]

	Asian-American	African-American	Hispanic/Latina	White
2001 – 2002 Mean $F = 106.7$, df = 487, $p < .0001$	2.3[2]	3.1	2.4	.9
2002 – 2003 Mean $F = 80.0$, df = 474, $p < .0001$	2.1	3.2	2.1	.8

[1] *Multiple comparison of means was done using Bonferroni test for significance.*
[2] *The highest score is a "4".*

Table 6: Number of Students in Same-Race vs. Cross-Race Mentoring Pairs, by Race, by Year

	Asian-American	African-American	Hispanic/Latina	White
2001-02:				
Same race	12	4	2	315
Different race	61	49	29	66
2002-03:				
Same race	8	9	2	327
Different race	60	28	16	56

Table 7: Mentors Responding to Year-End Survey,[1] by Race, by Year

	Asian-American	African-American	Hispanic/Latina	White	Total[2]
2001 - 2002	140 (11%)	59 (5%)	59 (5%)	1048 (80%)	1306
2002 - 2003	157 (12%)	43 (3%)	57 (4%)	1070 (81%)	1327

[1] *Samples include respondents to the year-end online survey on e-mentoring experience, satisfaction and outcomes. Data on race/ethnicity is from profile.*
[2] *Totals may not add up to 100% due to rounding.*